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INTERNATIONAL TECHNOLOGY TRANSFER AND ITS ROLE IN THE INDUSTRIALISATION OF LESS DEVELOPED COUNTRIES (LDCs) SUCH AS IRAN

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ABSTRACT

International Technology Transfer (the transfer of technology across national borders) is extensively believed to be necessary for the industrialisation of any country. The experiences of some successful countries in rapid economic and industrial development show that the acquisition of a significant amount of foreign technology has played a crucial role in promoting their managerial and technical expertise as well as increasing their productivity level. In particular, the experiences of some successful East Asian Newly Industrialised Countries (NICs) during the past three decades indicate that they could achieve rapid industrialisation and technological development through the adoption of a set of appropriate policies and strategies. The experiences of these countries can have valuable lessons and policy implications for other countries which wish to follow the same path of rapid industrialisation and technological development.

Although many Less Developed Countries (LDCs) have realised the great importance of technological transformation for their rapid economic and industrial development, they have not designed effective and efficient policies and strategies for the transfer of appropriate and high-level technologies. Therefore, it seems necessary for decision makers in these countries to formulate appropriate policies for effective and successful transfer of technology as well as rapid industrialisation. Iran, as a developing country with large natural and human resources has also attempted to adopt the best approach of technology transfer to improve and promote its technological capability and achieve rapid industrialisation. However, like many other countries, the industrial base of Iran can be characterised as being heavily dependent on importing their required parts and components for manufacturing outputs, which in turn is due to the assembly nature of many of its industries. In other words, Iran as well as many other developing countries has been faced with heavy technological dependency.

The main purpose of this study is to identify and examine the critical success factors for the effective technology transfer and rapid industrialisation of the LDCs in general and Iran in Particular. Firstly, some of the most important and relevant theoretical frameworks as well as conceptual issues of technology transfer and industrialisation of LDCs are analysed. The empirical and practical experiences of some selected countries in particular East Asian first and second tier Newly Industrialised Countries (NICs) as well as Mexico and Turkey are also studied. The critical success factors of these countries in rapid industrialisation and technological development are identified. Moreover, the past and present industrialisation policies as well as technology transfer status of Iran is investigated in detail to identify and determine the most important strengths and weaknesses which are needed for designing its future plan. Finally, a framework of an appropriate policy and strategy for international technology transfer to LDCs in general and Iran in particular is proposed. Some overall recommendations and suggestions derived from the research findings and results for the effective and successful technology transfer and industrialisation of LDCs in general and Iran in particular is also included.

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
APCTT	Asian and Pacific Centre for Technology Transfer
APO	Asian Productivity Organisation
ARC	Applied Research Centre
ASEAN	Association of Southeast Asian Nations
BKPM	Indonesian Capital Investment Co-ordination Board
BPPT	Indonesian Agency for Assessment and Application of Technology
CAD	Computer Aided Design
CAPFI	Centre for the Attraction and Protection of Foreign Investment
CBI	Central Bank of Iran
CHIR	Centre for Heavy Industries Researchers
CHSSI	Centre for Handicrafts and Small Scale Industry
CIM	Chamber of Industry and Mines
CONACYT	National Council of Science and Technology
CPR	Centre for Power Researchers
CRAESI	Centre for Research and Aluminium Engineering Services of Iran
CRDSTPM	Centre for Research and Development of Science and Technology of Polymeric Material
CRDT	Centre for Researchers and Development of Technology
CRPUMP	Centre for Research of Properties and Usage of Materials Power
CRSSI	Centre for Researchers and Self-sufficiency Services
CSRP	Centre for Science and Research Policy
DIBI	Development and Investment Bank of Iran
EIU	Economist Intelligent Units
EPP	Export Promotion Policy
EPZs	Export Processing Zones
ESCAP	Economic and Social Commission for Asia and Pacific
FJTVS	Factory Joint Technical and Vocational Schools
FDI	Foreign Direct Investment
FTZs	Free Trade Zones
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Products
GNP	Gross National Products
HCI	Heavy Chemical Industrialisation
HRD	Human Resource Development
IAJV	Iranian American Joint Venture
IBRD	International Bank of Reconstruction and Development
ICA	Industrial Co-ordination Act
ICBI	Industrial Credit Bank of Iran
IDB	Islamic Development Bank
IDRO	Industrial Development and Renovation Organisation
IEAT	Industrial Estate Authority of Thailand
ILO	International Labour Organisation
IMDBI	Industrial and Mining Development Bank of Iran
IMF	International Monetary Fund
IMO	Industrial Management Organisation
IMP	Industrial Master Plan
ISI	Import Substitution Industrialisation

ISIR	Institute of Standards and Industrial Research in Iran
ITRI	Industrial Technology Research Institute
ITT	International Technology Transfer
JICST	Japan Information Centre of Science and Technology
JIII	Japan Institute of Invention and Innovation
JIT	Just-In-Time
JRDC	Japan Research Development Corporation
KAIST	Korean Advanced Institute of Science and Technology
KITA	Korea Industrial Technology Association
LDCs	Less Developed Countries
LMO	Literacy Movement Organisation
LPG	Liquefied Petroleum Gas
MCHE	Ministry of Culture and Higher Education
MEED	Middle East Economic Digest
MIDA	Malaysian Industrial Development Authority
MITI	Ministry of International Trade and Industry
MOST	Ministry of Science and Technology
MNCs	Multinational Companies
NAFTA	North American Free Trade Agreement
NDP	National Development Policy
NEP	New Economic Policy
NICs	Newly Industrialised Countries
NIPC	National Iranian Petrochemical Company
NIPO	National Iran Productivity Organisation
NISI	National Iranian Steel Company
NSRC	National Scientific Research Centre
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturing
ONII	Organisation for National Iranian Industries
OPRII	Organisation for Promotion and Renovation of Iranian Industries
OSIRI	Organisation for Scientific and Industrial Researchers of Iran
PBO	Plan and Budget Organisation
PDA	Petroleum Development Act
PLC	Product Life Cycle
QFA	Qeshm Free Authority
RCITD	Research Centre for Industrial & Trade Development
R & D	Research and Development
RNTT	National Registry of Technology Transfer
SEEs	State Economic Enterprises
SIRIM	Standards and Industrial Research Institute Malaysia
TUBITAC	Turkish Scientific and Technical Research Council
UNCLA	United Nations Centre for Latin America
UNCTAD	United Nations Conference on Trade and Development
UNCTC	United Nations Centre for Transnational Corporations
UNDP	United Nations Development Programs
UNESCO	United Nations Education, Scientific and Cultural Organisation
UNIDO	United Nation Industrial Development Organisation
UNITAR	United Nations Institute for Training and Research
WIPO	World Intellectual Property Organisation
WTO	World Trade Organisation

CHAPTER 1

INTRODUCTION:

It is widely acknowledged that transfer of technology has played a key role in the economic and industrial development of any nation. It seems that Less Developed Countries (LDCs) can increase their productivity and efficiency levels through the acquisition of technical knowledge and skills from the developed countries. The effective transfer of technology enables these countries to utilise their natural and human resources efficiently through transformation of inputs into outputs. Therefore, it is essential for LDCs to study and examine how to exploit and employ their natural and human resources efficiently in order to expand and develop their technological base.

Technology transfer can be an important tool for this purpose, as it allows LDCs to utilise their natural and human resources efficiently. It also enables them to build up their technological capabilities by importing and adopting foreign technology. Technology transfer is also seen as an important strategic variable which must be integrated into national development planning of LDCs. As the experiences of some East Asian countries during the past three decades show, these countries could increase their output, upgrade the skills of their labour force and accelerate the process of industrialisation through the adoption, adaptation and absorption of imported technologies.

Technological change has also played a key role in the overall economic and industrial growth of developed countries in the past. Many studies have indicated that over 50% of long-term economic growth in advanced countries resulted from technological change which improved productivity, and contributed to higher levels of efficiency and higher quality of their products. For example, it is estimated that technological progress contributed as much as 65% to Japanese economic growth. Moreover, about 29% of the growth in manufacturing industry in Japan during the period between 1955-1979 could be attributed to technological progress [1].

The fact that the current developed and advanced countries could increase their technological levels over the last two centuries indicate that LDCs can also catch up with technologically advanced countries. It can be said that LDCs in the current situation can

take the most advantage from the availability of existing technological resources and therefore do not need to reinvent the wheel. The transfer of technology from the industrialised countries has enabled most LDCs to benefit from some of the advances made in the field of technology. Technology transfer has also introduced high-productivity techniques and in many cases encouraged technical change in LDCs. The acquisition of foreign technology can also contributed to improving competitiveness in the local as well as the international markets for these countries. However, while the development of indigenous technology should be encouraged, technology transfer can be considered as a vital process of industrialisation for LDCs. In other words, industrialisation is a process of acquiring technological capabilities in the direction of consistent technological change [2].

Despite the great importance of technology transfer in the process of industrial and technology development of LDCs, there have been some general problems in the process of an effective and successful technology transfer. These problems which include mainly the lack of absorptive capacity in the recipient country, and unwillingness of the transferor in transferring real technology and technical know-how, have led to unsuccessful technology transfers. Therefore, it is necessary for these countries to promote their local technological capability in order to adapt and absorb foreign technologies efficiently to their local needs and conditions. LDCs should also identify carefully their needs and objectives which they intend to achieve through the acquisition of foreign technology. It seems also essential for these countries to identify and improve those elements of technology in which they are weak, such as developing an appropriate industrial and technological infrastructure. The imported technologies should also be adapted and matched with the existing technologies which can lead to the rapid process of industrialisation.

Having recognised the great importance of technology for their development and industrialisation, LDCs seem to be unable to exercise real choice in designing effective strategies for their technological transformation. Many developing countries do not appear to have established the necessary procedures and criteria to choose the effective technology transfer policy needed for a rapid industrialisation and technological development. In other words, many LDCs lack an appropriate plan and strategy for an effective transfer of technology. LDCs are nowadays paying more attention on establishment and implementation of an appropriate strategy for technology transfer and development, as they find out more

about the significant effects of an effective acquisition of foreign technology on their overall economic and industrial progress. However, sufficient actions for the formulation of technology policies and plans have yet to emerge.

It seems that problems associated with technology absorption and adaptation have so far generally received little attention. Problems of technology transfer can generally be discussed from different points of view. For example, the major problem for the macro-economists point of view is to investigate the appropriate technology, how to adopt and adapt it effectively and use it for the development and industrialization of LDCs. Another is the of manager's point of view in LDCs; how do these managers choose the technology they import and how do they decide the channels through which technology will be transferred ?. Managers in LDCs also consider how to utilise their limited resources efficiently in order to promote their technological capability. Engineers and scientists are also more concerned about the technical and scientific aspects of the subject, the process of an effective indigenous technological development, industrial and technological research, and promotion of the skills and productivity of the labour force.

Technology transfer without promotion of indigenous technological capability has been especially common as LDCs attempted to increase their production capacities in a minimal amount of time. It seems that LDCs prefer to adopt and assimilate new technologies rather than trying to generate and create them, since it needs less traditional R & D, but they still require a high level of technical skills. Having explained the great importance of technology transfer in the industrial and technological development of any country, as indicated earlier, there have been little attempts to formulate and design the appropriate plan and strategies for an effective and successful technology transfer and development. Therefore, it is essential for the policy makers in LDCs to identify the overall goals and objectives which are needed in designing a suitable policy for their technology transfer and development.

It can also be said that the specific strategy and policy for technology transfer in a country cannot be separated and isolated from the overall national plan for its economic, industrial and social development. Therefore, the major aims and goals of technology transfer policy should be concentrated on finding the most appropriate and efficient methods to use technology in order to achieve a rapid economic and industrial progress. It is also important

for a LDC, in the formulation of its overall industrial and technology development policy and strategy, to place more emphasis on such important areas as the interrelation between the acquisition of foreign technology and promotion of indigenous technological capability, and the need to reduce the technological dependency on developed countries. In designing appropriate policies and strategies for their technology transfer and development, LDCs can also draw valuable lessons from the successful experiences of some Newly Industrialised Countries (NICs) in East Asia and Latin America.

1. 1 THE OBJECTIVES OF RESEARCH

This research is primarily aimed at examining and analysing the effects of technology transfer on the industrialisation of Less Developed Countries generally, and Iran in particular. The main emphasis of this research is placed on Iran, although the overall problems of LDCs in successful technology transfer and rapid industrialisation are also investigated. This study also attempts to find answers to such important questions as:

- What are the critical and the most important factors which can lead to a successful technology transfer and more broadly industrial and technology progress of LDCs in general and Iran in particular ?;
- What are the best strategies and policies of technology transfer and industrialisation that these countries can adopt, in order to promote their technological capability and industrialisation?;
- How can foreign technologies be used effectively in order to achieve rapid industrial and technological development in these countries ?;
- What are the best methods and mechanisms for the efficient acquisition of foreign technologies in order to maximise the success and effectiveness of technology transfer ?;
- How can the process and procedures of technology transfer be effectively monitored in order to attain the highest success in the rapid industrialisation and technological development of these countries ?.

It is hoped that the answer to these overall questions as well as so many other sub-questions can assist the policy makers in LDCs in general and Iran in particular to design an

appropriate plan and strategy for a successful technology transfer and more broadly rapid industrial and technological development.

1. 2 THE METHODOLOGY OF RESEARCH

As indicated earlier, the main objective of this research is to identify the most important and vital factors which can lead to a successful technology transfer and rapid industrialisation of LDCs in general and Iran in particular. To this end, a comprehensive survey of most current literature including the theoretical frameworks, conceptual issues of technology transfer and industrialisation, as well as empirical and practical experiences of some chosen countries in successful technology transfer and rapid industrialisation is undertaken. Based on the main objectives and questions of the research as well as an extensive review of literature, some important hypotheses can be formulated. For example, it is hypothesised that the process of rapid industrial and technological development in a country to a large degree depends on the successful acquisition and adaptation of foreign technologies as well as the development of its indigenous technological capability.

It can also be hypothesised that an effective technology transfer strategy for LDCs is a simultaneous utilisation of foreign technologies and promotion of local technological capability. It also hypothesizes that the success in adapting foreign technology to a large degree depends on the recipient's technological capability and efforts. The other main hypothesis of the research, which can be derived from the objectives of the research, is that the success of LDCs including Iran relies mainly on the adoption of a set of appropriate policies including an effective technology transfer strategy, an efficient human resource development policy, and an outward-oriented export promotion policy.

As indicated earlier, in order to answer the research questions, it is essential to conduct an extensive review and study of most current available information on the general area of the research which is concentrated more on International Technology Transfer and its role in the industrialisation of LDCs. However, the main methodology of this research is an in-depth case study analysis of some chosen countries in order to examine and identify their key success factors in effective technology transfer and rapid industrialisation. It can be said that among the alternative methods which are normally used for the social sciences, the case

study technique and historical analysis are the most appropriate methods for this research which enable an effective examination of the research hypotheses is to be made based on the past and current performances and experiences of the selected countries.

According to Marshal and Rossman (1989), "the historical survey is particularly useful in obtaining knowledge of previously unexamined areas and in re-examining questions for which answers are not as definite as desired" [3]. Therefore, countries are chosen on the basis of their successful past performances and experiences in the rapid industrial and technological development as well as their similarity with Iran in terms of economic, social, cultural and industrial characteristics. Some of the East Asian first and second-tier NICs including S. Korea, Taiwan, Malaysia, Thailand and Indonesia are selected because of their significant performances in the successful technology transfer and rapid industrialisation. Some other countries including Mexico and Turkey are also included in the country surveys due to their similarity with Iran in terms of the economic and social characteristics.

Each of these countries is studied in terms of its specific post Second World War industrialisation policy as well as its experiences of technology transfer and FDI, and human resource development policies. The main source of data and information which is used for the analysis of these countries include the most current literature in books, journals, newspapers, various published and unpublished papers, governmental reports, different reports and papers published by international organisations, mainly UNCTAD (United Nations Centre for Trade and Development), UNIDO (United Nation Industrial Development Organisation), UNESCO (United Nations Education, Scientific and Cultural Organisation), ILO (International Labour Organisation), ADB (Asian Development Bank), ESCAP (Economic and Social Commission for Asia and the Pacific), OECD (Organisation for Economic Co-operation and Development), EIU (Economist Intelligence Unit), and reports by several other international organisations.

As indicated earlier, Iran is the main focus of this research as a LDC which has attempted to achieve rapid industrialisation through the adoption of effective technology transfer. The identification of the most vital factors contributing to the successful experiences of the countries of the survey in their rapid industrialisation and technological development can have useful implications for other LDCs including Iran. Therefore, the main objective is to

determine an appropriate policy framework for Iran for an effective and successful technology transfer and rapid industrialisation which can in turn be useful for the other LDCs. The proposition of an effective technology transfer as well as industrialisation policies for Iran can have some useful implications and lessons for not only its own future overall development planning but also for that of other LDCs as recipients of technology. Although Iran's overall past and present industrial and technological development policies as well as its other relevant characteristics will be discussed later in detail, it is noteworthy to describe briefly the current status of the country's industrial and technological capability:

1. Iran has large natural and physical resources along with significant numbers of scientists and engineers, plus a substantial body of skilled workers and technicians. However, it seems that there are not enough, in view of the expansion and diversification of industry, and the promotion of the indigenous industrial and technological capability. According to statistics presented by UNESCO (1993), Iran possessed total numbers of 331,481 scientists and engineers and 218,532 technicians in 1990 [4]. However, these figures need to expand as Iran still faces shortages of the skilled labour, technicians, scientists and engineers required for its anticipated future technological development. During the Second Five-Year Plan, the number of technicians is projected to increase to 502,177. The Second Plan (1995-1999) also aims at the expansion of education at all levels, as well as increasing in the professional and vocational training of the labour force, and creating two million new employment opportunities by 1999.

2. In terms of industrialisation policy, Iran has adopted a simultaneous pattern of import substitution and export promotion policies during the First Five-Year Plan (1989-1993). Despite a relatively significant expansion of Iran's non-oil exports during the period of the First Plan which reached US$ 4.5 billion by 1994, this is still not enough if Iran wishes to reduce its heavy reliance on oil revenues. Non-oil exports are projected to increase to an average annual value of US$ 5 billion during the Second Five-Year Plan (1995-1999). During the First Plan (1989-1993), high priority was given to reconstruction and development of the industrial infrastructure through the implementation and completion of a large number of industrial and development projects as well as expansion of technological-based industry and

important basic industries, which are both labour and capital intensive. The Second Plan is also aimed at continuing the same path with more emphasis on the expansion and diversification of Iran's non-oil exports.

3. Most of Iran's industrial bases can be characterised as heavily dependent on importing their required parts and components for manufacturing outputs. This large reliance on the importation of foreign inputs is mainly due to the assembly nature of many of Iran's industries, and are also financed by oil incomes. Therefore the performance of the industrial sector in Iran is vulnerable to the fluctuation of world oil markets and prices. The country's industrial sector still lacks the adequate efficiency and productivity level needed to compete in the international market. The Second Plan (1995-1999) has introduced a number of measures to promote the quantity and quality of the industrial products, improve and develop domestic technological capacity, and make maximum use of the country's existing industrial potential. These measures mainly include the reduction of tariff rates to increase the efficiency in domestic production, continuing the privatisation of non-strategic industries and increasing incentives for attracting more foreign investment, encouraging the transfer of appropriate and modern technologies, and promotion of regional industrial development.

4. Industrial research institutes are being established and developed for the needs and skills of industry. Moreover, there has been an increasing trend in the research and development activities. The R&D expenditure as a percentage of GNP during the period 1989-1993 has been 0.35%, which is projected to increase to over 1% by the end of the Second Plan. However, most R&D funds (over 80%) granted by government have been allocated to ministries, and the rest to universities and other research institutes. Although there are skills in Iran for the storage, transfer, recovery, planning and development of technical information, there seems to be no overall co-ordination and integration between various research and development institutes in this regard.

5. The Second Five-Year Plan aimed at an average economic growth rate of 5.8% over the period 1995-1999. This figure is less than the projected target of First Plan

(8.1%), but more emphasis in the current plan is placed on a steady and sustainable growth rate. While in the First Plan industrial sector was the main engine of the growth, in particular the petrochemical and steel industries, the agriculture sector is announced to be the main pivot of the growth over the next five years. However, over the period 1995-1999, the oil sector is projected to grow with an average rate of 3.2%, and the industrial and construction sector with an average annual growth of 6.2%. The Second Plan also encourages the establishment and development of small, high-technology, industries linked to medium and large industries through a variety of subcontracting arrangements. Moreover, the Second Plan emphasises attracting as much FDI as possible as a major source of the country's technology, managerial expertise and foreign capital. It is expected that FDI will reach an average of US$2 billion per year over the period 1995-1999. This figure is expected to be achieved through the introduction of various incentive measures, and the formulation of new regulation and foreign investment laws.

6. The major objectives of technology development in the current Five-Year Plan are: expanding the amount of foreign technology into the country in particular through the attraction more FDI; promoting the country's indigenous technological capability through increasing the R&D activities; decreasing the dependency on imported parts and materials required for the production of the industrial outputs through the development of the supporting intermediate industries; and increasing the HRD programmes, including training the local technicians and skilled workers for the effective adaptation and assimilation of imported technologies.

It is hoped that the results and findings of this research would assist the policy makers in the LDCs in general and Iran in particular, to design and formulate an effective policy framework which can lead to successful technology transfer and rapid industrialisation of these countries.

1.3 THE STRUCTURE OF THESIS

This research includes eight chapters which start with an introductory overview of the research topic explaining the general background to the area of the study; the importance

of the area of research; the overall objectives of the research which are explained through proposing a number of questions and sub-questions; the research methodology which is defined from the main hypotheses of the research; and finally the organisation of the study.

Chapter two is devoted to an comprehensive review of the most current literature on technology transfer and industrialisation in LDCs. This includes the critical survey of the neoclassical approach towards technology transfer; the neoclassical views; the radical perspectives; the dependency school of thought; the product life-cycle theory; the technological gap theory and the big push theory of industrialisation. Some of the most important industrialisation policies including import substitution and export promotion policies are discussed. The main objective of this chapter is to find the most appropriate theory which can directly and explicitly be applied to the LDCs current conditions. It is concluded that despite the existence of various theories and schools of thought which have been examined in the chapter, there is still no specific theory of technology transfer which can be precisely applied to LDCs.

It is recognised that some of these theories, in particular the dependency school of thought and the technological gap theory, can bring about useful implications for policy makers in LDCs. Theorists in the dependency school of thought strongly urge the LDCs to reduce their technological dependency through strengthening their domestic technological capabilities and increasing R&D activities. According to the technological gap theory, the technological gap between LDCs and developed countries can accelerate the process of catching up technologically between these two groups of countries through adoption of an effective technology transfer policy based on the acquisition and adaptation of foreign technology, as well as promotion the indigenous technological capability.

In chapter three, the conceptual issues of technology transfer are extensively analysed through the definitions of technology and technology transfer; the classification of technology and technology transfer; the diagrammatic representation of technology transfer; explaining and examining the various mechanisms of technology transfer; technology transfer process and its formulation; the concept of appropriate technology; and the cost of technology transfer. This chapter is aimed at studying and evaluating the various relevant concepts of technology transfer which seems to be essential for better understanding, and

examining various aspects and features of technology transfer. A systematic model of the technology transfer process is developed in order to analyse in depth the process of successful technology transfer. This model has adopted a systemic approach to determine and evaluate the different stages of technology transfer process which can assist policy makers in LDCs to choose the most appropriate technology based on their goals, objectives, needs and capabilities. Moreover, technology transfer procedures are formulated through the introducing a Matrix which illustrates the best direction for the effective transfer of technology. An extensive analysis of various methods of technology transfer is also included in this chapter in order to identify the most appropriate channels of technology transfer.

Chapter four discusses a series of a comprehensive case studies analysing the experiences of some selected countries in technology transfer and industrialisation. The main objective of this chapter is to determine the most important and crucial success factors which led to effective technology transfer and rapid industrialisation in these countries. The countries are chosen based on their significant overall performance in rapid industrial and technological development over the past three decades, as well as the similar characteristics which some of these countries have with Iran. These countries include S. Korea, Taiwan, Malaysia, Thailand, Indonesia, Mexico and Turkey. It can be said that the identification of the critical success factor of each country can have valuable lessons for other LDCs in general and Iran in particular in the attempt to achieve an effective technology transfer and rapid industrialisation.

In Chapter five, the key success factors of the East Asian first and second-tier NICs are specifically examined. The significant performance and successful experiences of these countries in an effective technology transfer and rapid industrialisation necessitate an in-depth analysis of their success factors in order to apply them to other LDCs including Iran which try to follow their model. Moreover, despite some slight differences in terms of technological capability levels, one can find a commonality in their success factors which could encourage other countries to replicate their model in rapid industrial and technological development. Therefore, LDCs in general and Iran in particular may learn valuable lessons from the experiences of these countries in successful technology transfer and rapid industrialisation.

Chapter six examines in detail the industrialisation policies in Iran during the pre- and post - revolutionary period, in order to determine the strengths and weaknesses of these policies which give a useful insight for the future trend of the country. Moreover, an in-depth analysis of Iran's past and present industrial performances can be used as a primary basis for further discussion of technology transfer and FDI status in Iran in next chapter.

In chapter seven, the past and current situation of FDI and technology transfer, as well as human resource development and R&D activities in Iran, is investigated. This can give an overall view of the industrial and technological structure of the country which in turn is essential for the establishment and implementation of its future technology transfer and industrialisation policies.

Finally, chapter eight concludes the research findings and results, derived from the discussion, analysis and conclusions in the previous chapters. The similarities in the success factors of the countries surveyed in the previous chapters are further discussed in order to design a common policy framework for an effective and successful technology transfer and industrialisation in other LDCs in general and Iran in particular. Some problems and obstacles of the selected countries surveyed are also identified, which can be useful for the other LDCs, including Iran, to avoid in their future path of technology transfer and industrialisation. A number of recommendations and policy implications for LDCs in general and Iran are also presented.

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CHAPTER 2:
THEORETICAL FRAMEWORK OF TECHNOLOGY TRANSFER

2.1 INTRODUCTION

Historically, as far back as in the work of the classical economists, Adam Smith was one of the first to examine manufacturing technology systematically in 1776. He began the Wealth of Nations with an examination of the causes of technical change and productivity [1]. Later, Marx also found a central place assigned to technology.

> "... Technology discloses man's mode of dealing with nature, the process of production by which he sustains life ... "[2]

Karl Marx considered technical progress was responsible for the shift from one mode of production and from one economic system to another. However, Marx's work on technological change did not have a lasting impact on the concerns of economics. In the early 20th century, evidence in economic literature of the importance of technical progress is to be found in the work of Schumpeter [3]. In his analysis of capitalism, the waves of both short-run cycles and long-run development are, in great measure, attributable to technical progress. But this was treated as an exogenous process. He added that capitalism is characterized by periodic waves of innovation whereby older, inefficient firms and industries are replaced by new more efficient firms with newer technologies.

Robert Solow has also contended that technology is the main source of economic growth. He said that technology alone was responsible for raising the real income of the developed countries nearly ten times over the last century [4]. According to Solow, technology is assumed to be a public good, i.e., something that is available to everyone everywhere free of charge. Gaski, by a process of elimination, has made technology the single cause of the industrial revolution [5]. More recently, experts from various schools of thought have recognized the place of technology in explaining growth, usually reflected in a downward shift of the supply curve as new technologies are discovered and put to use in the production of commodities and services. The recent contributions also stress two new perspectives; one comes from the technological change school of economic theory, which holds that

technological knowledge has proven to be more the engine of economic growth than has capital. The other stems from the appropriate technology movement, which stresses the need for LDCs to adopt a mix of technologies; some high, but many that are low and of a labour-intensive nature. Once it is accepted that technology is a significant contributor to growth as well as economic development and industrialization, then technology transfer is viewed as an essential bridge across the wide technological gap which exists between developing and developed countries. Recognition of the importance of technology has also led to the effort for technological follower countries to maintain, reduce, or even reverse the technological gap. The technological development in such follower countries can, in a broad sense, use a combination of internally available resources and the transfer of technology from external sources.

It is necessary to have definitions of technology and technology transfer here. An extensive definition of technology and technology transfer will be considered in the concepts section of the discussion later, but it is essential to have a clear and accepted meaning in this occasion to avoid confusion. Many definitions for technology have been stated. Technology in its broadest sense can be defined as "knowledge, skills, methods, and procedure associated with production and utilization of goods and services in a given society" [6]. While this definition may be adequate for some purposes, it should be noted that technology needs to be reviewed not only as the specific production prices or manufacturing technology, but also various other types of knowledge and expertise necessary for the planning, establishment, and operation of a manufacturing plant and associated enterprises. Technology transfer can be defined as "the acquisition, development, and utilization of technological knowledge by a country other than that in which this knowledge originated" [7]. Thus, technology transfer is not simply the reproduction of an identical enterprise in a second area, but is an adaptation of the original to fit the second region's peculiar, social, political, technological, climatological, economic, and educational environment.

Rostow (1967) argues that Technology Transfer will lead to increased economic opportunities for developing countries [8]. Without technology transfer, the difficulties which confront Third World countries in attempting to create competitive local industries are enormous. However, technology transfer in itself will not lead to economic growth. The success of technology transfer depends more on the ability and willingness of the importing

society to accept and absorb the technology than on the support of the exporter. As Ito (1986) notes, a successful transfer can occur only if the recipient is sufficiently capable of maintaining an introduced production system [9]. Local or domestic technological capability is indispensable in order to alter, modify, and adapt transferred technology to local conditions.

Gee (1981) suggests that managers must be both oriented towards innovation and sensitive to their environment in order to implement successfully new technology [10]. Wallander (1979) implies the need for managers in LDCs to develop managerial skills such as the ability to plan, organize and solve problems [11]. In essence, it is management skill which is needed to weld the various elements of knowledge into a viable productive effort [12].

2. 2 THEORETICAL ISSUES OF TECHNOLOGY TRANSFER

According to Beamount and Reithinger (1981), transfer of technology can be examined from three points of view [13]:

1. The international political framework within which tendencies towards co-operation or confrontation between the developed and the developing world are largely determined.
2. The commercial framework in which the interplay of corporate motives and negotiating strategies determines the outcome of individual projects.
3. The operational framework in which the transferred technology may contribute, or may fail to contribute, to the recipient's economic and social development.

The theoretical framework of technology transfer has been surveyed in this research through the analysis of neo-classical theorists, structuralist, and the radical perspective. Moreover, the views of the dependency school of thought and the product life cycle theory of technology transfer have also been discussed in order to identify the most appropriate theory to be applied in LDCs. The Import-Substitution and Export Promotion Industrialisation policies have also been analysed. Generally, studies of the various aspects of technology transfer generally are based on case studies and concepts rather than theories. Case studies on the other hand, mostly fail to relate to an overall specific theoretical framework.

2. 2. 1 The Neoclassical Approach Towards Technology Transfer

Technology is defined in context of neoclassical theory as the available methods by which resources or inputs can be converted to products or outputs. Technology transfer in the view of neoclassical theorists can also be defined as the process whereby technology is moved from one physical or geographic location to another in order to manufacture products [14]. This transfer should include both hardware or machinery and equipment, and software, or technical knowledge and managerial expertise. Most of the earlier neoclassical approach has been concentrated on the effects of technological change in one country's pattern of national production, and the levels of its national welfare. However, much recent literature of neoclassical theorists has focused on the effects of technology transfer from one country to another or International Technology Transfer.

Having surveyed the views of some writers influenced by neo-classical theories of international trade, MacCulloch and Yellen (1976) examined the effects of free dissemination of technology on the recipient national welfare and on the distribution of national income between capital and labour [15]. They found that the supplier of technology may lose welfare due to the free flow of technology, and the receiver gains national welfare. It seems that their conclusion considering the gains of a recipient country from the free transfer of production technology can be useful for the applicability to the LDCs. However, other authors such as Burgules and Jones (1977), through their primary assumption that technology is embodied in factors of production, suggested that maximization of national gains from new technology requires the imposition of tariffs on the foreign use of technology [16]. On the other hand, some other neoclassicalists analysed the effects of international technology transfer on the recipient country's national welfare in the presence or absence of tariff protection and domestic distortions. They concluded that the recipient country's protectionist measures towards international technology transfer can reduce its level of national welfare [17]. Therefore, the recipient country can generally gain from technology transfer when there is no tariff.

The neoclassical theorists have also emphasised the role of the market in the more efficient allocation of resources and in the most appropriate technology choice for a developing country. In their belief, it is market mechanism rather government intervention that can enable the LDCs to maximise the utilisation of their resources and therefore lead to their

industrial and technological development. The neoclassicalists believe that government intervention and the resultant price distortions would produce inefficiencies and therefore the direct role of government in economic decisions should be reduced [18]. Acquiring technological capability, in their view, has been determined by integration in the world economy, through importing appropriate technologies from foreign countries. Once the required technology has been transferred, it must be adapted and absorbed to the local condition and the know-how can gradually be acquired through some methods such as imitation and reverse engineering [19].

However, the neoclassical theorists have been criticised by the new institution theorists (North, 1995) [20] as well as others (Kiely, 1994) [21], who believe that the neo-classical theory neglects the role of the state in industrialisation of some Newly Industrialised Countries in South East Asia and Latin America. While some writers influenced by neo-classical theory argued that the success of the East Asian NICs has been achieved despite state intervention, there is some evidence which indicates the very effective role of the state in the promotion of industrial and technological development in these countries. For example, in Taiwan, the state accounted for 57% of industrial production in 1952, and although there has been significant privatisation since then, the state's share of gross domestic investment still stood at 50% in 1980 [22].

As North (1995) stated, the state can never be treated as an exogenous factor in development policy, and getting the prices right only has the desired consequences when agents already have in place a set of property rights and enforcement that will then produce competitive market conditions [23]. Therefore, the new institutionalists believe that the neoclassicalist neglected the role of institutions in the development process. According to North (1989), institutions are a set of rules, enforcement characteristics of rules, and norms of behaviour that structure repeated human interactions [24].

2. 2. 2 The Structuralist Approach

The structuralist school of thought which contributed mostly to development literature in the 1950s and early 1960s, believed that free trade would not necessarily be to the advantage of LDCs. Hence, these countries should switch from a reliance upon trade and primary exports towards inward-looking based industrialisation. They sought to show that

the price mechanism in LDCs did not work in accordance with the perfectly competitive model, and that neoclassical theory was therefore largely inapplicable in LDCs. They also believed that structural transformation required a shift from the production of primary and agricultural products towards manufacturing products which in turn need an increase in the level of investment in the economy. In their view, the manufacturing sector can be considered as an engine of growth for LDCs, which the expansion of manufacturing sector in these countries may lead to an increase in the productivity of their labour force and therefore technological progress [25]. Many structuralists refer to the specialisation of LDCs in primary production as a major factor contributing to their backwardness. On the other hand, they found a strong link between industry and development which can be proved through several empirical evidence [26].

The structuralists have also emphasised the effective role of technology in the industrialisation of LDCs. In their view, technological capability can be acquired by building a local technological capacity through a process of technological learning. Furthermore, they argued that transferring inappropriate technologies will slow down or even hinder the process of technological development. They suggested that LDCs should build their own technological capability through the strategic government intervention in setting up adequate infrastructure needed for the expansion of indigenous technological capacity. Therefore, in the structuralist view, LDCs can also increase their ability to adapt and assimilate the imported technology more efficiently through more emphasis on the promotion of local technological capability. Structuralists have also been concerned with the problems of technological dependence which may arise as a result of excessive reliance on imported technology. However, the phenomenon of technology dependency has been analysed in the views of the dependency school of thought which will be discussed later.

Although structuralist perspectives may have very useful points for application in LDCs, in particular their emphasis on the development of indigenous technological capability, their focus on inward-looking industrialisation can be criticised due to its inefficiency for solving the LDCs' problems. As the experience of most successful East Asian and Latin American NICs countries indicated, despite the implementation of domestic-market based industrialisation in the early stages, it was their transition towards outward-oriented policies that can be credited as one of the major factor in the rapid industrialisation of these countries.

2. 2. 3 The Radical Perspectives

Following the survey by Griffin and Gulley (1985), radical analysis can be described as "that which is highly critical of capitalism, favours socialism, and often employs Marxian analysis" [27]. Moreover, many of the radical theorists have emphasised the limitations, problems and constraints which have impeded the industrialisation of LDCs. Much of the literature related to the radical perspective has common features with the structuralist views but with a relatively stronger stance. The major elements of industrialisation of LDCs under the radical points of view have been identified as : strong state intervention, adopting protectionist measures against foreign competition, controls over MNCs Foreign Direct Investment and pursing policies which emphasised more the promotion of domestic technological capabilities [28].

Several radical authors raised some important points on the limits to industrialisation in the LDCs, particularly on the role of transnational companies and their relations with the state and local capital, both logically and empirically. The notion of technological dependence of LDCs or "periphery" on the developed countries or " centre" has been put forward by radical theorists. They have argued that most multinational companies which are located in the developed countries have transferred inappropriate technologies to the developing countries. This is because much of the technologies created and developed in the advanced countries are highly capital intensive, or too large scale, so that LDCs are very hardly able to adapt these technologies to their local conditions. Most writers influenced by radical perspective argue that the trade of technology between "centre" and "periphery" not only do not increase the economic development of the periphery but it may also be considered as an obstacle in the industrial and technological progress of periphery.

Therefore, in the radical perspective, one of the most critical steps towards a more independent industrial and technological development in LDCs can be by promoting their local technological capability. Furthermore, for some other radicals, a removal of dependence requires a radical transformation of the economic and political structures within developing countries themselves [29].

2. 2. 4 The Dependency Theory

The dependency school of thought can be identified as an important and distinct approach within the radical theorists who have considered the capitalist development in the advanced countries as main source of dependency in developing countries. Dependency theorists are mostly concerned with the cultural as well as economic features of dependent relationship between advanced countries and less developed countries. In other words, as Dos Santos (1973) defines dependency as a " conditioning situation, in which the economies of one group of countries are conditioned by the development and expansion of others" [30]. Furthermore, Cardoso and Faletto (1979), in what is generally recognized as one of the classics of the dependency literature, define a dependent economy as "one which cannot grow on the basis of internal forces-". ... A system is dependent when the accumulation and expansion of capital cannot find its essential dynamic component inside the system [31].

As Stewart (1981) argued, technology dependency occurs where a major source of a country's technology comes from abroad [32]. Moreover, technology dependency also arises from the lack of adequate indigenous technological capability in LDCs to assimilate and adapt imported technologies efficiently to their own needs. In the dependency perspective, LDCs are characterised with some factors which have made them technologically dependent on the developed countries. Some of the most important LDCs' characteristics are the absence of a coherent technology policy; the lack of sufficient R&D activities; the under-utilisation of their natural and human resources; and the limited application of research results to their basic human needs [33].

The dependency theorists also argued that due to their lack of expertise, and weak indigenous technological capability, most LDCs are in a weak bargaining position and unable to adapt and absorb the foreign technologies. They also added that most technologies which have created and originated in the developed countries may often be inappropriate for the condition in LDCs. This is mainly because these technologies are mostly too capital intensive and too large-scale, so that may create little employment opportunities along with a great deal of unused capacities. Therefore, modern dependency theorist have strongly emphasised the importance of promoting local technological capability [34].

Another argument made by the dependency theorists is that developing countries not only spend a smaller proportion on research, but that the volume of technology produced by their research sectors is far below that of developed countries. That seems to be a logical conclusion from the claim of most of the dependency theorists that, in developing countries, inputs into research activity are marginal. There is yet another factor which they consider to be responsible for this low technology output namely, poor productivity of research. Advocates of the dependency school use patent data as one set of indicators to prove this point. Vaitos points out that the developing countries' share in the total number of patents granted in the world amounted to only 1 percent in the late 1960 [35]. It is also noted that in 1986-1987 only 4.3% of worldwide R & D expenditure was accounted for by developing counties [36].

The technological dependency, as is shown in the figure 2.1, indicates that Less Developed Countries are heavily dependent on the import of foreign technology from Developed Countries. As indicated earlier, most LDCs have been characterised with a low level of technological capability along with a weak industrial infrastructure which can partly be the result of a low level of research and development activities, and inefficient use of natural resources in these countries. Even though massive import of technology from developed countries may lead to the technological dependency for developing countries, there seems to be no other way for the LDCs to catch up with Developed Countries and close the gap existing between these countries. Moreover, the technological dependency at an early stage of industrialisation may not be viewed as a disadvantage for LDCs, as there is still not still an adequate indigenous industrial and technological capability for the creation and development of technologies in these countries.

However, the dependency theorists argued that LDCs usually imported inappropriate technologies which were not compatible to the indigenous endowments and factor conditions in these countries. They believed that most technologies which have been transferred by MNCs to LDCs, were capital intensive and therefore could not create employment opportunities for LDCs and therefore alternative sources of technology should be created by the LDCs themselves, preferably through intra-regional cooperation in research [37]. Some dependency theorists also argued that the majority of technologies developed in developed countries is aimed at meeting only those countries' economic and

cultural needs. They added that even if appropriate technologies are available, western multinationals express little interest in supplying them to developing countries' conditions and desires [38].

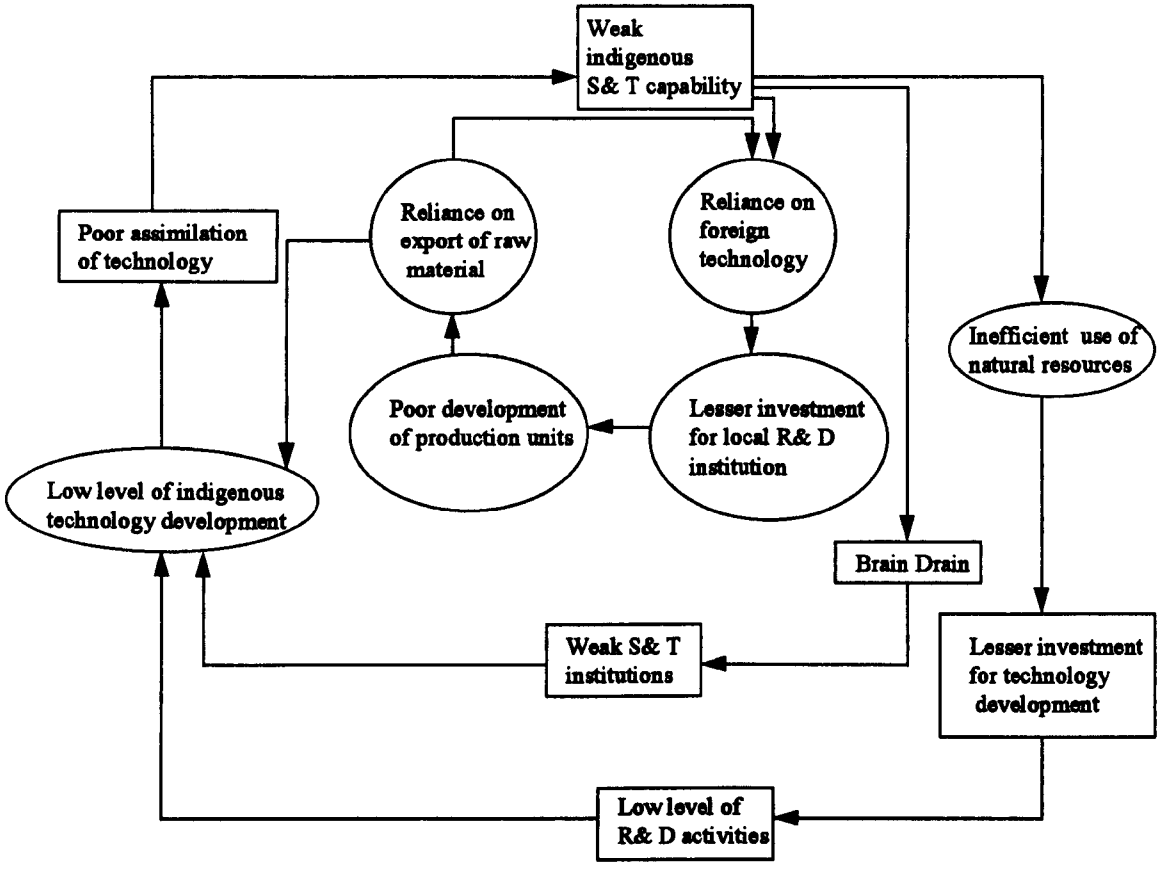


Figure 2.1: A Vicious cycle of technological dependency in LDCs
Source: Adapted from Technology Atlas Team (ESCAP), 1988.

The supporters of the dependency school of thought concluded that the flow of imported technologies may not essentially lead to the development of indigenous technological capability in LDCs. They even go one step further in saying that the transfer of western technologies may even have negative implications for LDCs' internal technological capability. Mytelka (1979) refers to some negative effects of foreign technologies on the willingness of some LDCs' domestic firms to rely on their own new products, which is considered to be connected with a physiological environment of dependence [39].

2. 2. 4. 1 The Criticism of Dependency Theory

The dependency theorists' argument on the inappropriateness of MNCs' technology policy can not be easily justified since their analysis is not well structured. The negative view of the dependency theorists towards the effects of foreign technologies on the developing countries is opposed by the successful experiences of a number of countries in international technology transfer which have led to a significant industrial and technological development in these countries. Moreover, it seems that the dependency school of thought has not taken into account the major reasons for most LDCs' failure in international technology transfer, which are believed to be mainly because of the lack of adequate local absorptive capacities, and also the lack of an appropriate internal policy toward technology transfer in these countries.

However, the experience of some countries, in particular, the Newly Industrialised Countries (NICs) prove that it is not technology transfer that leads to technological dependency, rather, it is the lack of local absorptive capacity to assimilate, adapt, and improve imported technologies, that leads to dependency on foreign suppliers. For example, the experience of some NICs such as Korea, Mexico, etc., shows that many of these countries have been able to move from almost total dependence on foreign technologies to independent production. Furthermore, unlike the dependency theorists belief in the negative impacts of imported technology on LDCs, some of these countries have not only successfully transferred foreign technology but they could also export some of their manufacturing products and transfer a significant amount of technology to the other countries.

The dependency school of thought has also been criticised by many authors of being vague in their division of countries as dependent and independent countries. As Seers (1979) [40], Lall (1975) [41], among others stated, nobody can claim that there is a country which is fully independent from other parts of the world. As Seers suggested, all countries either developed or underdeveloped are dependent, but with a different degree of dependency. Brewer (1980) also criticises Dos Santos' definition of dependence on the grounds that it wrongly asserts that the domestic countries enjoy independent (self-sustaining) development [42]. The dependency school of thought has also been criticised for not explaining the rapid growth performance and economic transformation of the NICs during the 1960s and 1970s.

Soete (1981) has also argued that the notion of technological dependence is irrelevant in analysing the underdevelopment of LDCs, since most developed countries also rely on foreign technology. He concluded that there is no discussion on the presence or absence of dependency but in the degree of such dependence. As he states; " one may hardly find a country which was completely technologically independent, as many developed countries such as Japan and Germany have run large deficits in terms of technological payments and receipts". Therefore, he suggests that " one should really emphasise more the enormous benefits and advantages of a massive import of technology rather than focusing on the limits, costs and problems generally associated with international technology transfer" [43].

2. 2. 5 The Big Push Theory of Industrialisation

According to this theory, industrialisation is defined as the way of achieving a more equal distribution of income between different areas of the world by raising incomes in depressed areas at a higher rate than in rich areas [44]. This theory indicates that simultaneous investment by various sectors of the economy using the available technology, can create income for each sector that becomes a source of demand for goods in other sectors, and so enlarge their markets and make industrialisation profitable. According to the big push theory, the development of a profitable industry would act as a leading sector in a LDC, creating productive jobs and generating an income multiplier process [45]. This theory generally supports the argument in favour of the role of large-scale manufacturing and modern technology in the industrialisation of LDCs. Although this theory has been experienced and applied by some European countries where it was initially formulated, it has generally failed to replicate the European success story in the LDCs, due to its strongly pro-capitalist and interventionist assumptions.

2. 2. 6 The Product Life Cycle Theory of Technology Transfer

It seems essential to study initially some of the main assumptions and limitations of the product life cycle theory of technology transfer, since these assumptions differ significantly from those of traditional international trade theory. Among the most important traditional theories of international trade, one can refer to the Heckscher-Ohlin theory which indicates that a country exports products which have comparative advantage and uses its abundant

factors of production, and reversely imports those products that require more of its scarce factors [46]. While traditional trade theory is based on free availability of information and stable production functions, the product life cycle theory is based on assumptions that the flow of information and skills across regions or national borders is restricted. The product life cycle theory of international trade also assumes that products undergo predictable changes in production technology and marketing methods over time; and the production process is characterized by economies of scale, that it also changes over time; and that market characteristics (consumer tastes) also change over time [47].

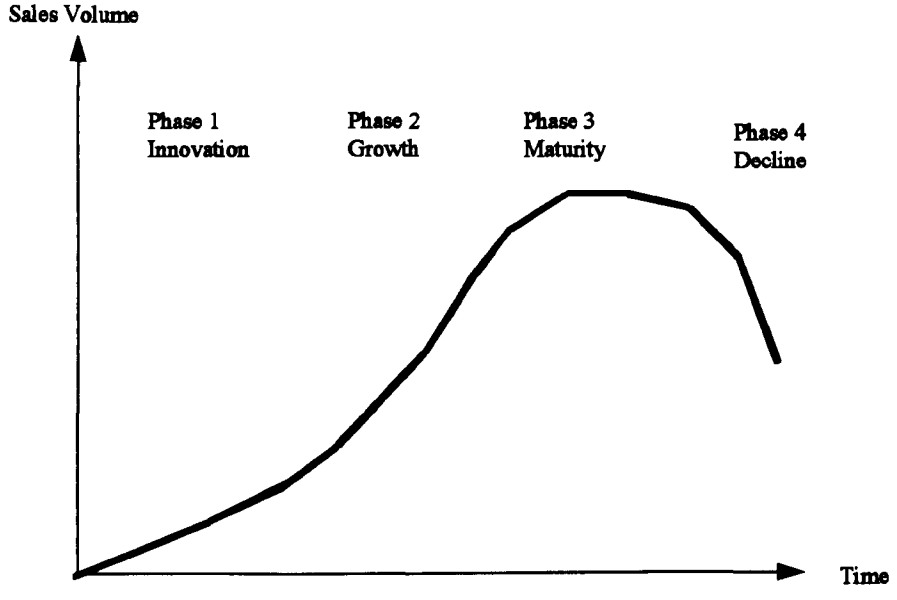


Figure 2.2 The Product Life Cycle

This theory also shows the sequences of a product's development and production during its life from introduction phase to decline. The first phase (introduction) mostly takes place in developed countries and is characterised by a large amount of resources allocated to Research and Development (R&D). The second stage of the life cycle of the product is usually characterised by diffusion of technology (product) and increases in foreign demand. In this stage, countries with less technical expertise begin to produce and market the products. The next stage or maturity phase is associated with the standardisation of the product; more emphasis on the innovative aspect of the product; and efforts for minimising the production costs. Then, the last phase of the life cycle of a product ends with ultimate decline and replacement by new products. The product life cycle remains a fundamental

theory in marketing, where it is used to generalize about circumstances across stages for a product class or product brand [48].

The product life cycle theory of technology transfer provides an invaluable tool for explaining the early post- second world war MNCs direct investment in other countries. As indicated earlier, because of restrictions in the flow of information across regions or national boundaries, innovation and development of new products is more likely to occur in developed countries. The developed countries have an advantage in producing and exporting new products and technologies, while Less Developed Countries have a comparative advantage in producing standardized or mature products and exporting them to the developed nations [49]. Despite innovation and creation of many new products and technologies in developed countries and their inflow to developing countries, according to the product life cycle theory, the flow of new products may be reversed from recipient countries to origin countries due to LDCs' cheap and skilled labour and low cost of production.

2. 2. 6. 1 A Critique of Product Life Cycle Theory

As is explained earlier, the product life cycle theory implies for analysing the role of MNCs investment in the industrial infrastructure of developing countries. Despite several examples of the application of the product life cycle theory, with the rapid growth of some Newly Industrialised Countries in 1970s and 1980s and their capability to innovate the products, the primary concept of Product Life Cycle theory that innovation of products firstly takes place in developed countries and would only reach a LDC in the later stage, was questioned.

In addition to the above point, some NICs also involved in research-intensive investments in the developed countries in order to gain access to their higher level of technology which again could not be analysed effectively within the conceptual framework of the product life cycle theory. Giddy (1978) noted that the product cycle was no longer consistent with the developments in international trade and investment in the late 1970s. He added that the explanatory power of the product life cycle has itself undergone maturity and decline [50]. Moreover, although there were a number of examples in the support of PLC theory in which MNCs in developed countries have transferred old technologies to developing countries,

there were also some examples in which MNCs were transferring their latest technology to their subsidiaries located in LDCs.

2. 2. 7 Technology Gap Theory

Technology transfer can generally take place when there is a gap in technological level of supplier and receiver of technology. Therefore, it seems that the transferor or supplier of technology is mostly in a higher position in terms of technological capability or more technologically advanced than the receiver. In other words, the technology gap which exists between the transferor and transferee accelerates the flow of technology. However, in order to be successful in technology transfer, it is essential for a recipient country to adapt, assimilate and absorb the imported technology which in turn relies on its technological level and capability. Therefore, the higher the level of absorptive capacity in the recipient country is, the higher the assimilation of foreign technology would be.

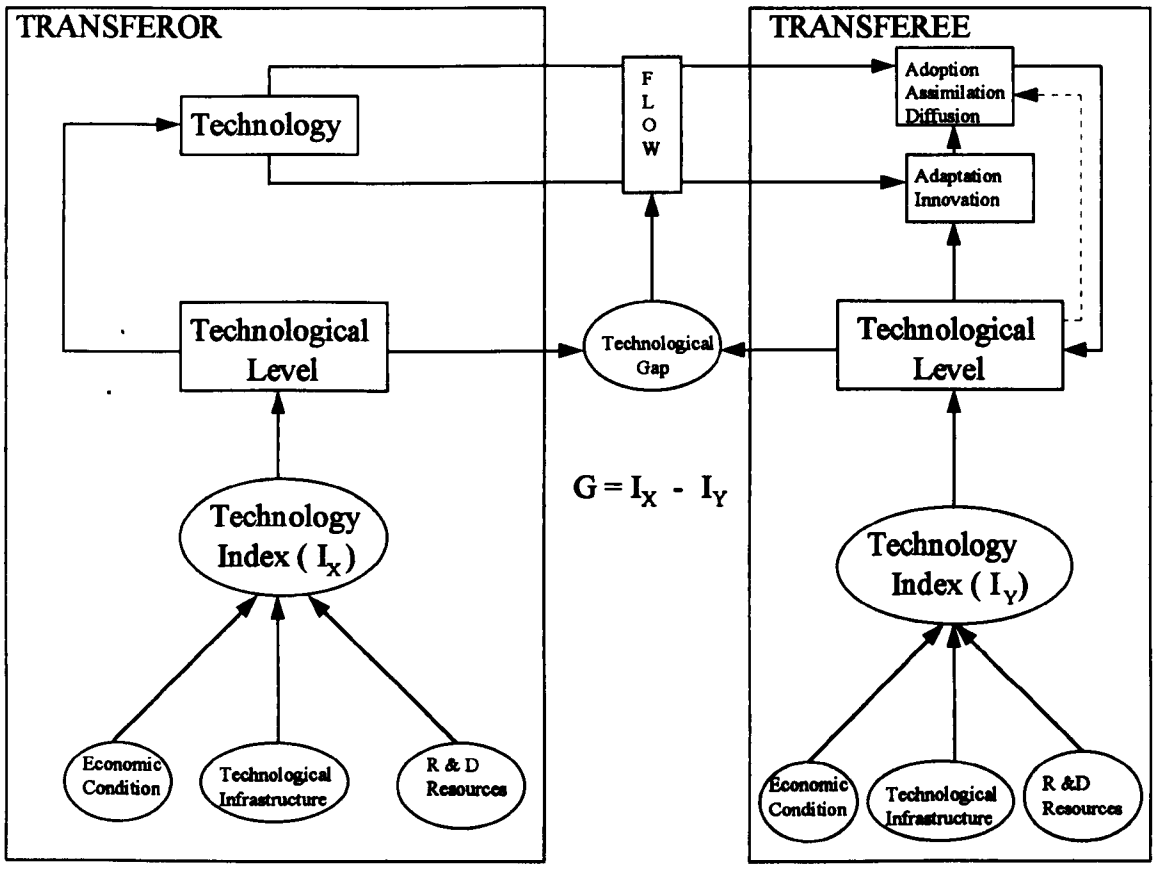


Figure 2.3 Technology gap as main factor for technology transfer

The technology gap theory was firstly generated in an international trade model by Posner (1961) who believed that technological gap between developed and developing countries

can be considered as one of the most important causes of trade between these two groups of countries. As he stated " trade may be caused by technical changes and developments that influence some industries and not others; because particular technical change originates in one country, comparative cost differences may induce trade in particular goods during the lapse of time taken for the rest of the world to imitate one country's innovation" [51]. Therefore, in Posner's view, technological differences among countries can be considered as the major cause of trade between these countries. In other words, according to this theory, the capability to innovate technologically is considered to be a necessary factor in a country's competitiveness. Moreover, the idea of imitation gap was also introduced by Posner in order to measure the time difference between the generation of technology in the country of origin and its adoption by an imitating country.

One can also say that the technological gap between less developed and developed countries represents great promise for the technologically backward countries. Although it is difficult for backward countries to fill this gap, it can accelerate the process of catching up between these two group of countries. As the experiences of some successful East Asian NICs in their rapid industrial and technological development indicated, they could lessen their technological gap very rapidly with the adoption of a series of appropriate industrial and technology policies which will be discussed later. The experiences of these countries also shows that in order to catch up with the leading technologically countries, a developing country needs to enhance its efforts in technology transfer as well as promoting its indigenous technological capability. It is argued that a less developed country may be able to close or even reverse the technological gap with more developed countries through devoting a substantial amount of investment on R&D activity. Moreover, the creation of an efficient absorptive capacity to adapt the imported technology may also enable a backward country to close or reverse the technological gap [52].

It is also argued that the ability to catch up with the technological frontier countries depends on the growth rate of domestic demand for the specific products. Therefore, the higher is the growth rate of domestic demand, the faster the technological gap can be reduced. This is mostly because the rapid growth rate of domestic demand allows investment in new capital, specialisation, and acquisition of the experience to learn new technologies [53]. Moreover, the analysis of some example countries by Verspagen (1991)

shows that the pace of the catching up process in the countries characterised by a large technological gap and a low social and indigenous industrial and technological capability was slower in comparison with the countries with a relatively higher technological capability [54].

This is mostly because of the inadequate capacities of those countries with a relatively high degree of backwardness to acquire the know-how from the more advanced countries. In a similar analysis of the catching up process of some East Asian NICs, Verspagen (1993) found that the high rate of competitiveness, and the high degree of openness and investment intensity in these countries, were among the major factors which enable them in closing the technological gap with more advanced technologically countries. Therefore, he concluded that a pre-catching up phase is needed before the catching up process, in which the backward countries should build up an indigenous learning capability through extensive investment in education of the labour force, infrastructure and research and development activities [55].

The technological gap theory has gone through a period of significant development and expansion since Posner's initial view, and some other scholars such as Krugman (1979)[56] and (1985) [57], Jensen and Thursby (1987) [58], and Dollar (1989) [59] among many others contributed further to this theory over the years. Having compared the technology gap models which have been studied by these authors, they generally indicate that the developed countries export technology-intensive goods to the LDCs, in return to importing imitated products from LDCs. According to technology gap models, the developed north gains relatively higher than developing south, due to their monopolistic power on innovation which results in exporting high priced products to the developing south and importing low priced goods from them. However, according to Krugman (1990), technical progress in the most advanced countries always benefits less advanced countries, but a catch-up by a less advanced country may hurt the technological leader [60].

2.3 IMPORT SUBSTITUTION INDUSTRIALISATION STRATEGY

The Import Substitution Industrialisation (ISI) trade strategy, can be defined as the substitution of domestic production for imports of manufactured products [61]. This

strategy aimed at protection of domestic industries from foreign competition through a high wall of quotas, tariffs and overvalued exchange rates, and was very popular among less developed countries in the 1950s and 1960s. The widespread implementation of this strategy among so many LDCs is considered to be mostly because of the problems in their balance of payments, and economic depression resulting from war and region conflicts. Despite an annual average growth rate of 6% in the industrial products of some Latin American countries which implemented ISI strategy extensively in the 1950s and 1960s, these countries faced serious problems in their balance of payments and high inflation [62]. Therefore, this strategy has been criticised by many neoclassical and even structuralist theorists who had been among the main advocates of ISI [63].

They believed that this strategy created an inefficient industrial sector, unable to compete in the international market. This is mainly due to the small size of the market in many of these countries which had been saturated by the domestic products. They also believed that this strategy leads to the inefficient utilisation of natural and human resources due to the lack of a competitive environment to maximise the utilisation of the domestic resources. Moreover, while this strategy aims at substituting the imports of foreign products with the domestic goods, the overvalued exchange rate which is among the incentives for the implementation of ISI, causes an increase in imports which seemed to be cheaper than domestically produced goods. Moreover, the very process of indigenous production would create its own imports of raw materials and components [64].

As indicated earlier, although both neoclassicalists and structuralists have criticised the ISI strategy, the structuralist criticism of the ISI strategy differs from that of the neoclassical. Neoclassicalists argued that ISI strategy and protectionist measures in most LDCs resulted in the creation of an inefficient industrial sector unable to compete in international markets and therefore gives little incentive for their technical progress. The neoclassical critics of ISI also referred to its failure regarding to the extreme interventionist role of government in the industrialisation process. They also believed that ISI strategy has intensified such problems as imbalance of payments, inequalities in the distribution of income, unemployment and neglecting of the agriculture sector [65]. Thus, they recommend that LDCs should decrease the protectionist measures through the removal of trade barriers such as quotas and custom duties and encouraging the role of market forces. Structuralists, on the other hand, argued

that the failure of the ISI was mostly because of the productive structure and social class formation in LDCs. They believed that the adoption of the import substitution strategy in many LDCs not only led to the decrease in the these countries' imports but it also encouraged the importation of inappropriate technologies and therefore resulted to an outflow of capital in the form of royalty payments and transfer pricing [66].

Despite several criticisms of ISI strategy, as the experiences of most successful NICs shows, it seems that the adoption of ISI strategy has been essential for the establishment of an adequate industrial infrastructure needed for a transition to an outward-oriented strategy in these countries. The adoption of ISI strategy had initially encouraged the establishment and expansion of such industries as textiles and footwear manufactures in which these countries had a comparative advantage [67]. For example, the effective implementation of ISI in their early stages of industrialisation enabled S.Korea and Taiwan to develop their indigenous technological capacity, economies of scale, and infrastructure, which provided the basis for a successful transition to export-oriented strategy.

It is also argued that the adoption of ISI strategy, followed by the protection of a specific industry for a limited period of time is essential for the domestic producer to gain confidence through lowering the cost of production and learning the technology from experience with its use (learning by doing). If protection is not provided, domestic producers may find themselves unable to compete in the international market. However, it is also argued that the success of the ISI strategy to a large degree depends on the size of the market. The larger the size of the domestic market, the more rapid the speed of achieving technical abilities for producing a particular type of manufacture products would be. Therefore, the large markets allow for intensive learning through experience from the production, initially, for the protected domestic market [68]. Therefore, one can say that the adoption of an effective ISI strategy seems to be a pre-requisite for a successful transition to the Export Promotion Industrialisation strategy, since it allows the build up of a strong domestic industrial base.

2. 4 THE EXPORT PROMOTION INDUSTRIALISATION POLICY

The Export Promotion Industrialisation policy can be defined as a preference for production for the foreign relative to the domestic market [69]. As the experiences of some East Asian and Latin American NICs show, these countries have shifted to an outward-oriented export promotion industrialisation policy, as their market had become saturated with the domestically produced goods. The adoption of an EPI strategy in most of these countries have associated with a significant increase in the GDP growth rate in these countries. One can therefore say that EPI policy may indeed be superior to ISI strategy. This is largely due to the several advantages of the EPI policy in comparison with the ISI policy.

Firstly, it is widely believed that the EPI strategy improves the efficient allocation of resources through the creation of a competitive environment, allowing greater capacity utilisation, overcoming the limitation of the domestic market, concentrating in producing the products with most comparative advantage, permitting the exploitation of economies of scale, and increasing the productivity of the human resources. Secondly, the export promotion policy accelerates the efforts for better acquisition and assimilation of foreign technologies. This is mainly because in order to be more competitive in the world market, more modern technologies are needed. Therefore, an strong EPI strategy encourages the national innovation system to keep up with innovations worldwide, and also provides incentives in terms of technology transfer and technical assistance from buyers [70]. Thirdly, the adoption of EPI strategy leads to the use of labour-intensive technologies, consistent with the LDCs' factor endowments and comparative advantage which in turn creates more employment opportunities and improvements in income distribution [71].

The adoption of EPI policy usually associated with introducing some export incentive measures such as a reduction in tax and custom duties, export credits and loans for the domestic exporters, and exchange rate devaluation. However, the implementation of EPI strategy does not mean that ISI policy cannot be continued. As the experiences of some LDCs show, these countries have continued the second stage of ISI strategy while they implemented an outward-oriented EPI policy. Although the adoption of EPI policy can lead to a significant growth rate, this strategy has also been criticised for causing a dependency on import of foreign inputs and materials needed to produce manufacturing products for

exports. It should also be noted that the success of the EPI strategy relies heavily on the continued growth of the world economy and therefore this strategy is vulnerable to the effects of policies in advanced countries [72].

2. 5 TECHNOLOGY CHANGE AND GROWTH MODELS

As indicated earlier, technological change refers to improvements in transformation of inputs into outputs, including improvements in the quality of output. However, while in developed countries technical change involves mostly such activities as the reduction in cost of production as well as the creation of new products and technologies, in less developed countries technical change constitutes mostly the adaptation of imported technologies to their local conditions. Most of the previous studies about the role of international technology transfer on the economic growth of LDCs generally assumed that new technology is exogenous. Yet technological progress is considered to be an indigenous economic process responsive to supply and demand conditions, costs and returns [73].

One can refer to some studies conducted by Kozumi and Kopeky (1977) [74], and Findly (1978)[75], within the growth models and theories which assumed that the superior technology to be transferred internationally is exogenous to the economic system modelled. Most of these growth theories have attempted to concentrate on the relation of capital inflow to technology transfer. According to these theories, the recipient country is assumed to benefit from the effects of the technology transfer process. However, more recently, attempts have been made to endogenise the process of technological change. In most of these studies, innovation has been considered as an endogenous process that requires the allocation of a large amount of R&D activities to create product and process for commercial use. R&D may include all activities that lead to new discoveries, as well as imitation activities that lead to the adoption of products or techniques known elsewhere.

For example, the work by Rodrigez (1978) shows that the devotion of substantial R&D may enable a backward LDC to close the technological gap between its level of technology and that of an advanced country [76]. He therefore shows that a backward country may be able to close or reverse the gap. The main findings of more recent research on R&D spillovers shows that more technologies are transferred from developed countries to LDCs through

trade. Therefore, LDCs imitate more the technology of their trading partners than the technology of other countries, even though those other countries might have superior technology to that of their trading partners [77].

One can also refer to the other studies which have recently discussed the growth models concerning endogenous technological change, such as Lucus (1988)[78] who concentrates on human capital models; and the study of Grossman and Helpman (1990) [79], who focuses on the introduction of new goods with learning by doing. However, most of these models are generally ignored to explain the important linkage between International Technology Transfer and the growth. However, a very recent study by Zhang and Zou (1995) develops a model which build a direct linkage between foreign technological imports and productivity increase in LDCs by assuming that the rate of technological growth is a positive function of foreign capital imports. According to their model, it is the quality gap between the developing country's home technology and imported technology from developed country that encourages the former to catch up with the latter. Therefore, a developing country can reduce the technological gap and eventually become a NIC, through effective learning by doing [80].

2. 6 SUMMARY AND CONCLUSIONS

It becomes clear from earlier discussion of theoretical framework of technology transfer that we still lack a rigorous theory of technology transfer which can be applicable to the less developed countries. However, it appears that some theories are much more useful than other theories in the terms of their applicability to LDCs. Most theoretical discussions of technology transfer treated new technology as exogenous in their models. Other theorists, however viewed technological progress as endogenous. Thus, different treatment of technology result in different theories and conclusions.

As discussed earlier in detail, it appears that neoclassical discussions of technology transfer lay great stress on the production factor analysis of the role of technology. According to the neoclassical school of thought, technological change is considered to be a factor of production expanding by the residual in the production function. Moreover, neo-classical theorists focus more on market as a means of allocating resources which has been criticized

by others who believe that neo-classicalists neglect the role of the state in the industrialization of some newly industrialized countries in south-east Asia and Latin America. As already analysed, early structuralists sought to show why free trade is not necessarily to the advantage of LDCs, by criticizing the neoclassical analysis of trade. They believed that the price mechanism in LDCs did not work in accordance with the perfectly competitive model. Modern structuralists, however, emphasize the importance of developing local technological capability. Furthermore, the structuralist approach also concentrated more on the role of the state in promoting national development and technological capability in LDCs.

The product life cycle theory of technology transfer can be an important theory base for LDCs. According to this theory both developed and less developed countries can gain from technology trade. As this theory indicated, new products mostly originate in developed countries. For a period of time, the flow of new products may be reversed from recipient countries to origin countries, if developing countries have lower costs and wages and become relatively efficient in the production of new goods. This theory may also be applied to a wide range of technologies in LDCs. As indicated earlier, technological gap theory stresses the role of catching up process in closing the technological gap existed between LDCs and DCs. However, it fails to some extent explain and elaborate clearly the reasons for the importance of technological gap in the technological progress of the backward countries.

The dependency theory is also a very important theory which can be applicable to LDCs. This theory implies that imported technologies have mostly resulted to a technological dependency for LDCs. Therefore, the dependency theorist strongly recommend the LDCs to increase their research and development efforts in order to promote their indigenous technological capability. Although dependency theory can bring about some useful aspects for LDCs, most of its studies has been criticized for its failure to distinguish between so called dependent countries. Substantial differences exist between dependent countries regarding their structural situation and development problems. The dependency school of thought fails to explain properly the reasons behind the successful experiences of some NICs such as Korea, Mexico,..., which have been able to move from almost total dependence on foreign technologies to a certain level of indigenous technological capability and

technological independence. In conclusion, having surveyed the theoretical framework of technology transfer, one can mention the notion of the product life cycle theory and dependency school of thought are as the most empirical validation to apply in LDCs. However, these theories have yet to be integrated into an overall framework that can offer some guidance to planner involved in technology transfer. Moreover, most theories which are discussed earlier, neglected to examine the dynamic interaction between indigenous technological capability and imported foreign technology. Consequently, most of these theories are vulnerable to the attack of being rather limited in scope.

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CHAPTER 3: CONCEPTUAL ISSUES OF TECHNOLOGY TRANSFER

3.1 TECHNOLOGY AND ITS DEFINITIONS

Technology is a word in widespread use, especially in conjunction with other words such as development and industrialization. Technology means different things to different observers. Its definitions vary from simple dictionary explanations to complex elaboration. Many definitions and descriptions of technology are very broad and sometimes almost all encompassing. A selection of definitions will be considered to cover the various dimensions of technology.

Technology as a combined word originating from Greek words of "transferring" (art, craft) and "logos" (word, speech) refers to all the ways in which people satisfy their needs and desires through the systematic study of techniques and use of the inventions and discoveries. Many scholars define technology as knowledge of particular techniques, for example; the art of industrial production. Definitions of this type are of limited value, however, because the meaning and use of the word technology has changed over time, it is used differently by different schools of thought and between different languages; its common use is haphazard, and the definition does not convey much of the complexity of meaning attributed to the term in the literature. A number of different approaches to defining technology should therefore be examined. The Concise Oxford Dictionary, in a similar manner to other dictionaries, defines technology as the science of practical or industrial arts [1]. This definition does not include other areas, because industrial art is not by any means the only area in which technology plays a role. According to Webster Dictionary, technology is the science of the application of the knowledge to practical purposes in particular field [2]. This definition makes it clear that there can be many technologies as many as there are particular fields. Some definitions explicitly point to the soft and hard side of technology. According to Jantsch (1967), technology denotes the broad area of purposeful application of the contents of the physical, life, and behavioural sciences. It comprises the entire notion of techniques as well as the medical, agricultural, management, and other fields with their total hardware and software contents [3]. Schon (1967) defined technology as " any tool or technique, any product or process, any physical equipment or method of doing or making, by which human capability is extended" [4].

According to Thompson (1967), technology is " a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome [5]. Galbraith (1967) defines technology as "the systematic application of scientific or other organised knowledge to practical tasks" [6]. Merrill (1968) sees technology as bodies of knowledge, skills, and procedures, for making, using, and doing useful things [7]. According to Root (1968), technology is "the body of knowledge that is applicable to the production of goods and the creation of new goods" [8]. Peno and Wallender (1977) define technology as "knowledge embodied in products, processes formulas, and techniques needed for managing operations" [9]. According to Barquin (1981), a technology is the set of disciplines, methods, techniques and supporting instruments which make up the process by which a tangible or intangible product is elaborated [10]. In another definition used by the Organisation for Economic Co-operation and Development (OECD), technology means systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service, including any integrally associated managerial and marketing techniques [11]. Dahlman and Westphal (1981) define technology as a collection of physical processes which transforms inputs into outputs [12]. This definition is also similar to that of Technology Atlas Team (1988) which consider technology as a black box where inputs in the form of natural resources go into the box and outputs in the form of produced resources come out from the other side. Thus, one can say that technology performs as a transformer of inputs into outputs [13].

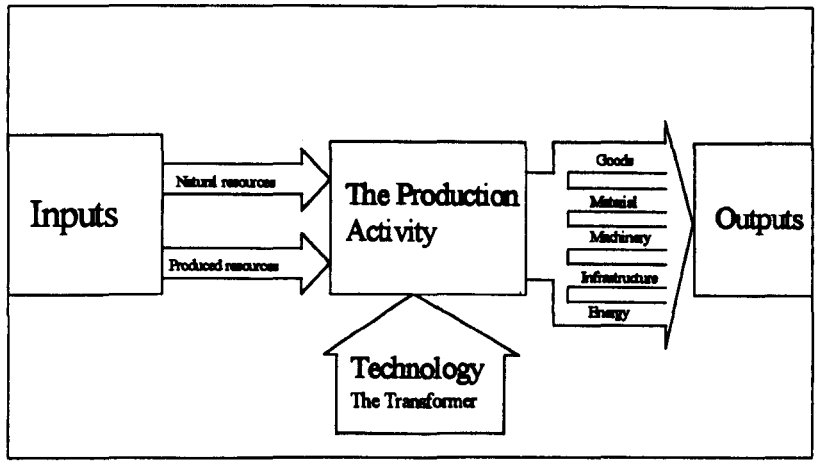


Figure 3.1: The Schematic Representation of Technology

Source: APCTT (Asian and Pacific Centre for Technology Transfer, U.N. " Technology Atlas", 1988.

According to Mansfield (1982), technology consists of society's pool of knowledge concerning physical and social phenomena, knowledge regarding the application of basic principles to practical work, and knowledge regarding the day-to-day operations of production (such as the rules of thumb of practitioners and craftsmen) [14]. In its broadest definitions, Evans (1984) defined technology as the means by which man undertakes to change or influence his environment [15]. Dosi (1984) sees technology as a set of segments of knowledge, containing directly practical and theoretical know-how, procedures, experiences of successes, and points out that technologies consist not only of hardware (machines and mechanical equipment) but also comprise the technical knowledge and skills of participants of an organisation [16]. Fransman (1984), believes that technology is defined broadly so as to encompass everything pertaining to the transforming of inputs to outputs [17]. This definition is widely used by economists, describing the relationship between inputs or factors of production, and output. According to Meissner (1988), technology is a process by which knowledge and experience are applied to achieving more efficient, effective, and timely use of available resources in a community that aims to increase its cultural and material welfare, according to the community's own values and means [18]. Dunning (1993) defines technology as the output of technological and organisational capacity, which determines the way (or ways) in which tangible and intangible resources may be physically converted into intermediate and finished goods and services [19].

It becomes obvious from these extensive technology definitions that technology is seen by many as the most significant factor in improving productivity, quality, and competitiveness. The main feature of most definitions is that they indicate to one or more specific aspects of technology such as its type, method and subject. Moreover, the various definitions for technology emphasise to its multi-dimensional characteristics such as flexibility, institutional, organisational, and cumulative nature.

3.2 TECHNOLOGY CLASSIFICATIONS AND COMPONENTS

Technology can be classified according to many variables, e.g. the cost of its supporting hardware, the type of end-product obtained, or the complexity of its methods and techniques. Hall and Johnson (1970) distinguished three kinds of technology:

1. General technology includes technical information common to companies operating in the same activity,
2. System specific technology corresponds to the knowledge and know-how firms develop for solving particular industrial problems. In other words, system-specific technology refers to the information possessed by a firm or an individual in a firm, which might have been acquired through engaging in certain tasks or projects. Such information comprises procedures related to a particular system, solutions to unique problems, or requirements which differentiate them from procedures encountered in other systems. A system-specific technology is acquired by a firm in one industry, and usually not by other firms in the industry manufacturing the same item or engaged in the same activity. It gives the firm a competitive edge or differentiation.
3. Company-specific technology covers the corporate skills and capabilities deriving from the general activity and experience of each individual firm. In other words, it refers to knowledge which a firm acquires beyond the general knowledge possessed by the industry as a whole. Such knowledge is not attributed to any specific item the firm produces or system it uses, but it results from the firm's overall or collective activities [20].

There are some other classifications of technology which have been stated by other authors. Mansfield (1975) used "embodied", (physical goods and skilled labour) versus "disembodied", (soft goods such as, industrial property, know-how, technical data, technical services and technical assistance,...) technology [21]. Madeuf (1984) has elaborated this classification as capital embodied, human embodied and disembodied technology [22]. He has also drawn a distinction between technology alienated by property rights (patterns) or secrecy and know-how which could not be transferred without an effective participation of the firm holding it.

According to another classification, technology is divided to production and consumption technology. Production technology considers the methods, processes etc, for production of goods and services, whereas consumption technology considers methods, processes and techniques by which a particular need or demand may be satisfied, for example, the need for inland transport, satisfied by using the horse and buggy, the automobile, trains, bicycles or a subway system [23]. According to Simon (1991) technology falls into multiple categories.

First, those technologies that are explicitly related to purely civilian commodities or the harvesting and production of these commodities such as textiles and agricultural products. Second, those technologies that are directly links to military items such as weapon systems. The third type of technology is not really technology at all, but is best labeled scientific or basic research. The last type of technology, and perhaps the most controversial is what is called dual use technology. Dual-use technologies are those whose development and application are intended for civilian purposes, but could have potential application in the defense sector. Much of what is called high technology items, such as super computers, would fall in this category [24].

Bhalla and James (1991) determined four levels of technology; traditional, intermediate, conventional, and newly emerging [25]. Traditional technologies are " the evolutionary product of a long process of natural selection of innovations often stretching over several centuries." Ordinarily, traditional technologies exhibit little change and fit comfortably with local socio-economic conditions and value systems. They tend to be very old and are rooted in local tradition and culture. Intermediate technologies commonly result from incremental conventional technical improvements that upgrade traditional technologies. E.F.Schumacher (1973) characterised intermediate technology as technology that:

1. Is able to create a new workplace with low investment outlays;
2. Makes only modest demands on skills, and
3. Uses locally available inputs [26].

Conventional technologies comprise the technological core for production in developed countries and modern sectors of third world nations.

Emerging technologies can be distinguished by four characteristics:

1. They are the product of recent scientific research and development;
2. They are being developed and applied at rates that exceed those of most past and contemporary technologies;
3. They show no clear signs of losing their dynamism in the near future, and
4. They appear to have the potential for widespread application that will bring about

significant social and economic change.

According to another classification, technology is classified into visible and invisible messages. While the former include drawings, specifications, manuals, documentation, computer programs, database, or patents, the latter represents know-how, skills or software that are not easily transferable in a descriptive form [27].

Technology Atlas Team (1987) identify four components of technology:

1. Object-embodied technology which can be called Techno-ware, and consists of tools, equipment, machines, vehicles, physical facilities, etc.
2. Person-embodied technology which can be called Human-ware, and refers to experiences, skills, knowledge, wisdom, creativity, etc.
3. Document-embodied technology which can be called Info-ware and includes all kinds of documentation pertaining to process specifications, procedures, theories, observations, etc.
4. Institution-embodied technology which can be called Orga-ware and consists of management practices, linkages, etc [28].

Zeleny also defines technology's four components:

1. Hardware, which refers not only to a particular physical structure of components, but to their logical layout as well.
2. Software, which refers to the know-how of carrying out tasks to achieve goals and objectives.
3. Brain-ware, which refers to the application and the justification of hardware/ software deployment, the know-what and know-why of technology; that is, what to employ, how, when, and why; and
4. Support net, which refers to the complex network of physical, informational, and socio-economic transformations that support the proper use and functioning of a given technology the unity of hardware, software, and brain-ware toward stated goals and objectives [29].

One may find three common features in the classification of technology components. These are hardware or techno-ware, brain-ware or human-ware, and info-ware or software. In any technology transfer process, all components of technology are required for transformation of inputs into the outputs. In other words, both hardware (machinery and equipment) and software (the know-how for using those machinery and equipment) are needed in order to have an effective technology transfer. Moreover, the skillful labour force (human-ware) and managerial and organisational expertise (orga-ware) can also promote the level of recipient adaptation and absorption of imported technologies.

3. 3 TECHNOLOGY TRANSFER AND ITS DEFINITIONS

The literature offers several definitions in respect of technology transfer which indicate to its importance. Technology transfer has been defined initially the process whereby technology is moved from one physical or geographic location to another for the purpose of application toward an end product [30]. This transfer can take place either domestically, from one sector or firm to another, or it can take place across national boundaries, from one country to another, which is generally accepted as international technology transfer. According to Get (1981), technology transfer is the process by which technology developed for one purpose is employed either in a different application or by a new user [31]. Kayak (1985) has defined technology transfer as the transition of know-how to suit local conditions, with effective absorption and diffusion both within a country and from one country to another [32].

According to another definition, technology transfer is the "utilisation of an existing technique in an instance where it has not previously been used" [33]. Chesnais (1986) defined technology transfer as the transition of the capability to manufacture a product or process from firms in one country to firms in another. He argued that this transfer includes not only the technical knowledge needed to produce the products, but also of the capacity to master, develop, and later produce autonomously the technology underlying these products [34]. Larsen et al. (1986) define technology transfer as the process by which technological innovations are exchanged between individuals and organisations who are involved in R & D on one hand, and in putting technological innovations into use on the other hand [35]. According to Meissner (1988), transfer of technology is the act of sharing

know-how by such devices as constancy, joint ventures, gifts, licenses, franchises, and patents [36]. Aggrawal (1991) on the other hand, view technology transfer as the communication, adaptation and use of technology from one place or economic region into a second region. He also adds that this technology has to be adapted to local conditions by the receiver to fit to its social, political, cultural,, economic, and educational environment [37].

There are several fundamental characteristics concerning technology transfer deriving from these definitions:

First, as it discussed earlier, technology has many components and dimensions, and almost always involves more than one element of technology. Various elements of technology involved in a particular case interact with each other as if they constituted a system. In addition, the technology package must be periodically re-evaluated as conditions change, and as the project cycle advances, and as new information becomes available. Thus technology transfer is a dynamic process. Second, industrial technology is different from scientific knowledge. Industrial technology consists of product design, production techniques, and managerial systems to organise and carry out production plans. Although scientific progress in a country may contribute to innovation and facilitate the application of science to production, scientific progress by itself is not adequate for technological progress. The scientific progress must be converted into industrial applications which are, in turn, made commercially viable through managerial know-how. Technology may be embodied in products, or disembodied, and recorded or held in minds of persons. It may have its applications in new products, new services, or old services and products with lower resource costs. The international transfer of technology thus means that people, products, or materials (data, manuals, blueprints) must be transferred across national boundaries. To be successfully transferred, the technology must be absorbed into the production process of the host nation, which will depend on cultural and social factors.

Third, the effective transfer of technology requires an adequate infrastructure, which may include scientific institutions; research and development facilities; vocational, technical and management training institutes; and skilled personnel of different specialisation, within the recipient country. It also requires a suitable cultural environment. Both the infrastructure

and the cultural environment are basic determinants of the effectiveness of technology transfer. Fourth, technology developed in a specific context can hardly ever be introduced into a new environment without at least some degree of modification. Modification and further development of technology are thus very often an integrated part of transfer. This often involves changing the scale of a production process and the adaptation of products to local market characteristics.

Tyre (1991) points out that new process introductions often involve considerable problem solving and even innovation at the plant level. The degree of changes in the technology is affected by the attributes and business environments of the units involved in the transfer [38].

3. 4 TECHNOLOGY TRANSFER CLASSIFICATION

It is important to distinguish among several types of technology transfer. The International Technology Transfer has been classified according to different criteria. Useful classification was provided by Mansfield (1982), who distinguished between material transfer, design transfer, and capacity transfer.

Material transfer consists of the transfer of materials, final products, components, equipment, and even turnkey plants. In brief, this is the transfer of the technological artefact itself, it is not so much a transfer of knowledge as it is the transfer of the results of knowledge. The receiving country is merely a passive consumer of the knowledge produced by others, and it cannot reproduce that knowledge. The main objective is either to supply the physical capacity to produce or the desired products themselves. Design transfer, which basically involves the movement of designs, blueprints, and the know-how to manufacture previously designed products or equipment. The major objective here is to provide the basic information, data, and guidelines needed to create a desired capability. In other words, foreign items are imported in order to copy their designs, and the recipient nation begins to produce domestically the artefact formerly imported in the material type of transfer. Nevertheless, it still remains dependent upon technological knowledge produced elsewhere. Capacity transfer includes provision of the know-how and soft-ware not simply to manufacture existing products but, more importantly, to innovate and adapt existing

technologies and products, and ultimately design new products [39].

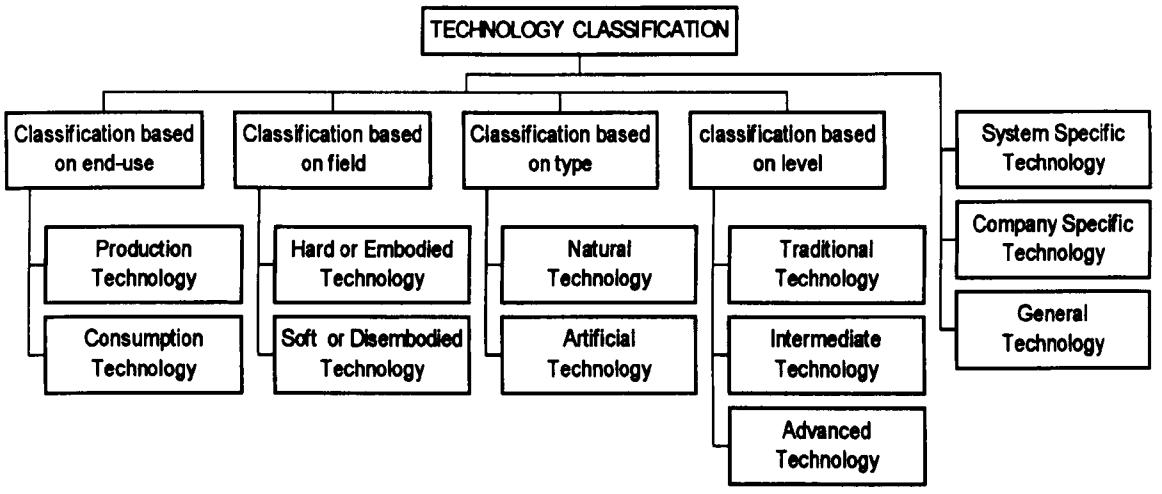


Figure 3.2: The different classification of technology

Another classification distinguished between two basic types of technology transfer; vertical transfer and horizontal transfer. Vertical transfer refers to the transfer of technical information within the various stages of a particular innovative process, i.e. from basic research to applied research, from applied research to development, and from development to production. In other words it is the transition from the principle to practice, or from pure science to its practical application. Since vertical technology transfer entails technological progression from science to a completed product, there seems to be tend toward organising R & D by vertical integration. Horizontal transfer occurs when technology is used in one place, organisation, or context is transferred and used in another [40].

3. 5 DIAGRAMMATIC REPRESENTATION OF TECHNOLOGY TRANSFER

As noted earlier, technology transfer can be classified to different types. One can generally demonstrate four kinds of technology transfer as following:

3. 5. 1 The Partial Transfer

In this method, foreign technology T supplied in the year 1 is adapted by R&D centres to

local conditions, before going to production and then to market. This method needs a long period of time to take technology to the exploitation stage.

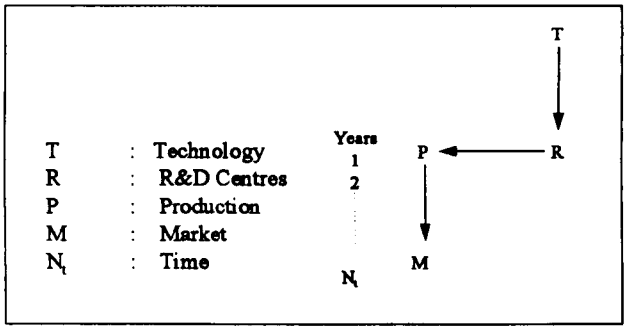


Figure 3.3: The Partial Transfer

3. 5. 2 The Incomplete Transfer

In this case, the technology T is being imported in the year 1 and simultaneously used in production, and then is being adapted by local R&D centres in the year N_t before going to market. Therefore, production has first priority.

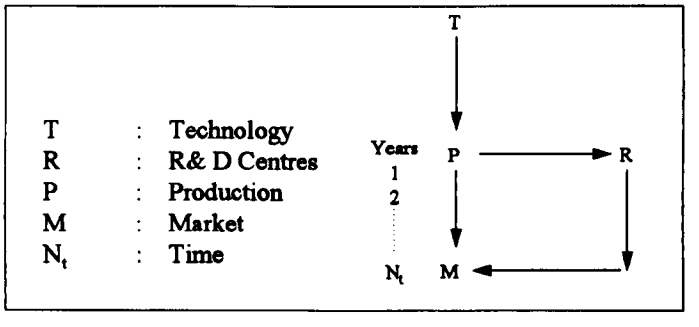


Figure 3.4: The Incomplete Transfer

3. 5. 3 The Complete Transfer

This method is the combination of the previous methods. Firstly, the technology is taken to R&D centres and then used for production and finally after a period in the production process, the R&D centres develop an improved version of the technology. There is a significant role for R & D both in adapting the technology and customising it for the receiving country, and also in assimilating the "know-how" embodied in technology. There is a significant role for R&D centres in this method.

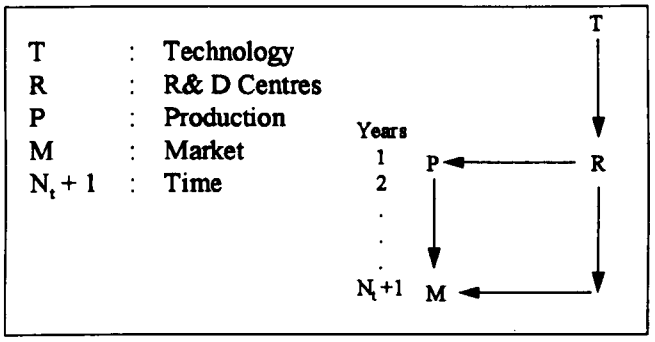


Figure 3.5 The Complete Transfer

3. 5. 4 The Barter Transfer

In this method, technology is used directly in production, and after a period of time, it should be reimported again, because it becomes obsolete. The R&D centres have no role in this method.

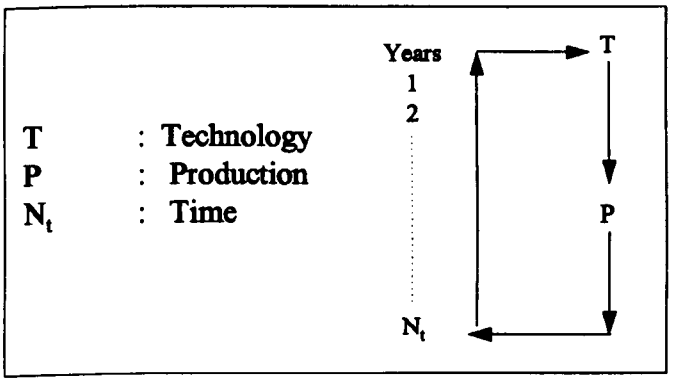


Figure 3.6 The Barter Transfer

3. 6 TECHNOLOGY TRANSFER MECHANISM

Technology transfer among nations (International Technology Transfer) can take place through a number of different channels and mechanisms that may in some cases exist independently of other channels. Cooper and Sercovich (1971) [41] and Stewart (1979) [42] distinguish between direct and indirect mechanisms of transfer. Direct mechanisms are those used when the recipient is in direct contact with the supplier of technology. Direct forms of transfer include direct contracting of individual experts and consultant companies, engaging engineering design and plant construction enterprises, training nationals for specific production projects, technical information activities and transfer of the process

technology embodied in capital goods by importation of equipment purchased directly from machine manufactures. Indirect mechanism of transfer occurs when for example a company in an advanced country plays an intermediary role packaging the technology for the developed country. Generally, indirect mechanisms tend to be adopted where a country lacks the capacity to undertake direct purchase, where proprietary technology is involved which will not be released, or where (for marketing or other reasons) the recipient wishes to acquire trade marks.

Buckley (1985) divides the modes of ITT into two main categories; internal and external, specifying 10 forms of technology transfer:

1. Wholly owned foreign subsidiaries;
2. Joint ventures;
3. Foreign minority holdings;
4. "Fading-out" agreements;
5. Licensing;
6. Franchising;
7. Management contracts;
8. Turnkey contracts;
9. Contractual joint ventures; and
10. International subcontracting.

The first type, wholly owned foreign subsidiaries, is the conventional form of foreign direct investment for technology transfer. The mode of transfer for the first three forms is internal; that for forms 5,6,7,8, and 10 is external. For the fourth form, the fading-out agreement, the mode of transfer is internal at the beginning but becomes external when the period of agreements ends. The mode of transfer is mixed for the ninth form, contractual joint ventures [43].

Erdilek and Rapoport (1985) refer to formal and informal mechanisms of technology transfer. The formal channels of International Technology Transfer (ITT) are licensing agreements, direct foreign investment, sale of turnkey plants, joint ventures, co-operative research arrangements, and co-production agreements. The informal channels are those

which do not involve an actual agreement between supplier and receiver of technology such as export of high-technology products and capital goals, reverse engineering, exchange of scientific and technical personnel, science and technology conferences, trade shows and exhibits, education and training of foreigners, commercial visits, open literature (journals, magazines, technical books, and articles), industrial espionage, end-user or third country diversions, and government assistance programs. International technology transfer through most of these channels is very difficult to detect and monitor. Formal channels usually involve the market mechanism and assign an explicit value to ITT. It is not known whether the bulk of ITT occurs through the formal channels or through the informal ones that much more difficult to detect and monitor [44].

A study by United Nations Centre on Transnational Corporations (UNCTC) (1987) distinguish between commercial and non-commercial channels of international technology transfer. The commercial transfer involves payment of a direct and indirect price for technology and thus generates more complicated issues in the international arena than non-commercial transfer. For instance, friction between the supplier and recipient of technology often arises in regard to price for, and range of technology supplied, teaching and learning attitudes, etc. Moreover, interaction between the supplier and recipient through technology transfer is a long process, unlike the transaction of a physical commodity. Therefore, the nature, method, and means of interaction can take various forms, appropriate or inappropriate. The commercial channels include:

1. Foreign direct investment,
2. Joint ventures,
3. Licensing,
4. Franchising,
5. Marketing contracts,
6. Technical service contracts,
7. Turn-key contracts,
8. International subcontracting.

The non-commercial modes of ITT include the review of technical journals and the training of foreign students, exchange of scientists and engineers, co-operative research and

participation in international conferences [45].

Karake (1990) specifies channels by which technology is transferred in two major categories. The first category can be termed "packaged transfer" channels, such as direct foreign investment and joint ventures, whereby technology is tied to other inputs of production such as capital and management. Generally, the higher the degree of packaging, the more control the donors can maintain, and thus the less beneficial the effects for the recipients. Developing countries wish to import technology separated from the packaging as much as possible for this reason, and donors wish the opposite. The second category, "un-packed transfer" channels, includes a wide range of activities that can be acquired independently of control and ownership of the resources of suppliers. This category includes, among other channels, machinery and equipment exports, contracts awarded, personnel training, and technical programs [46].

Olukoshi (1990) discusses the international technology transfer mechanisms regarding elements of embodied and disembodied technology. He summarised the ITT channels as: flows of books, journals and other published materials; movement of people between countries including immigration, return emigrants, study visits and foreign courses; import of machinery and equipment for production; i.e. production technology; licensing, patents, trade-marks and know-how agreements; technical co-operation at bilateral and multinational levels; and import of consumer goods, i.e. consumption technology. He explained that each of these forms contains elements of embodied and disembodied technology or a complex combination of both. For example, the flow of books and journals is one means of transferring disembodied technology while the sale by foreign corporations of patents, trademarks and licenses are an embodied form of technology transfer. Similarly, the provision by multinational companies (MNCs) of constancy, management and financial services falls into the category of disembodied technology. However, the supply of machinery and equipment for production is a classic example of transfer of embodied technology, where the supply of machinery and equipment goes in hand with the provision of training and technical services for example, then the transfer process can be said to involve both embodied and dis-embodied forms of technology. In many cases, technology transferred by MNCs to developing countries usually entails a complex combination of embodied and disembodied technology [47].

Simon (1991) placed the most important channels of ITT in to five generic categories [48]:

1. The international technology market, which is made up of independent buyers and suppliers.
2. Intrafirm transfer, whereby resort to the market is avoided and the transfer takes place through either a joint venture or wholly owned subsidiary.
3. Government-directed agreements or exchanges, where the counterparts can be either public or private actors.
4. Education, training, and conferences, where the dissemination of information is made public for common consumption by either a general or specialised audience.
5. Pirating or reverse-engineering, whereby access to the technology is obtained while resort to the market is avoided but at the expense of the proprietary rights of the owner(s) of technology.

He emphasised the first and second channels as the most critical ones, but this is not to deny the relative importance of three other channels noted, especially the role of education and training.

Kim (1991) analyses the international technology transfer mechanisms by classifying them to market and non-market mediated [49]. In market mediated, he refers to those mechanisms which may be determined by the market. The transferor and transferee may negotiate the cost of technology transfer, either embodied in or disembodied from the physical equipment. In the non-mediated mechanisms, technology transfer usually takes place without formal agreements and payments . He demonstrates the mediated and non-mediated mechanisms of technology transfer in a useful four-cells matrix to identify and evaluate different mechanisms of international technology transfer. As is shown in the following figure, those mechanisms in the cell 1 are among the most important technology transfer modes which the supplier of technology has exercised an active role in directing the technology transfer process including control over the quality and quantity of know-how being transferred, and the possible restriction imposed on the use of know-how. The channels of TT which are shown in cell 2, indicate those market-mediated modes which the suppliers of technology play a relatively passive role, with less control over the way in which technology and know-

how are transferred to the recipient country. Finally, those methods which are shown in the cells 3 and 4 refer to the non-market mediated mechanisms and suppliers play a relatively passive and active role in transferring technological know-how respectively.

Market mediated	Direct foreign investment, foreign licensing, turn-key plant, technical consultancy, made-to-order machinery	Standard (serial) machinery purchase (Cell 2)
Non-market mediated	Technical assistance by foreign buyers, technical assistance by foreign vendors (Cell 4) Active (role	Imitation (reverse engineering) observation, trade journals, technical information service (Cell 3) Passive (role of supplier)

Table 3.1 The Mode of Foreign Technology Transfer

Source: Kim, L. , Pros and Cons of International Technology Transfer: A Developing Country View, 1991.

Lall (1993) has also analysed the modes of technology transfer by distinguishing between two broad categories: internalised and externalised forms of technology transfer [50]. By internalised he refers to those modes which transferor has a significant and continuing financial share in the success of the affiliate, allows it to use its brand names and to have access to its global technology and marketing networks, exercise control over the affiliate's investment, technology and sales decisions. However, externalised forms lack one or all of these characteristics and include such mechanisms as licensing, international subcontracting, and joint ventures with local control-which may be referred to as non-FDI forms of TT. He also argued that the choice of internalisation of technology transfer mode is determined by some factors such as the nature of technology (its degree of complexity); the strategy of the supplier; the capability of receiver to absorb imported technology; and host government policy. Therefore, he believes that the internalised technology flows can be a very efficient means of transferring a package of capital, skills, technology, brand names and market access to LDCs. On the other hand, he also argues that the more standardised and diffused the technology and the more capable the receiver, the more economical will the externalised modes be.

Tho (1993) has classified the channels of international technology transfer into two broad categories, public and private [51]. In the first category, technologies can be considered as public goods, and the transfer is conducted by public organisation, such as governments of advanced countries and international agencies. The transfer of such technologies is conducted as a part of the technical assistance or economic co-operation provided to LDCs. The private channels of transfer relate to technologies that are developed by private firms and transferred on a commercial basis. The MNCs are usually the suppliers of such technologies which usually transfer their technologies through such channels as FDI, licensing agreements, plant export, original equipment manufacturing (OEM), and others. He also argues that the importance of each channel depends on some factors such as strategy of MNCs supplying the technologies, the characteristics of the technologies, and the policies, absorptive capacity, and managerial resource endowments of the recipient countries. He adds that MNCs prefer FDI with whole or majority ownership when the newly developed technologies are transferred. On the other hand, recipient countries usually use licensing agreements, when the environment is considered risky. Moreover, the choice of OEM as channel of technology transfer depends on the technological level of recipient country.

It appears that different mechanisms will involve different agents of transfer and will affect the actual amount and composition of the technology transferred, the level of control for the exporting and importing country, and the return (costs and benefits) on technology for the parties involved. For example, if the mechanism is the export of product-embodied technology, the amount of actual knowledge and skill transferred is slight (assuming that the recipient can not reverse engineer the underlying design and thus appropriate the necessary know-how to manufacture the product on his own) [52]. Moreover, the choice of transfer mechanism will also determine the costs and benefits for both supplier and recipient of technology. In other words, the determination of the mechanism of transfer in a particular case is the outcome of the willingness of the supplier of technology to supply the technology in a particular form and the desire and ability of the recipient to acquire in a particular form.

The effectiveness of each channel depends on the nature of the technology that is being acquired, the type of the organisation, and the absorptive capacities of the recipient. Thus, the various methods of transfer can be determined by following factors:

1) Motivation, purpose, criteria, and benefits agreed upon between recipient and donor on technology transfer,
2) Technology-vending strategy of donor,
3) Technology level and managerial capacities of recipients,
4) Available information sources and bargaining power of the recipient, and
5) Technology and trade policy of the recipient's nation [53].

So, the recipient of technology should keep in mind that effectiveness of technology importation is significantly affected by the forms and mechanisms of technology transfer. The various mechanisms and channels of international technology transfer have been examined from different points of view so far. Now, it is essential to describe and explain each of these methods, in order to examine their applications according to different situations and circumstances.

3. 6. 1 Foreign Direct Investment

It is believed that Foreign Direct Investment (FDI) is one of the most important channels of technology transfer [54]. The transfer of technology through FDI usually occurs when a Multinational company involves in the flow of capital, technical, managerial and marketing skills through its affiliates in a foreign country of which MNC can have the whole, majority or minority of ownership. In other words, direct investment represents the horizontal and vertical extension of business enterprise across national boundaries, motivated by purely commercial considerations [55]. Since MNCs can be considered as one of the major sources of most modern technologies, their direct investment plays an important role in transferring technology to developing countries [56]. However, MNCs have sometimes been criticised for not transferring the appropriate technology and the know-how needed for adapting the foreign technology to LDCs' local conditions. This is mainly due to the low values of research and development expenditures of MNCs in host LDCs which is because of the small size of local markets in many LDCs and also the lack of adequate industrial and technological infrastructure and the shortage of skilled labour force in these host countries [57].

According to Vickery (1986), the flow of FDI can either take place where a foreign owner

establishes business in the host country, or the inflows from established overseas affiliates to their parents [58]. However, it should be noted that the term affiliate is commonly used for joint venture, which is a specific form of FDI and will be discussed later. The foreign branch of a MNC is usually called a subsidiary when there is effective control by the parent firm. While there is a common agreement on the significant role of FDI in transfer of technology and managerial expertise to LDCs, one can not easily explain the preference of FDI for a particular channel of transfer compared with other channels. However, it is generally argued that FDI has flowed more to the countries which have some characteristics such as a relatively cheap and skilled labour and abundant natural resources and preferably, although not necessarily, to areas in close geographical proximity [59].

There is considerable general literature on the advantages and disadvantages of foreign direct investment for developing countries. One of the main advantages of FDI is that it brings in new knowledge, technical know-how, marketing and entrepreneurial skills. Therefore, this complete package of knowledge and skills can certainly have a major impact on the recipient country. The importance of FDI as one of the major mechanism for technology transfer can be seen in the preference of this method over the other channels by both receiver and supplier of technology. It is argued that through the 1960s, the establishment of a wholly owned foreign subsidiary or a majority-owned foreign affiliate was the predominant method of MNCs' direct investment and a prime source of technology transfer to LDCs [60]. However, many LDCs proposed rather more restrictive policies towards MNCs in particular their whole ownership, as most of these countries wished to strengthen their indigenous industrial and technological capability which enabled them to adapt and assimilate foreign technologies more efficiently.

The choice between exports and foreign direct investment as channels of technology transfer is more complex. One might expect that export would be the preferred choice as suggested by product cycle theory. However, it can be seen that in many respects, firms in LDCs prefer direct investment for technology transfer [61]. According to Dunning (1988), what makes a firm (MNC) enter a foreign investment activity instead of exporting of its products is the exploration of the location specific advantage and the ownership specific advantage [62]. In other words, the main reasons for a firm to involve in foreign investment are to control enterprises in other countries and also to use the firm's competitive advantage

abroad.

The importance of FDI as a mechanism of technology transfer has been important for many developing countries and in particular for the East Asian NICs, except for S. Korea where FDI has been an important source of technology in specific industries such as chemicals, electronics and petroleum refining [63]. According to a recent World Bank Publication, FDI is the dominant source of resource flowing to developing countries and the primary source of private capital flows for low-income countries. The UNCTC using International Monetary Fund (IMF) data, has estimated that during the five years 1985-89, world FDI flows totalled over $ 630 billion on a balance-of-payments basis. FDI on a balance-of-payments basis is a measure of changes in owners equity in business organisations or real assets that these owners control. The $ 630 billion figure cited above thus is far short of the total value of assets that came under foreign control as a result of FDI [64].

The aggregate flow of FDI to all developing countries exceeded $ 38 billion in 1992, and $ 80 billion in 1993, an increase of 50% over the previous two years and a 400% increase since the mid-1980. As a source of external capital for developing countries, FDI makes up more than 75% of the total. While global FDI flow has declined slightly in the last couple of years, the flow to developing countries has increased in absolute amounts and in the share from less than 12% of the total in 1987 to over 22% by the end of 1991[65]. Within the developing countries, the bulk of FDI flow goes to Asia, which attracts over 60% of the total. However, this still constitutes less than 10% of the world's FDI flow. In contrast, developing countries in Latin America attract no more than 5% of the world's FDI flow. In addition, over the past few years there has been a slight shift of FDI flow from Latin America to Asia) [66]. There are several reasons for this, including the international debt crisis, the increased attractiveness of Asian economies to FDI, and the better macroeconomic prospects of Asian economies. Table 4 gives a picture of the changing pattern of the top 10 FDI recipients in the developing countries over the past two decades.

Recipients	1970-1980	Recipients	1980-1990	Recipients	1988-1992
Total FDI flow to LDCs	20.6	Total FDI flow to LDCs	18.7	Total FDI flow to LDCs	164.5 (estimated)
Brazil	11.3	Singapore	2.3	China	25.6
Mexico	0.6	Mexico	1.9	Singapore	21.7
Egypt	0.3	Brazil	1.8	Mexico	18.4
Malaysia	0.3	China	1.7	Malaysia	13.2
Nigeria	0.3	Malaysia	1.1	Argentina	10.
Singapore	0.3	Hong Kong	1.1	Thailand	9.5
Indonesia	0.2	Egypt	0.9	Hong Kong	7.9
Hong Kong	0.1	Argentina	0.5	Indonesia	5.6
Iran	0.1	Thailand	0.7	Taiwan	6.0
Uruguay	0.1	Taiwan	0.5	Indonesia	5.6
Share of flow to top 10 (%)	66	Share of flow to top 10 (%)	68	Share of flow to top 10 (%)	75

Table 3.2 Top 10 Annual Flow of FDI to Less Developed Countries.($ billions)
Source: Columns (1-4) UN, World Investment Report, 1992; Columns (5-6), The Economist, Oct., 1994, P:29

As is shown in table 3.2, during the 1970s, Asia had five recipients in the top 10 but this increased to six and seven during the 1980s and early 1990s respectively. The top slot switched from Brazil in 1970s to Singapore in 1980s, and has recently shifted to China in early 1990s. One can also see that the average share of Asia in the top 10 increased from only 5% to 58%. It should be understood that FDI flow is fairly uneven, and as more countries have become receptive to FDI the pattern of flow has altered considerably. Less than one quarter of all FDI flow goes to developing countries and over two-thirds of this goes to only 10 countries.

While the composition of these 10 has changed over the years the aggregate flow of FDI to developing countries has increased about twice as fast as the rate of growth of their GDP during the latter half of 1980s and early 1990s. In 1989, Japan emerged for the first time as the world's largest investor. The slow-down of the global FDI outflow after 1990 was largely caused by a drop in Japanese FDI outflow from $48 billion in 1990 to $31 billion in 1991. Japan's share in global FDI outflow increased from 10% for the period 1980-1985 to 20% between 1986-1990, surpassing the UK (17%) and the USA (14%). MNCs from

Japan became the world's most important moves of international capital and the world's most important source of technology transfer. Japanese MNCs have tended to concentrate their investment in North America and the EC, which together accounted for more than half of Japan's total investment outflow in manufacturing during the period 1950-1990. Although Asia's share in absorbing Japan's total investment outflow was a mere 15.3%, its share in manufacturing outflow was much larger (22.9%) [67].

3. 6. 2 Joint Ventures

A Joint Venture (JV) is a business association between two or more parties who agree to share the provision of equity capital, the investment risk, the control and decision making authority, and the profits or other benefits of the operation [68]. In other words, joint ventures can be defined as a collaboration or new investment involving shared ownership between local firms in host country and its foreign partner [69]. As indicated earlier, with many developing countries adopting some restrictive policies toward the MNCs foreign investment in particular in the form of the whole ownership, a new form of foreign investment has been shaped. The local and foreign partners were interested more in entering a new formal agreement for transfer of technology and managerial expertise which both parties share in the decision making, control and benefits of the operation. Therefore, the elements of technology provided by MNCs under joint venture agreement can include any or all of those provided under foreign direct investment. However, the parties involved in a JV contract, agree to share the provision of equity capital, the investment risk, the control and decision making authority, and the profits and the other benefits of the operation.

In other respects, the only way in which the behaviour of the joint venture is likely to be distinguishable from the behaviour of a wholly owned subsidiary is in its ability to secure favourable treatment from the host government. Frequently, however, a joint venture combines the different skills and resources of the foreign and the local partner and divides the responsibilities of the management between them [70]. It seems that many developing countries have adopted a policy of requiring foreign investors to form joint ventures with local private or government entities. Since the interests of local partners are to be more in line with the overall interests of the host country than those of foreign firms, participation of local investors in the joint venture's decision-making process is expected to enhance the

net benefits to the host country. Moreover, active involvement of nationals in day-to-day operations of a joint venture is believed to lead to a speedier transfer of know-how than would be the case with a wholly owned subsidiary.

Joint Venture agreements have been classified to different types. Killing (1983) distinguishes between two ways in which a local firm in the recipient country can use a joint venture to acquire technical and managerial expertise from a potential technology supplier. One is to form a dominant parent joint venture in which the dominant parent and the technology supplier is the passive parent; the other is to enter a shared management venture with the technology supplier. He states that while there is a possibility of very good technology transfer in a shared management venture for both local and foreign partners, however, the probability of failure is much higher in a shared joint venture than a dominant parent venture [71]. White (1983) [72] and UNCTAD (1988) [73] and many others, have made a distinction between two types of joint ventures: The equity joint venture in which assets, rights and liabilities are shared through joint ownership of an incorporated enterprise; and non equity joint venture where the co-operation between partners is established on a contractual basis. Non-equity joint ventures include all types of collaboration contracts and production sharing agreements.

The share of equity in the hands of local partner can have an important impact on the technology transfer process. Therefore, it is vital to consider the important terms and conditions of transfer of technology through equity joint ventures: Firstly, the use of equity joint venture as a mechanism of technology transfer relies on the organisational arrangements made for ensuring an effective adaptation, assimilation, and absorption of the technological knowledge by the recipient enterprise. These organisational arrangements may include the co-ordination of the different financial and other interests of the parties, the degree of association and participation in areas such as research and development, quality control and marketing. Secondly, in the case that the local partner is a public entity, foreign enterprises often manage to capitalise their technological contribution, putting up little or no cash for their equity share in the joint venture. Although this practice has been impeded by the regulations of some developing countries, however, state enterprises in many cases accepted the capitalization of foreign know-how in joint ventures with MNCs. Thirdly, joint ventures may play the role of distributing to the foreign partner, through royalty fees,

for certain technological contributions in addition to the profits deriving from the share of the equity. For example, some countries have adopted specific criteria for the payment of royalties by joint venture, such as the experience of Brazilian government in the reduction of the royalty fee in proportion to the share of the foreign licensor in the joint venture [74].

Whatever the ownership structure of a venture, local production is likely to start with the assembly of components imported mainly from sources affiliated with the foreign partner. The host government, however, generally seeks to induce the joint venture to expand its level of operations to include locally produced raw materials and components. The level of the foreign equity participation in a joint venture depends on the amount of technical assistance that may be required from the foreign supplier in production, management, and marketing including exports [75]. The interests of the foreign and local partners, however, are by no means identical. Whereas the local partner can be expected to strive for maximal returns from the joint venture, the foreign partner generally seeks to limit the extent of local manufacture and indigenous management and attempts to charge the joint venture maximum possible prices for the know-how and technical services supplied. However, foreign partner involvement can be important in promoting and maintaining the efficiency and competitiveness of the venture. One can also say that because of different objectives between local and foreign partner, the foreign partner will resist pressure to increase domestic content longer and more vigorously than will the local partner [76].

There are two other types of joint ventures: production sharing ventures and joint research ventures. In the production sharing ventures, the foreign partner performs as general contractor and conducts the operational responsibility over the project. Production-sharing ventures can generally create a better opportunity for the development of local technological capabilities, based on the level of technical expertise of the local partner. However, joint research ventures between local and foreign partners can also be an efficient method of transferring technological knowledge and promoting technological activities in the country. Particular advantages of such ventures are the exchange and diffusion of technological information; practical training in laboratories, results of evaluation testing, etc.; and participation in attaining fixed objectives in the project. This type of venture may require distribution of risks and costs among partners [77]. As Hadlik (1985) [78] states that some factors such as scale of the marketing of the host country, the technical competence of the

partner, and technological resources of the host country, are important for a foreign partner to enter into joint research venture with a local partner.

Having surveyed some studies which have analysed the choice of joint ventures against other alternative methods, Stopford and Wells (1972) [79] in their analysis of the foreign entry decision for 155 multinational enterprises, found that the use of joint ventures relative to wholly owned subsidiaries declined with the importance of technology and, in particular, marketing and product standardisation increased. They also found that joint ventures were more likely when the entry included a product diversification, for the reasons of acquiring local expertise in new areas. Another point in their findings indicates that equity share is influenced by the strategic importance of the R&D or marketing expenditures and product diversity . Caves and Mehra (1986) [80] through the analysis of entry decisions of 138 foreign firms into U.S. manufacturing industries found that the choice to enter to a joint venture is influenced by the size of the targeted firm relative to that of the foreign firm, by the characteristics of the industry, and by the cultural characteristics of the foreign and home countries.

There are generally some advantages and disadvantages for joint ventures: Joint ventures represent a significant change in industry structures and in competitive behaviour. Joint ventures permit firms to create new strengths. They permit firms to share in the use of technologies they could never afford to explore alone. A joint venture may also create lower operating costs and become more efficient than a wholly owned subsidiary, because of complementary skills, economies of scale and scope, and the local partner's knowledge of the local environment. The importance of joint ventures in comparison with other channels of technology transfer has recently increased because product lives are shorter, cost advantages are becoming more pronounced, and greater numbers of firms which operated formerly only in domestic markets are becoming global competitors. Joint ventures can also be increasingly important in the development of new industries, the revitalisation of mature industries, and the enhancement of firms' competitive advantages [81]. Furthermore, as Kogut (1988) [82] states, joint ventures are more efficient mechanism for transferring tacit know-how and for minimising transaction costs.

However, it may have some disadvantages. For example, different goals of the parties in

a joint venture can cause problems. When a product designer enters into venture with a manufacturer, the two may have different goals. The designer may be interested primarily in the further development of the product and may view the joint venture as a means to that end. The manufacturer, by contrast, may be motivated principally by a desire to establish a high volume of production and sales of the existing products [83]. Therefore, one can conclude that the success of joint venture agreements will increase when the supplier and recipient's goal and objective are in the same direction.

3.6.3 Licensing Agreements

Licensing is the sale of manufacturing technology by a multinational enterprise (licensor) to a non-controlled entity located outside the home country of the multinational enterprise (licensee) [84]. In other words, a licensing agreement is a legal contract under which the licensor confers certain rights upon the licensee for a specified duration in return for certain payments (usually royalties) [85]. The rights may consist of permission to use industrial property rights, such as patents, trade marks, brand names and copyrights, and it can include secret un-patented know-how, such as methods of production, scheduling and quality control, which are usually combined with the provision of technical services. Licensing is believed to be the most versatile mechanism for transferring technology, as it offers flexibility in the choice and opportunity for the recipient country to require its needs through the negotiation [86].

The major difference between licence agreements and joint ventures is that, in the former, there is no sharing of equity by the firms involved. The licensor agrees to provide the required technology through the complete capital investment by the licensee. One can also refer to two different types of license agreement. The current technology agreement, by which the licensee can only access the available technology at the time of signing the agreement; and the current and future technology agreement, in which licensee and licensor agree that the available technology will be developed in a specific product area before transferring it to the licensee. Although the current and future agreement can provide the opportunity for an effective technology transfer, however, they are usually offered only for older products [87].

Frankel (1990) recognises some incentives for both licensee and licensor in entering into a licensing agreement [88]. The major impetus of licensee is to obtain more advanced technology and with lower costs and shorter time rather than involving in its own development of similar technology. In other words, from the licensee's point of view, licensing results in faster commercial development and market entry or enhanced market share than costly internal R & D would permit [89]. The main objective of the licensor, however, can be attributed to its willingness in getting help for financing the development of technology and in sharing the risk of technology development and its application with others in particular licensee. As Frankel states, licensing is a strategic decision for both licensee and licensor which needs effective market, technology, and cost valuation and forecasting. Therefore, it is vital for the licensee to develop an effective strategy of choice, timing, method of application and benefit objectives [90]. It is also necessary for the licensor to make an efficient strategy of timing and pricing of technology licensing. It is also believed that the main reasons for the licensor to license the technology are: to earn revenues not otherwise possible; to extend the technology's life (declining in commercial use in the licensor's market); and to establish or test the market for future FDI [91].

It is believed the main advantage for both licensee and licensor is that the license agreement allows transfer of technology to take place without risks associated with financial involvement [92]. Moreover, licensing affects the development of new technology and may encourage or discourage new research and development. The advantages of licensed technology depend heavily on how current the technology is, and whether the licensee is permitted to retain the rights to any improvements made. It is also believed that there is more tendency towards large firms which spend more on R&D activity to consider licensing as part of their strategic planning. Large and leading firms consider license agreements as a means for gaining benefits from their investment in technology and the follower firms view licenses as a way to have access to that technology without spending a large amount of expenditure to imitate and develop it [93]. Moreover, some of the important factors which determine the propensity to license are size of local market (licensee), the stage of industrial development in recipient country, the availability of skilful and capable labour force in the host country, and a level of political risk and knowledge of the new market [94].

Although licensing is considered to offer a quick and handy way of transferring technology

to foreign countries with a relatively low risk and control, however, as Holstius (1993) has argued, there is often a possibility for the licensee to become a competitor for the licensor by using the expertise gained through the licence [95]. Moreover, when industrial technology is transferred through a licensing agreement, the success of the licensee in a license agreement to a large degree depends on how it can efficiently handle production in accordance with the agreement. In other words, the licensee requires a rather large package of technology including production know-how, and product design, the specification of inputs and machinery, and market studies. As indicated earlier, the licensee can use licensed and patented or non-patented technology in exchange for a fee which is often calculated on the basis of gross sales of the product. The price which a technology licensor can charge depends on its competitiveness and its stage of development [96]. Most licences are granted to subsidiaries and affiliates and to other multinational firms. The smallest share of licences goes to local firms in developing countries. Thus, the benefit from licensing may be largely within the set of already rather prosperous firms, which have the information networks about who has what and who needs it [97].

Having compared the use of licensing with other channels of technology transfer, one can say that the firm licensing the technology can exercise a greater degree of control over how it is used, adapted, and developed than if it were simply a minority partner or even equal partner in an equity joint venture. Moreover, the licensee can investigate to negotiate, as part of the transfer agreement, attractive arrangements for the training of its personnel as well as search of the best combination of price, and other technical characteristics while the local firm may locked in through a joint venture to a single technology source with a possibility of imposing monopolistic pricing from the foreign partner [98]. However, the bargaining strength of the licensee depends on its local capacities to assimilate and absorb the licensed technology. The more the licensee's absorptive capacity is, the higher the degree of its success in the effective assimilation of licensed technology would be.

In Prasad's (1981) view, licensing may act as an attractive alternative to FDI. This is mainly because licensing is generally a cheaper source of technology and also stimulates technological self-reliance in the recipient country relatively more than FDI [99]. Moreover, licensing may be an attractive alternative to direct foreign investment, if the licensee is capable:

1. to choose the technology required;
2. to survey and select a suitable licensor and negotiate knowledgeably;
3. to organise the complementary infrastructure needed for the technology;
4. to monitor future technological developments.

However, licensing is considered to be more complementary to FDI rather than a substitute. While one cannot deny the great importance of FDI in transferring technology and managerial skills, as the LDCs' level of industrial and technological capability have increased during the past years, the share of acquisition of technology licensing has also significantly risen. Therefore, one can see that although all LDCs are not equal in their technological absorption capacity, those LDCs that have this capacity can move away from foreign investment toward more reliance on licensing.

The main reason for the increasing proportion of licensing as a vehicle for the sale and transfer of technology to LDCs is their unwillingness to permit unrestricted or unnecessary FDI. There has recently been a greater tendency among more advanced countries such as Japan and European countries to use technology licensing rather than foreign equity participation, because of the increased competition among suppliers of technology and the resulting need to sell existing technology to be able to finance future research and development [100]. It is also believed that these countries are able to make full use of licensed technology with little technical assistance from the transferor [101].

Licensing is but one of the fields in the technological battle between MNCs. There are two broad reasons for the use of licensing agreements by MNCs, as licensors. Firstly, to substitute for controlled foreign direct investment when licensing proves to be more profitable, and secondly, to gain access to technology of other firms through complementary grants of licenses. In the first case, licensing to a non-controlled entity provides an alternative to entering foreign production with a controlled investment; in the second, access to other firms' technologies provides an alternative to R & D.

As indicated earlier, the ability of a licensee to absorb and improve upon licensed technology depends greatly on its capability to understand and control embedded technology as well as embodied technology. In other words, the licensee or the user of licensed

technology needs technical expertise nearly equal to that of licensor or supplier of technology in order to absorb the technology more effectively. This knowledge includes contract administration and patent management, which are generally considered to be managerial, rather than technical, skills [102]. Furthermore, in many licensing agreements, licensees prefer to include further improvement of licensed technology for additional fees by licensor to ensure technology upgrading. This can also be achieved through the agreement obliging the licensor to assist licensee in the research and development activity. However, because of the risk that such an agreement may cause for the licensor that (the licensee become its major competitor in the future), these agreements are often limited through some restrictive measures to reduce such a risk for the licensor [103].

International payments for patents, licenses and technical know-how were worth $11 billion in 1982, $ 12 billion in 1983. In constant terms the volume of payments increased by 2 per cent per year between 1975 and 1983; (payments measured in 1980 prices and exchange rates). Countries with a vigorous and broadly based domestic technological effort are reducing the extent of their direct reliance on foreign technology. Japan has been a major importer of foreign technology licences and has very successfully adapted and used this technology to develop manufacturing industry and export [104]. In the 1960s the Japanese government vigorously controlled direct investment by United States companies but welcomed licensing arrangements that involved wanted technology and know-how, and maintained an active screening control over licensing agreements. These licensing agreements were supplemented by the importation of modern plant machinery and equipment, the provision of basic training by licensors for the acquisition of embodied technology and the foreign visits of Japanese businessmen and students for the purpose of acquiring new, non-proprietary knowledge [105]. A large part of the industrial success of the NICs such as India, South Korea, Taiwan and Hong Kong is attributable to local firms licensing or copying foreign technologies rather than to the modality of foreign direct investment.

3. 6. 4 Patents and Patents Agreements

Patents are considered as one of the main types of licences. As defined by Prasad (1981), "a patent is a temporary monopoly granted by a state to an inventor, justified on the grounds

that such monopolies provide essential incentives for innovation and risk-taking" [106]. In other words, a patent is government protection given to an inventor providing the exclusive right of manufacturing, exploiting, using, and selling the invention for a specified period of time [107]. The patents are widely used by developed countries as one of the most important forms of industrial property which give them the right to prohibit the unauthorised use. This right, however, can be easily passed on to the licensee to use it as a major source of marketing strength. As Saghafi Nejad (1991) states," patents play a key role in providing the legal barriers to competitive imitation, thus shielding the innovator long enough to gain from dynamic efficiency" [108].

However, the tendency towards the methods for protecting intellectual property vary among different countries and among different industries. For example, Japanese enterprises tend to rely more heavily on patenting than their American and European counterpart. The role of patents in LDCs, on the other hand, is relatively different with that of developed countries. In developing countries, the licensee's main need through a patent licence agreement, is usually more focused on access to technology (know-how), technical assistance and markets rather than patent rights. It is also argued that patents in many LDCs, tend to prevent competition and local innovation rather than encourage it. This is because the vast majority of the patents issued to foreigners by LDCs are not exploited [109]. In developed countries, however, patents are considered as legal means for protection of industrial technology. It should be noted that although patents have generally provided effective protection for technological innovation, some LDCs have limited the use of patents in some particular fields, such as drugs and food processing industries [110].

3. 6. 5 Know-how and the Know-how Agreement

Know-how is a body of industrially useful, secret, novel and valuable information, and associated technical and other information and skills [111]. It can be said that know-how agreement is among the most important methods of technology acquisition for LDCs which may cover various processes, formulas, and industrial techniques. It is argued that know-how agreements with MNCs enable LDCs enterprises potential access to developments in products and processes. This is mainly because know-how agreement usually provide LDCs' firms with a package of technical information needed for efficient adaptation and

assimilation of imported technologies.

Having compared the know-how and patents agreements, while know-how is in part considered secret information, some of its components and elements may be published information or information known to specialists. Also, some part of know-how may be obtainable from other industrial sources. Moreover, while the patents have defined expiration dates and an agreement based only on a patent cannot be extended beyond that period, there is no expiration date in the know-how, and the duration of an agreement is mutually agreed upon by the two parties [112]. Furthermore, as indicated earlier, patents have little relevance in LDCs and are mostly used by developed countries' firms and MNCs who possess secret industrial information and try to protect their patent rights.

3. 6. 6 Trade Mark and Trade Mark Agreement

Trademark is a sign or a special name which serves to distinguish a manufacture's goods from others, in other words, "trademarks are distinctive visual and sometimes aural devices, words or emblems (symbols), or a combination of them, that a firm applies to the goods it trades in, or to the services it performs, to indicate to the public that they are the firm's goods and services" [113]. Trade marks can assist the consumers to distinguish between products of different manufactures and also assure them about the quality of the products and therefore play an important role in market-place. Most trademarks in LDCs are registered by developed countries which are more prevalent in consumer goods and of lesser significance for capital and intermediate goods [114]. Since trade marks are usually used by firms in order to represent the quality of their products, some countries take the view that transfer of the right-of-use of the trade mark to another party is not possible without the concurrent transfer of the goodwill of the firm. It is also believed that unlike the patents, trade marks may not be licensable property in all countries [115].

3.6.7 Technical Assistance Contracts

Technical assistance agreements, which may be considered as the most un-packed form of technology transfer, normally include the manufacturing drawings, maintenance and repair of machinery, obtaining specifications, assistance in setting up production facilities, advice

on process know-how, engineering services such as procurement of materials and equipment, information as to the sourcing components, personnel training, consultation with manufacturing, quality control procedures, and testing of final products. Hence, technical assistance is usually required by a firm in a developing country which has less experience in operation and setting up of any productive activity [116]. The advantage of this method of technology acquisition is that it may enable the recipient country to access the foreign technology easily and quickly, with the technical assistance of the supplier of technology. Although it may cause to some extent technological dependency on the supplier, however, because of the time-limitation in most technical assistance agreements, the recipient country attempts to decrease its technological dependency on the supplier and even become self-reliant after the duration of the agreement.

The services may also be provided on a consistent and long-term basis, such as in the case of new firms in LDCs which require a continuous flow of technical assistance enabling the local personnel to absorb the supplier's expertise. There are usually no restrictive constraints from the supplier unless the technical assistance required by the clients includes substantial engineering innovations such as a naphtha cracker in the petrochemical industry. Therefore, technical assistance agreements can be an appropriate method for transferring technology and know-how to LDCs because these agreements provide not only embodied technology in the form of drawings, specifications and services but, more importantly, confidential know-how accumulated through educating and training of the recipient's labour force and learning by doing [117].

3. 6. 8 Turnkey Contract

A turn-key contract is one in which the contractor firm undertakes the responsibility for carrying out all of technical and managerial operations and activities needed for the planning, construction, and installation of a technical project before handing it over to local ownership in exchange for a fee [118]. Therefore, the contractor of turn-key is responsible for the completion of the whole project and delivery of a fully operational production system [119]. In other words, turnkey agreements provide for the complete physical package of technology, from one party to another. Less developed countries usually use turnkey plant in the early stages of their industrialization. The turn-key contracts are also widely used in

the transferring technology in heavy industries including chemical and petrochemical industries, metallurgy and iron and steel, and construction materials such as cement and glass. However, as the technological capability in many developing countries increases, there is gradual tendency towards replacing turn-key contracts with technology licence agreements for manufacturing technology and know-how [120].

Although this method may accelerate the process of transferring machinery and hardware to the recipient country, but as the experiences of some LDCs has indicated, in most cases when the whole package together with its design and operation is installed through a turn-key plant, the recipient country failed to acquire the know-how and software for that machinery and hardware. Moreover, this method is considered to be more costly for the recipient country due to its high charge. It is also argued that there is more degree of dependency on the supplier of technology in turn-key agreements because of recipient's need for the technical and managerial expertise of the supplier. Furthermore, the supplier in turn-key agreements usually imposes some restrictive regulation on the recipient such as enforcing the recipient to purchase the components and materials from them.

3. 6. 9 Management Contracts

According to a definition by UNCTC (1987); " management contract is an arrangement under which operational control of an enterprise, (or over one phase of its activities, which would normally be exercised by the board of directors or the managers elected or appointed by its owners), is vested by contract in a separate enterprise which performed the necessary managerial functions (such as production management, personnel management, procurement of goods and services, marketing, and financial management) in return for a fee" [121]. Management contracts are often part of other agreements including joint ventures, turnkey plants or to accompany a technical assistance or license agreements. They are widely used in such industrial sectors as transportation, mining and oil projects, heavy engineering, basic industry and other manufacturing ventures. The management contracts are also employed in service activities such as tourism, telecommunications, port management and others [122].

The advantage of management contracts as means of technology transfer is that a substantial amount of organisational skills can be transmitted to the recipient country through specific personnel training programs or by working together with the supplier. These contracts also provide the possibilities for the recipient to have access to high expertise of the supplier personnel, R&D activities, and other technology sources of supplier. However, these agreements have also some disadvantages which may affect an effective transfer of technology to the recipient country. These include the diverging objectives of the parties regarding the operation and duration of the project, and the intense control by the management contractors which may not differ from a turn-key contract or a wholly owned joint venture [123]. Therefore, it is necessary for the recipient country to formulate some regulation to protect and control management contracts, in the context of overall technology transfer regulation.

3. 6. 10 International Subcontracting

Sub-contracting is a business practice whereby the party offering the sub-contract (patent firm or company) requests another independent enterprise (sub-contractor) to undertake the whole or part of an order it has received instead of doing the work itself, while assuming full responsibility for the work vis-à-vis the customer [124]. The subcontracting usually takes place when a multinational company in a developed country wants to relocate some of its manufacturing products in a developing country in order to take advantage of raw materials and cheap labour. Therefore, the MNC provides production know-how and technology of producing assembly products in the LDC using some cheap natural and human resources of the host country for its own production or marketing needs. No explicit payments for technology are involved, since it is the MNCs that pays the subcontracted firm for the amount of the work performed for them. For this reason, it might be argued that this relationship does not belong to the category of transfer of technology arrangements. Subcontracting in developing countries is mostly concentrated on clothing, electronic equipment and components, and semiconductor assembly. International sub-contracting is particularly well suited to labour-intensive, export-oriented industries such as textiles, clothing and electronics [125].

According to a study, by Watanabe, on the Association of Southeast Asian Nations

(ASEAN), established in 1967, industrial subcontracting, "i.e. supply of parts and components from subcontractors to an assembler" has developed considerably within ASEAN, largely as a result of the local government's regulations which require certain minimum domestic content with respect to locally assembled products. All the countries in the region except Singapore have been following such a strategy [126]. Berthomieu and Hanaut (1980) in a study of the conditions in international subcontracting relationships between developed and developing countries, identified three main types of international subcontracting [127]:

1. cross-border international commercial subcontracting,
2. cross-border international industrial subcontracting, and
3. within-border international industrial subcontracting.

International commercial subcontracting, typically in the area of consumer goods, generally develops spontaneously, on the initiative of the participating parties. Industrial subcontracting almost always requires active encouragement on the part of public authorities. Industrial subcontracting can also have industrialising effects under a durable government sponsorship. Hong Kong, South Korea and Singapore are characterised by the extensive practice of cross-border commercial and, to a smaller extent, industrial subcontracting. These countries are rich in efficient labour, and their trade and industrial policies are liberal and export-oriented, taking advantage of their geographical conditions which are convenient for international trade. In contrast, within-border industrial sub-contracting is dominant in India, where the government's import substitution policy has been obliging major firms, and especially foreign subsidiaries to increase local content of their products and sub-contract part of their work to smaller local firms [128].

3.6.11 The Franchising Agreement

A franchise is a particular form of licensing agreement indicating an agreement between the franchisor and franchisee in which the franchisor provides rights, usually including the use of a trade mark or brand name, plus the services of technical assistance, training, merchandising and management, in return for certain payments. In other words, franchising is " a system of distributing goods or services that is often associated with high-reputation

trade and service marks in which the franchiser supports, trains and to some extent controls the franchisee in selling the goods or in rendering the services" [129]. In developed countries, franchising is today one of the most rapidly growing forms of licensing. One of the most recent examples of franchising in developing countries is the hotel chain franchise. One can see that there are similar features between a franchise agreement and trade-mark and management contracts. However, LDCs' governments prefer the management contract mode when the franchisor is a foreign firm. This is mostly because the institutional structures in some LDCs are not adequate enough to protect franchising.

3. 6. 12 The Imports of Capital Goods and Machinery

The import of capital goods and machinery is among the major modes of technology transfer for building industrial infrastructure and strengthening the recipient country's technological capability. This channel of technology transfer which is used by many LDCs particularly the East Asian NICs assisted these countries to access to the advanced technologies embodied in the machinery and equipment. However, the success of this method of technology transfer in the development of recipient country's local technological capability relies on the level of industrial development together with the degree of technical and managerial expertise and its absorptive capacity [130]. It is argued that the implementation of strong export promotion policies in East Asian countries enable them to finance capital goods and machinery imports due to higher export revenues. For example, S. Korea is among the major East Asian NICs which was used capital good imports extensively as a method of transfer of technology and in 1987 had capital goods imports equal to 31% of its GDP [131].

3. 6. 13 Buy-Back Agreement

In the buy-back contracts, the supplier of technology agrees to set up production facilities for the buyer, and will subsequently purchase from the buyer products produced in those production facilities [132]. A buy-back transaction usually includes not only the sale machinery and equipment, but also a grant of licence to use the supplier's patent rights or know-how and technical assistance for manufacturing of the products. The major incentive for the supplier of technology to enter into a buy-back agreement is to take most advantage

from the natural and human resources in the recipient country. For the receiver, the main incentive is the transfer of industrial technology and utilisation of its natural and human resources. In other words, the buy back is an incentive contract, a buyer of capital equipment is interested to offer so as to satisfy his desire for state-of-the-art technology. The buy-back agreement can also be considered as a way to finance technology transfer. Therefore, it is a popular method of technology transfer for LDCs which are in shortage of foreign exchange [133].

It is argued that buy-back agreements may be considered as a way to deal with institutional or regulatory obstacles such as the prohibition of foreign ownership [134]. The buy-back contracts enable new factories to take advantage of economies of scale earlier than the size of their domestic markets would otherwise permit [135]. Despite some common features with the subcontracting contracts, however, unlike a subcontracting contract where the recipient already has the production equipment in place, in a buy-back agreement, the receiver needs capital equipment or know-how to perform the contract which the supplier provides.

3. 6. 14 Reverse Engineering and Imitation of Foreign Products

Technology transfer can also take place either through reverse engineering or through imitation and copying of imported products, particularly those with less sophisticated technology and know-how. Reverse engineering is usually achieved by purchasing of samples of machinery and their dismantling and copying. In other words, reverse engineering involves the acquisition of detailed knowledge of how the product was designed as well as understanding of why it was designed in that particular way. However, this method may not be applicable on such industries as chemicals and pharmaceutical.

Reverse engineering and copying are usually performed legally through the granting of licence rights by a foreign country (licensor) to allow firm in a developing country to make a similar product to specification provided by the licensor. However, in most cases the leading MNCs are reluctant to license their up-to-date and advanced technology to the LDCs. Therefore, the only alternative way for the firms in LDCs to access these technologies may be to reverse engineer the products. In this case, the domestic firm in a

LDC tries to build another product similar to the design of original product. In other words, the major purpose of the local firm in a LDC is to invent around the patents and copyrights surrounding the product [136].

Reverse engineering is relatively common in some industries with easily and readily available components such as computers, and some parts of the informatics sectors such as semiconductors. It enables a competitor to get the same advantage as could be obtained through manufacturing that product. However, in the case of complex systems technologies like sophisticated integrated circuit (IC) designs, and telecommunication systems, the reverse engineering becomes increasingly difficult without a high investment in research and development activity by the domestic firm in a LDC [137]. Some NICs in East Asia and Latin America such as S.Korea, Taiwan and Brazil have successfully practiced reverse engineering as a channel of technology transfer in particular in machine tools and components. Many firms in these countries have passed the stage of reverse engineering and reached the stage of significantly modifying or generating technology. However, it seems more difficult for countries with less technological capability to rely on reverse engineering in their infant stage.

3.6.15 Original Equipment Manufacturing (OEM)

The original equipment manufacturing refers to contractual arrangements by which a foreign firm orders in volume products which the OEM supplier agrees to make according to its precise specifications [138]. The firm in a LDC which decides to use this method of technology transfer can take benefits from the technical information in the form of detailed specifications (blueprints, manuals, data, tapes, etc) provided by the customer. Moreover, the large volume of many OEM orders enables the domestic firm in a LDC to acquire economies of scale, as well as technical expertise. Furthermore, due to customer responsibility for marketing and distribution of the finished product, the local firm in a LDC can save noticeable investments in its own marketing effort and distribution network. This method is widely used in the electronics and electrical appliance industry.

3. 6. 16 Industrial Espionage

Industrial espionage refers to the illegal exportation of data and information, materials, parts, or equipment. Industrial espionage seems not to be restricted to any geographical setting, although the Silicon Valley of Northern California and Geneva, Switzerland have relatively experienced more industrial espionage than any other places [139]. However, industrial espionage may be considered as an ineffective form of technology transfer. In the real world, there is no clear distinction between industrial espionage and other informal methods of communication. When industrial espionage is perceived as a totally distinct and completely undesirable activity, and when actions are taken to deter it, damage can easily be done to much more important forms of technology transfer. Information exchange through personal and informal networks may be impaired and innovation which should emerge from such exchange may be impeded [140].

3.7 ANALYSES OF THE CHANNELS

It appears from the previous discussion of technology transfer mechanisms that no single method is appropriate for all situations, and methods vary depending on the nature of the technology and the specific circumstances prevailing in each case. The effectiveness of the different approaches differs in terms of the ability of the technology recipient to learn and to acquire increased technological know-how. It is generally the combination of the desire of the transferor to supply technology and know-how in a particular form, and the ability of the receiver to acquire it in that form, which determines the mechanism of transfer in a particular case [141]. It is also argued that the technological content of the operations in the industry, the extent of barriers to entry, the degree of competition, and the bargaining power and policies of host countries can also be considered among major determinants of the methods of technology transfer [142]. Moreover, as indicated earlier, the recipient's absorptive capacity to utilise the imported technology effectively may also affect the choice of appropriate channel for the acquisition of technology. The importance of the choice of technology transfer mechanisms has made many developing countries examine various methods of technology acquisition in order to select the most suitable one which will enable these countries to reduce the cost of technology and to absorb and assimilate the imported technology more efficiently to their local condition.

As explained earlier, one can generally identify FDI, joint ventures and licensing agreements as the most important channels of technology transfer to LDCs. As already been discussed, a number of factors are likely to affect the effectiveness of alternative channels. It is believed that the nature of existing technological capabilities in the recipient countries is among the first and the most important factors. In the case of relatively weak technological capability, a technology package in the form of FDI may be most appropriate. Licensing, however, can be a viable mode when the recipient country is able to complement imported technology with its own technological resources. Joint venture can also be an efficient technology transfer channel mainly because the foreign supplier who shares the risks and profits of the project, is directly interested in its success. Capital goods imports, on the other hand, are believed to be necessary as an important channel of technology transfer when LDCs want to establish new industries [143].

Therefore, it can generally be said that LDCs should make most of their attempts to find the appropriate conditions for effective transfer of technology whether such a transfer occurs in the form of FDI or technology licensing. However, as the survey by many studies about the technology transfer channels indicates, generally those methods that involve significant human contact together with some measure of education and training can be considered as the more effective approaches. In other words, much technology can successfully be transferred through the person-to-person contacts and through the transfer of skilled personnel and know-how associated with that technology. For example, a survey of the transfer of textile technology from Japan to Thailand stresses that transfer can really take place only through human contacts. This indicates the importance of the transfer not only of production technology but also of managerial skills in the rooting of new technologies in the local society [144].

A number of studies have shown interaction in terms of interpersonal communications and mobility to be of great importance in technology transfers. Utterback (1975) looked at the role of applied research institutes in transfer of technology to Latin America. Studying twenty completed projects of four institutes, he found, among other things, that personal contacts and direct links between the supplier and recipient of technology was the most effective channel of flow of technology, and working abroad was critical in establishing the

necessary communications links [145]. Bass (1974) has also identified close face-to-face interaction as an important characteristic that increases chances of successful transfer of technology [146]. Adeboye (1977) also found that the use of interpersonal transfer mechanisms was more frequent in the more innovative business he studied [147]. In a study of the effectiveness of aerospace and defence technology transfer to ninety-three electronic firms, Hayes (1968) found direct interpersonal communication to be the most important transfer mechanism [148]. However, it seems that the importance of personal interaction will be greater in the higher and more dynamic technologies, which are more person-embodied, and less in more simple and stable technologies where the technology can be embodied more easily in blueprints and intermediate and capital goods.

The experiences of such successful countries as Japan and S. Korea in the early stage of their industrialisation indicates that they have systematically tried to adopt the mechanism for acquiring technology through the flow of human beings, together with the purchase of machinery and equipment. For example, the great emphasis in the Japan's early stage of development in the nineteenth century was placed more on employing foreigners. Even in more recently, many Japanese enterprises are actively involved in sending organised teams of their personnel abroad with the task of absorbing a particular element of technology through the visiting the industrial plants and then putting all piece of information together in order to take most advantage of the technology of the foreign firms involving in a similar activity [149].

Teece (1981) has identified four linkage mechanisms with which LDCs can gain access to the world stock of technical, managerial and organisational knowledge, namely multinational companies (MNCs), equipment vendors, foreign aid agencies and an indigenous science community [150]. It is obvious that multinational companies are among the major source of technology transfer for LDCs. The most important reasons for MNCs entering into technology transfer agreements with LDCs' firms are believed to be export potential, market protection, market penetration, increased production to reduce units costs, and to obtain financial resources for further R&D activities [151]. However, as indicated earlier in the theoretical framework, the MNCs have generally been criticised for charging LDCs high prices; subordinating host country interests to those of their own interests; failure to provide local personnel with crucial skills and know-how; and transferring inappropriate

technology to LDCs which found it to be either too advanced or obsolete [152]. Despite these criticisms which are made primarily by dependency theorists, their key role in transferring advanced technology to LDCs can not be denied. Since technology is highly concentrated within multinational corporations, their licensing, direct investment and other activities are the major modalities of technology transfer in LDCs [153].

According to Baranson (1970), MNCs prefer direct investment to licensing if they have the required resources, and if control over market development, know-how, product policy system, integrity, product standards, or trade name is important, or if the transfer requires a sustained relationship between the supplier and recipient [154]. Elsewhere, Baranson (1971) concludes from case studies in the automotive industry that MNCs desire maximum control to maintain: managerial control over manufacturing; control over reinvestment of profits for future growth, and wider latitude in intercompany pricing [155].

According to UNCTAD (1972), the desire and ability of the multinationals to secure more control will be higher for more sophisticated technologies, recently developed and novel technologies, larger technology suppliers, more important trademarks and brand names, and higher income consumers [156]. Through the 1960s, the establishment of wholly-owned foreign subsidiary or a majority-owned foreign affiliate was the predominant method of foreign expansion by MNCs and a prime source of technology transfer [157]. However, as the level of industrial infrastructure and local technological capability in many LDCs increased, they imposed rather more restrictive regulations and policies towards MNCs in particular the wholly-owned subsidiary during the 1970s and 1980s [158]. For example, some countries such S.Korea and Mexico adopted a restrictive policy on majority ownership by foreign firms in all but export and high-technology activities [159]. Therefore, with the increased regulation of foreign investments in several countries, joint ventures have become a far more important form of operation for the MNC [160].

Vernon (1972) sees MNCs placing more capital in wholly owned subsidiaries than joint ventures, providing better access to their world-wide distribution system, and to their pool of technical and managerial skills. He mentions, however, that the reinvestment rate is higher in joint ventures. Overall, he concludes that wholly owned subsidiaries are slightly more attractive than joint ventures from the developing country's point of view due to the greater

permissiveness of the technology supplier and its greater interest in the recipient's success [161]. According to Stopford and Wells (1972), joint ventures, relative to wholly owned subsidiaries, are less likely to be chosen when the firm has more experience in the foreign market [162].

Pavitt (1971)[163] claims that licensing and joint ventures are inferior choices in comparison with foreign investment, because they may give other firms legal rights and technology which can later be used in competition against the licensor. He argues that the returns from foreign direct investment are often found to be greater than from licensing. On the other hand, he also shows that during the period between 1955 and 1964 in the OECD area, international technology transfer through licensing agreements between independent firms, or between parent firms and their foreign subsidiaries, grew rapidly. His data also indicate that the choice of technology transfer mechanism depends on the type of industry. For example, while the main transfer mode in the plastic industry was licensing agreements and joint ventures, in the pharmaceutical industry foreign direct investment was important when technology was transferred internationally. There was no FDI in aircraft industry, because of factors related to military security. However, he argued that these differences among industries depend on some factors such as the extent of competition in the industry and the extent of specialisation of firms in different product areas. Thus, it can be concluded from Pavitt's survey that the nature of the transfer mechanism adopted varies with the industry. The more technologically sophisticated, the more difficult it is for countries to rely on direct transfer. The extent and nature of property rights over technology vary with the industry, and does the significance of trademarks.

Contractor (1985) argued that the choice of technology licensing versus direct investment by U.S. MNCs is influenced by both country and industry characteristics. He found through the cross-sectional analysis that the ratio of licensing to investment increases with technical capability in a country. He also found weaker support for the idea that the proportion of licensing increases, with government control and regulation of direct investment and decreases, on the other hand, as more incentives are offered on direct investment [164].

The UNCTC (1987) [165] also reported that the use of new forms of technology transfer varied widely from industry to industry: production-sharing contracts in primary production

and turnkey, franchising and management contracts in the service sector. In food and beverage processing industries FDI and joint ventures remain the important form of technology transfer. However, FDI has been of considerably less importance in the textile industry due to its relatively low rate of innovation and the insignificance of research and development expenditure. In the pharmaceutical industry, FDI has been a major mode of technology transfer, followed by licensing of patents and trade marks with a lesser degree of the importance. In the fertiliser industry, joint ventures and licensing agreements have been the major channel of technology transfer. The main mechanisms by which technology have been transferred in the automobile industry have been both FDI and licensing agreements. The main means of technology transfer in the electrical power equipment industry, have been FDI and licensing agreements. In the semiconductor industry, FDI and licensing have been the principal vehicle for technology transfer.

Contractor (1984) analysed the data for 1977-1980 from the last Commerce Department Benchmark Survey to determine whether the relative use of arms-length licensing versus foreign direct investment can be statistically explained on the basis of foreign country and industry specific variables. He concluded that licensing is shown to be positively linked to the number of patents filed in a country. However, the absolute level of licensing in a country appears to be negative to the level of direct investment. He also indicated that the relative propensity to use licensing increase with the technological capability and decreases with level of economic development of recipient country [166].

Davidson & McFetridge (1985) [167] also examined the impact of recipient country, firm, and technology characteristics on the choice between licensing and direct investment as a vehicle for international technology transfer. Using data on 1226 inter-firm and market technology transactions carried out by 32 US-based MNCs during the period 1945-1978, strong statistical support is received for a number of variables hypothesised to affect the transfer mode. The probability of using wholly owned subsidiaries instead of licensing was greater:

1. for newer technologies,
2. for technologies with fewer previous transfers,
3. for technologies closely related to the transferor's principal line of business,

4. the more R & D intensive the transferor was,
5. if the transferor had an affiliate in the receiving country prior to the transfer, and
6. for transferor with more prior technology transfers.

In their survey, market size and sophistication are not shown to be important factors in the choice between licensing and direct investment. However, public policy variables seem to be a more significant factor in this choice. According to Raymond Vernon (1986), recipient (LDCs) countries prefer "arms-length" technology licensing agreements or joint ventures to exports or foreign direct investment as a way of maximising overall return and control over the technology and its uses in their territory [168].

Stewart and Nihei (1987) believe that the mechanisms for ITT depend either upon the type of technology (proprietary, non-proprietary, highly sophisticated, un-sophisticated, etc) or the agent undertaking technology transfer (firm, government agency, non-profit agency, etc). In concentrating on technology transfer via human resource development by Japanese and US organisations, an implicit decision has been made to concentrate on specific agents of technology transfer that are believed to be of greatest importance to the recipient countries studied (Thailand and Indonesia). It seems that the principal agents are business firms, and the principal mechanism is direct investment. They have pointed out that the mechanism of ITT also depends on the technological capability of the recipient country. As LDCs improve their absorptive capacity, more technology transfer is via licensing, and more licensing is to independent firms rather than to affiliated firms [169]. Kogut and Singh (1988) [170] in their study of choosing technology transfer mode found that the choice of technology transfer mechanisms can be influenced by cultural factors. They found that the greater the cultural distance between the country of the investing firm and the country of entry, the more likely it was that the firm would choose a joint venture to reduce its uncertainty in those markets. They distinguish between transaction costs that are independent of a firms country of origin and those that are determined by cultural factors. They suggest further investigation of the cultural factors involved in managerial decision making.

Aharoni (1991) argues that the choice of an appropriate channel of technology transfer is a joint function of the goals of the technology donor and the absorption capacity of the

recipient. Therefore, if the level of absorptive capacity in the recipient country is low, a turn-key project may be more appropriate than licensing. Aharoni adds that: "technology may also be transferred without being received or received without being transferred". An example of the first case is a turnkey project where the donor builds an entire factory but no one in the recipient country knows how to replicate it. An illustration of the second is when engineers in recipient country create a new product through reverse engineering" [171]. According to Aggrawal (1991) the nature and extent of technology transfer channel can be influenced by internal government policies as well as by national political and economic strategies. Unlike the view of some authors who emphasise the role of personal contacts and networks in technology transfer, Aggrawal refers to the international extension of the life cycle of new products by business firms as the major mechanism for TT. He argues that new products and technology are usually generated through an extensive investment in research and development, which it can recover by progressively developing and supplying markets for that product in as many countries as possible [172].

A survey by Yu and Tang (1992) shows that wholly owned subsidiaries generate a higher level of profits than joint ventures and licensing. Wholly owned subsidiaries enable MNCs to control their operations fully in host countries. Due to their potential for generating the highest level of profits, wholly owned subsidiaries are usually the preferred strategy of MNCs when there are no environmental constraints. However a joint venture is preferred to a wholly owned subsidiary if significant cost reductions can be achieved through combining the strengths of a multinational corporation and a local firm. Furthermore, a joint venture is the dominant entry strategy when there is a formidable local competitor and the risks of operation are high. On the other hand, licensing is usually preferred by host governments, because it is a low-risk strategy. MNCs treat licensing as a fallback strategy when other strategies are not feasible [173].

Holstius (1993) [174] believes that the best technology transfer mode is the one that matches the recipient's resources and objectives, and its need for technology. Holstius (1993), and Mason (1981) [175] have classified various modes of technology transfer with respect to the level of their risks and control. As it can be seen in the following figure, it seems that exporting has the smallest degree of the risk and control compared to the other channels of technology transfer. It also appears that there is high level of risk when the

technology is transferred through joint ventures and foreign direct investment in particular in the form of the wholly owned subsidiary. This is especially true in the case when large-scale projects are completed over a long period of time, and the recipient is actively involved in the technology transfer process during the implementation stage. Foreign direct investment implies the highest level of control and it has also the largest potential for profit. The financial risks, such as profit repatriation, and political risks, are also higher than in direct investment and other modes of technology transfer.

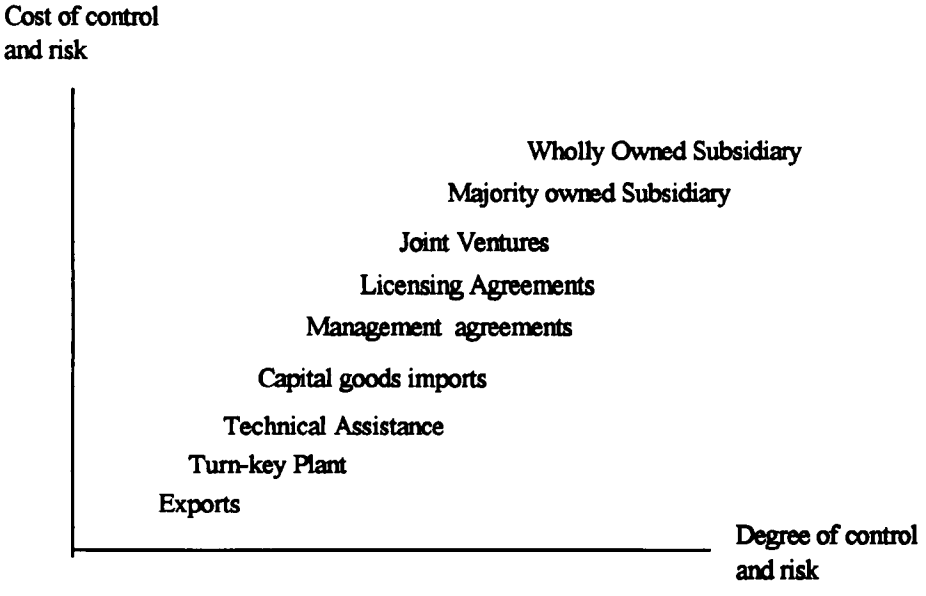


Figure 3.7. The Degree of Control and Risks For Mechanisms of Technology Transfer
Source: Mason, H. "Comments on Alternative Channels and Modes of International Resource Transmission", in T. Saghafi-Nejad et.al. (Eds), 1981, P:31.

Another useful analysis, is the relationship between technological complexity and organisational modes of international technology transfer. In other words, a strong correlation has been found between the technological complexity and the level of equity ownership. For example, in a study by Davidson and McFetridge (1985) which was discussed earlier, they argued that newer technologies and technologies developed by a more R&D intensive transfer agent are more likely to be transmitted through direct investment as opposed to licensing [176]. To sum up, it seems that some mechanisms are more active or effective in transferring technology and others more passive or ineffective. Generally, the main determinants of the form of technology transfer are the technological

content of the operations in the industry, the extent of barriers to entry, the degree of competition, and the bargaining power and policies of host countries. However, most studies of ITT mechanisms have reinforced the conviction that LDCs must improve their ability to negotiate with sellers of technology, both by understanding feasible alternatives and by developing mechanisms to evaluate the social costs and benefit of each channel.

3.8 TECHNOLOGY TRANSFER PROCESS

One can identify three overall stages in the process of international technology transfer: acquisition; adaptation; and improvement of technology [177]. However, it would be better to consider a more elaborate sequence of activities that constitute the process of technology transfer, using a systematic approach. A systematic approach to the technology transfer process is shown in figure 3.8. It is believed that developing a systematic framework for a technology transfer process can assist policy makers and planners in Less Developed Countries (LDCs) to a successful acquisition of imported technology. This approach has broken down the process of technology transfer into a sequence of interrelated stages in order to analyse both transferor and transferee's goals and objectives through technology transfer.

In the first stage, policy makers in the LDCs make their decisions for selecting technology by identifying the needs and objectives that are required through technology transfer. The country's weaknesses and capabilities are also recognised at this stage. This may include accessing the country's natural and human resources as a potential strength, or lack of adequate infrastructure which may limit a country's ability to absorb foreign technology. Once the country's needs and objectives are identified, in the next stage various technology alternatives are studied in order to choose the appropriate technology based on the country's standards and constraints. The appropriate technology can be selected by ranking priorities for different technologies based on the decision-maker's judgement. The establishment of the input-output relationships between different technologies can be a useful method for efficient allocation of resources in terms of identified priorities [178]. For example, an output from the oil industry can be used as an input for the petrochemical industry, or an output from the steel industry can be used as an input for the automobile industry.

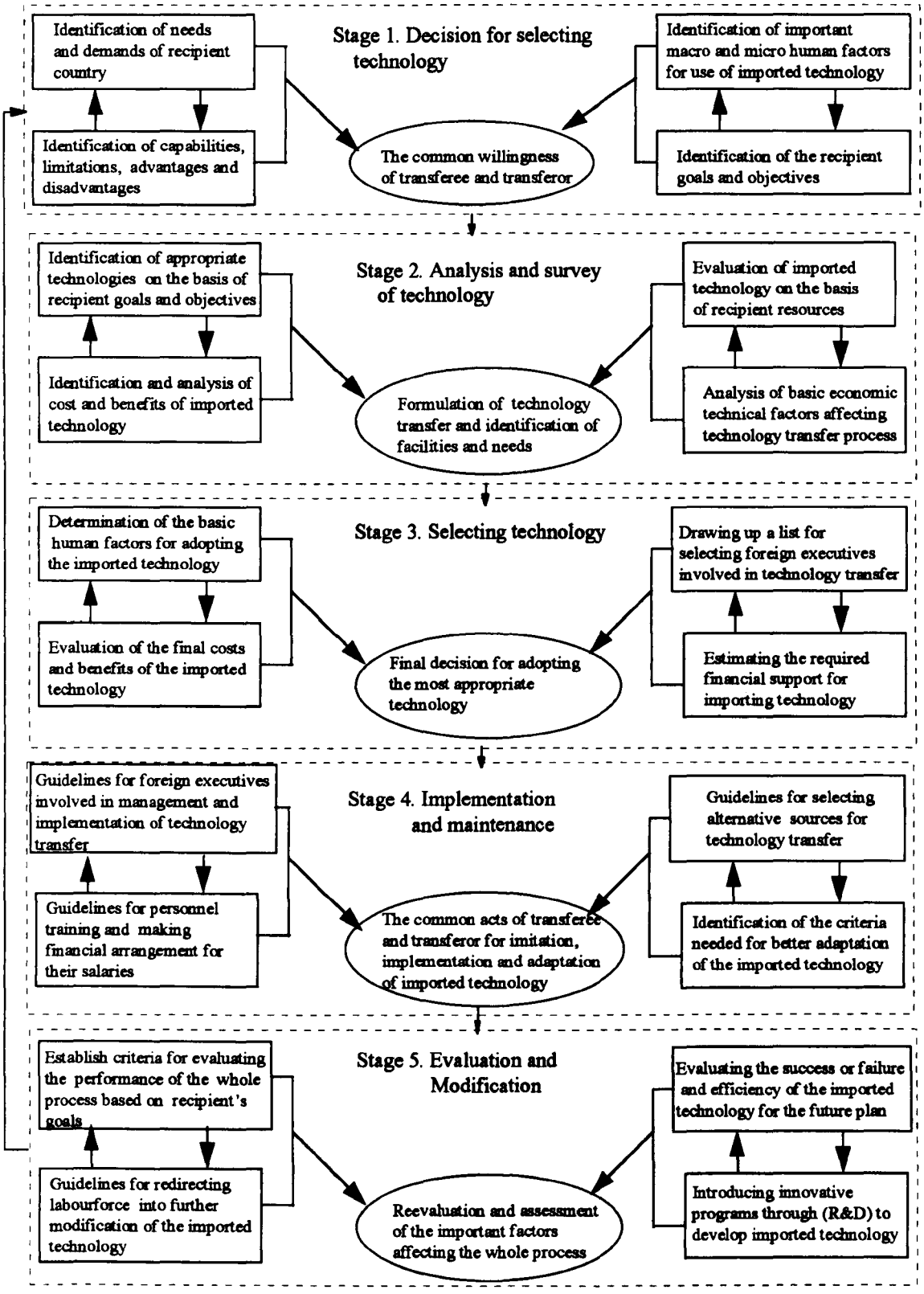


Figure 3.8 A systematic approach for the technology transfer process

Source: Salami, R. and Reavill, L. "The Critical Success Factors for ITT to LDCs", in W. Grimberg et.al. (Eds). Technology Transfer Models for Growth & Revitalization", 1996.

In the third stage, the decision makers in the country make their final decision for selecting the most appropriate technology. They also determine an appropriate transferor, considering different criteria such as quality of technology, cost of technology, and trade relationships. They also evaluate the financial support needed for importing technology through their final cost and benefit analysis. In the implementation and maintenance stage, some important criteria needed for better adaptation and assimilation of imported technology are identified through the common acts of transferor and transferee. These criteria differ for each country and depend mainly on the socio-economic and cultural factors in the recipient country. For example, the existence of a relatively skilled labour force may increase the rate of assimilation and absorption of foreign technology in the recipient country. Therefore, it may be necessary for both transferor and transferee to make their efforts in designing some specific training programs for the human labour in the recipient country to enable them to adapt the imported technology for local use.

Finally in the evaluation and modification stage, some of the most important success and failure factors affecting the whole process of technology transfer will be assessed and evaluated. The evaluation of the whole process can be done through analysing the performance of the country's goals and objectives in order to ensure that all of them are being satisfied. It may be realised that some innovative research and development programs are needed for further improvement and updating the existing technologies.

3. 9 FORMULATION OF THE TECHNOLOGY TRANSFER PROCESS

The following assumptions are needed for the formulation of technology transfer process:

We assume the domestic know-how which exists within country (A_1), and foreign know-how which must be imported (A_2). We suppose machinery and equipment required for production of goods exists in the country (B_1) and if there is not enough, the required machinery and equipment must be imported from a foreign country (B_2). Assuming the local expertise needed for using machinery (C_1), if there is not enough local expertise, foreign expertise will be needed for using the machinery (C_2). The technology transfer process can be formulated by 8 formulas as shown in the following matrix:

Stage (1)	Stage (2)	Stage (3)	stage (4)
$A_2B_2C_2$	$A_1B_2C_2$	$A_1B_1C_2$	$A_1B_1C_1$
	$A_2B_1C_2$	$A_1B_2C_1$	
	$A_2B_2C_1$	$A_2B_1C_1$	

Figure 3.9 The appropriate direction for the effective technology transfer
Source: Salami, R. And Reavill, L.R.P. "The Appropriate Policies for a Successful International Technology Transfer to LDCs", in : Proceeding of the Conference on Global Change, Manchester. 1996.

The first formula shows that the recipient country is fully dependent on foreign technology, because all the technology, machinery, technicians and expertise are imported from a foreign country. In the second formula, the R&D institutes in the recipient country have attempted to prepare know-how for the imported technology. In formula three, the recipient country has attempted to do research and development for copying the machinery but it must employ foreign expertise. While the first stage has a large degree of cost and dependency, there is less dependency and costs in the fourth stage. Thus, the cost and dependency are decreased from first to fourth stage. Each recipient country can be located in one of these four stages.

In every stage, there is an effort to change one of the previous factors which were imported from abroad, such as foreign know-how and technicians, to indigenous know-how and technicians. In the fourth stage, C_2 changes to Ç , thus we can show a step by step progression by the following forms:

$A_2\ B_2\ C_2$
$A_1\ B_2\ C_2$
$A_1\ B_1\ C_2$
$A_1\ B_1\ C_1$

This set of formulas seem to provide the most appropriate direction in which to co-ordinate the industrial and economic policies of the recipient country. Although there is a possibility to go directly from the first formula to the eighth formula, this will depend on the local

technological capabilities of the recipient country.

3.11 THE CONCEPT OF THE APPROPRIATE TECHNOLOGY

Rosenblatt (1979) has defined appropriate technology as "the set of techniques which makes optimum use of available resources in a given environment" [179]. According to Watanabe (1980), appropriate technology is defined as "a set of production techniques which can improve the standard of living through creation of employment and economic growth than any available alternatives" [180]. According to Betz (1984), appropriate technology can be defined "as providing technical solutions that are appropriate to the economic structure of those influenced: to their ability to finance the activity, to their ability to operate and maintain the facility, to the environmental conditions involved, and to the management capabilities of the population" [181].

In other words, a technology may be considered as appropriate which is able to utilise the national and human resources efficiently and can also be easily assimilated to the local conditions of the recipient country. However, it is argued that many definitions of the appropriate technology are limited in their static nature, in particular from the view of policy analysis [182]. Therefore, the choice of an appropriate technology for a LDC needs to be evaluated within the context of its development strategy [183]. Furthermore, as Sharif (1986) noted, the notion of the appropriateness is a rather complex one, requiring the identification of several criteria and factors and also involving with the goals and objectives of the recipient country. He believed that technological appropriateness is also a very dynamic concept and relies more on the purpose of transferring technology [184]. For example, if the purpose of the recipient country is to achieve competitive advantage in international market, then a labour-intensive and less advanced technology would not seem to be an appropriate choice.

An appropriate technology can be recognised by its various characteristics. For instance, in terms of material aspects of appropriate technology production, appropriateness indicates to the use of renewable sources of energy and materials, minimum damaging impact on the environment, and maximum utilisation of local resources. In terms of the mode of the production, an appropriate technology is more labour intensive (capital saving), soft and

intermediate (harmonious with the local environment) and located near the points of consumption to meet better the local demands. In other words, it involves with production techniques that are more compatible with LDCs' resource endowments in order to tackle such problems as unemployment, and income distribution [185]. In terms of the application, appropriate technology should be easily adapted to the local social, environmental and cultural conditions of the recipient country. It should also be flexible to any changes in local conditions [186]. The appropriate technology should also be capable of developing and producing new products; capable of improving quality performance of products; capable of expanding product export and increase earnings of foreign currencies; capable of developing managerial expertise in the recipient country and contributing to the advancement of scientific and technical standards.

There are some other criteria relating to an appropriate technology. These include the capability to increase product output and economic growth rate; to reduce unemployment and balance of payments deficit; to provide better income distribution; and to make the recipient self-sufficient from the import of raw material and components [187]. Moreover, the adaptability of technology to the indigenous conditions of the recipient country can be considered the most important criteria for its appropriateness. In a survey analysing the various factors which affect the appropriateness of technology, Teitel (1993) identifies some important criteria for a technology to be inappropriate. The technology is believed to be inappropriate; when the domestic needs and preferences of the local market are not taken into account adequately; when the technology depends on importing raw material; when the technology is not fitted to the size of the local market; when there is not adequate local skills for effective adaptation and assimilation of that technology; and when the technology can only be transferred at a high cost. Furthermore, damaging the environment and using scarce energy inputs are among other criteria for an inappropriate technology with a lesser degree of importance [188].

Schumacher (1973) in his book "small is beautiful" has used the term " intermediate technology" to be more suitable for the LDCs [189]. He argues that the large scale and capital intensive technologies are usually too costly and complex to be assimilated by the LDCs. However, he prefers to use the term intermediate technology instead of appropriate technology, because of the broad and relatively vague concepts of the latter.

As Schumacher indicates, an intermediate technology has some characteristics such as small scale, cheap, labour intensive, self-sufficient from the import of raw material, and profitable for the recipient country. This indicates that a small scale technology can be easily absorbed by the local labour force in the recipient country. A labour intensive technology seems also to be more suitable for the LDCs, as it creates more employment opportunities for the masses of people. It also mostly relies on the local natural resources and inputs so that the recipient country is less dependent on import of foreign parts and materials which result to saving a substantial amount of its foreign exchange. Enos (1989) argues that the most appropriate technology for the LDCs might not be available, therefore, it seems reasonable to suggest that these countries should seek a less advanced technology which would be more easily and cheaply accessible to them [190].

There is another idea which believes that the big is wonderful and emphasises the adoption of more modern and large scale technologies as an appropriate choice for LDCs. The supporters of this idea argue that developed countries could achieve a high level of industrial and technological development through the acquisition and development of more large scale as well as modern and advanced technologies. Therefore, those LDCs which want to follow the same pattern of industrial and technological development should transfer more advanced technologies. They also argued that the modern technologies generally are more efficient and productive for the LDCs' local conditions. These technologies assist a LDC to modernise its industrial sector and promote the managerial skills and productivity of its human labour in order to be able to compete in the international market. This idea is also largely criticised by many authors who argue that most advanced and large scale technologies which have been developed in industrialised countries are for their own needs and conditions, and therefore are inappropriate for the local conditions of LDCs.

However, others such as Haustein (1983) believe both approaches of small is beautiful and big is wonderful are not appropriate [191]. It is argued that LDCs require software and hardware, small scale and large scale, and simple as well as modern technologies in order to increase their industrial and technological capability and competitiveness. Moreover, as the experiences of some LDCs indicate, some countries such as S. Korea and Taiwan adopted labour-intensive and small-scale technologies in the early stage of their

industrialization which were suitable for their local conditions. However, as the level of industrial and technological capability in these countries developed, they switched to transfer of more capital-intensive, modern and large-scale technologies.

As Pack (1981) also noted, the gradual shift from employing labour-intensive technologies towards more capital and modern technologies in these countries can be considered as a reward for good performance in the early industrialization period [192]. Therefore, the appropriateness of technology for a specific country depends to a large degree on the particular circumstances and the level of industrial and technological capability in that country in a certain period of time. While a labour-intensive technology can be considered suitable for a local condition of a country in its early stage of industrial and technological development, this may not be an appropriate choice of technology for that country in the later stage, when it needs to transfer more advanced and capital-intensive technology to be able to compete in the international market. In other words, it can be said that the technologies which believed to be appropriate in the specific period of time may not be considered as appropriate choice in an other phase. So it is clear that the independent choice of large scale advanced technologies, or small scale or intermediate technologies, cannot lead to technological development in LDCs. Therefore, a combination of these technologies can be regarded as an appropriate choice for LDCs and especially for Iran. According to the various characteristics of an appropriate technology that have been discussed earlier, there are three main sectors which are necessary for choosing an appropriate technology :

1. Leading factor, that is necessary for obtaining foreign exchanges in the future.
2. Driving factor, that reduces the technology gap in the future.
3. Evolving factor, that tries to meet the agricultural requirements and basic needs in the short term

Sector	Objectives	The most important criteria of appropriateness	The needs of operating process
Leading world	To compete in the world technology market in order to take most advantages from exporting technology	Maximum profits from the international market	To predict the condition of technology in the future, and to evaluate the R&D activities and marketing aspects
Driving sector	To make technology more modern in order to use it in the selected fields for promoting their productivity	More gains and less losses	To transfer, evaluate and adapt technology
Evolving sector	To achieve the gain from using technology in selected fields, in order to meet the needs of the people in rural areas by using local technologies	Less damaging to the local tradition, and culture and environment	To provide information about assimilation, absorption, adaptation and innovation of technology

Table 3.3 A three sector model for choosing appropriate technologies

Source: adapted from Sharif, M.N. "Management of Technology Trasfer", APCTT,1986.

Thus each developing country needs a combination of strategies to be able to choose its appropriate technologies considering these three sectors. It is necessary for LDCs to make their best effort to choose those technologies which seem more appropriate to their local socio-cultural, as well as technical, conditions. In order to be successfully in transferring appropriate technologies, they need to improve their endogenous absorptive capacity through designing some regular training programs for promoting the skill level of their labour force, and also spending more investment on the research and development activities. Moreover, it seems also vital to formulate effective mechanism for making the appropriate choice of technology within their overall national policies for technology transfer.

3.11 THE COST OF TECHNOLOGY TRANSFER

As discussed earlier, in the conceptual issues of technology transfer, in a technology transfer, both the recipient and the supplier of technology adopt strategies to maximise their

benefits from the technology transfer. The main objectives of the supplier of technology are to get the highest price for a specific technology; to minimise the quality of the technology without any impact on its price; to get access into another market and keep its market share; to get benefits from the cheap natural and human resources of the recipient country and therefore obtain access to a possibly diversified and lower cost source of funds [193]. On the other hand, the strategy of the recipient is based on such factors as paying the least amount for the price of a packaged technology; minimising its cost of technology transfer and maximising its benefits from the transferred technology and obtaining the high quality and standard technology from the supplier without paying any additional price. The recipient country can also get some benefits from TT including encouraging the expansion of local industries, creating local employment opportunities, and promoting its economic growth considering the efficient adaptation and assimilation of imported technologies and its effect on the recipient's export potentials.

There are some direct and indirect costs for the recipient of technology. The direct cost of transfer includes royalities (as a percentage of net sales), the outflow of dividends, maintenance imports from the use of particular foreign technology, the payment for managerial and technical expertise, cost of training technical information, licensee fees and lump-sum payments which usually involved payments for less sophisticated technology or production techniques that are transferred on a one-time basis. Moreover, the payment for technical services depends on the extent and the nature and quality of services be provided, such as the length of a visit by technical personnel of the licensor and the extent of the training of the local workers [194]. However, indirect costs can be incurred when the recipient is heavily dependent on the import of material and components; or costs resulting from restrictive measures imposed by the supplier; or costs involved in transfer of inappropriate technologies which are not compatible with recipient's local conditions; the costs resulting from the recipient's inability to train its labour force; and the costs due to low levels of absorptive capacities in the recipient countries.

3.12 FACTORS AFFECTING THE SUCCESS OF TECHNOLOGY TRANSFER

There are some key factors which can assist the recipient country to adopt and adapt foreign technologies more effectively and efficiently. The overall success factors of successful

international technology transfer and rapid industrialization, based on the experiences of some East Asian first and second-tier NICs will be discussed later in detail. Here, it seems necessary to identify some specific factors which affect the efficient acquisition and assimilation of foreign technologies which could certainly be very useful for the policy makers in the LDCs. Some of the most important factors are as following:

3.12.1 Effective Management

It is essential for decision makers in the recipient country to be familiar with the most recent and up-to-date managerial expertise which can assist them in better absorption and assimilation of imported technology. The existence of efficient managerial expertise in a LDC can also lead to an effective utilisation of its natural and human resources which in turn will result in the promotion of its productivity level. The professional managers can also identify the most appropriate technology based on the recipient countries' needs, capabilities and objectives. The experiences of some successful countries in an effective technology transfer and rapid industrial and technological development show that the existence of a large numbers of well-trained and qualified managers in these countries have played a very important role in their success in the efficient adaptation and assimilation of foreign technologies. Therefore, it is essential for decision makers in LDCs to improve their managerial expertise and skills in particular the ability to plan, organise and solve problems.

3.12.2 Research and Development

The research and development activity is among the most important factors which not only assist the recipient country to modify and adapt the imported technologies to its local conditions but it may also lead to creation and generation of new technology and products. The allocation of a substantial research and development expenditure as a percentage of GNP is obviously necessary if a country wishes to promote its indigenous technological capability. For example, some successful countries such as S. Korea have increased the R&D expenditure as a percentage of GNP from 1% in 1984 to more than 2 % in early 1990s which has led this country to reach the level of technological maturity. More significantly is the contribution of its private sector to such expenditure which rose from 32% in 1980 to 82% in 1986 [195]. It seems that other LDCs are also paying more attention to increase

their R&D expenditure as a percentage of their GNP in order to promote their absorptive capacity level which can assist them in an effective transfer of technology.

3. 12. 3 Market Size

A country with a relatively adequate size of market would have better learning and absorptive capability for the successful adaptation and effective transfer of technology to its local environment. The large size of the market in the recipient country can also encourage the flow of FDI in to that country which in turn bring about technological know-how and managerial expertise as well as marketing skills.

3. 12. 4 The Absorptive Capacity of Recipient

The recipient country's absorptive capacity level can also play an instrumental role in the success of technology transfer. The absorptive capacity of a recipient country can increase through the development of its technological capability. The higher is the level of local technological capability in a country, the more this country would be able to absorb and assimilate imported technologies to its local conditions. The absorptive capacity of a recipient country can also increase through massive investment in the country's industrial infrastructure as well as promotion of the managerial skills and education and training of its labour force. As indicated earlier, the increase in the research and development activity can also lead to the promotion of the absorptive capacity level in a recipient country. Therefore, it is vital for the LDCs to enhance their absorptive capacity level through enhancing, improving and developing their infrastructure including an effective communication system, transportation networks, power stations, etc.

3. 12. 5 The Government Regulations and Policies

The supportive role of government in the recipient country, through adoption of appropriate regulation particularly for attracting FDI and implementation of an effective policy framework, can also contribute to its success in technology transfer. The government can provide financial assistance, loans and credits for those private and public industrial firms which are involved in the acquisition of foreign technology. The government in the recipient

country can also create a stable macro-economic and policy environment which is necessary for an effective and successful technology transfer. Therefore, it is crucial for the government in an LDCs to introduce effective regulations for technology transfer which allow the free flow of appropriate technology to their countries.

3. 12. 6 The Social and Cultural Values

The other important factor which can affect the success of technology transfer is the recipient country's cultural and social value system. The social and cultural values of a country can include traditions, religious and ideological believes, historical habits, attitudes of people towards the new devices, etc. The awareness and understanding of LDCs' social and cultural value systems in technology transfer decision making will enhance the successful transfer of appropriate technology. Therefore, the policy makers in a recipient country should pay their adequate attention when they design and formulate the overall plan for transferring foreign technologies to their countries. It can be said that the higher is the cultural and social gap between the supplier and recipient societies, the bigger is the need to consider the social and cultural aspects in the overall plan for the technology transfer. Therefore, it is believed that the success of an international technology transfer also depends on the compatibility of the cultural values of countries involved in such transactions [196].

3.12.7 The Willingness of Transferor and Transferee

In any technology transfer to occur, there must be a recipient and supplier of technology which the former is usually lagging behind the latter in terms of technology level. Moreover, both the transferor (supplier of technology) and transferee (the receiver of technology) should have some goals and objectives which they intend to achieve through technology transfer. Therefore, the compatibility and willingness of both parties are necessary for a successful technology transfer. While the recipient of technology may import foreign technology mostly because of its needs and demands, the supplier of technology may transfer its technologies for such a reasons as the incentive of larger profits, wider markets, and new or additional sources of raw material supply.

However, both supplier and receiver of technology may impose some restrictions on technology transfer. For example, the unwillingness of recipient country may be due to transfer of inappropriate technologies which have resulted in heavy dependency on imports of foreign parts and components from the supplier. Moreover, some capital-intensive technologies cannot create employment opportunities for a country with large human resources. The supplier of technology on the other hand may not be willing to transfer its up-to-date technologies to the LDCs for the fear that such technology might be used in the long term as competitors and rivals in the international market..

3. 12. 8 The Export Promotion Policy

The adoption of an export promotion policy in the LDCs is among the most important factors for a successful acquisition of foreign technology and promotion of its technological capability. This will be analysed extensively in the case study survey later. However, it can be briefly pointed out here that the implementation of EPP can accelerate the efficient utilisation of the LDCs' natural and human resources in order to compete in the international market. It can also be said that the faster exports grow in a LDC, the more rapidly new technology can be transferred into that country. This close relationship between the expansion of growth and the acquisition of foreign technologies is mainly because of the current very competitive international markets which necessitate a country to transfer high level and modern technologies in order to shift its comparative advantage from labour-intensive to more skill and technology intensive industries to become more capable of competing in the international market. As will be discussed later in the country studies, the experiences of some East Asian first and second-tier NICs in successful technology transfer and rapid industrialization have provided a strong support for the role of the expansion of exports in their rapid productivity growth and technological upgrading.

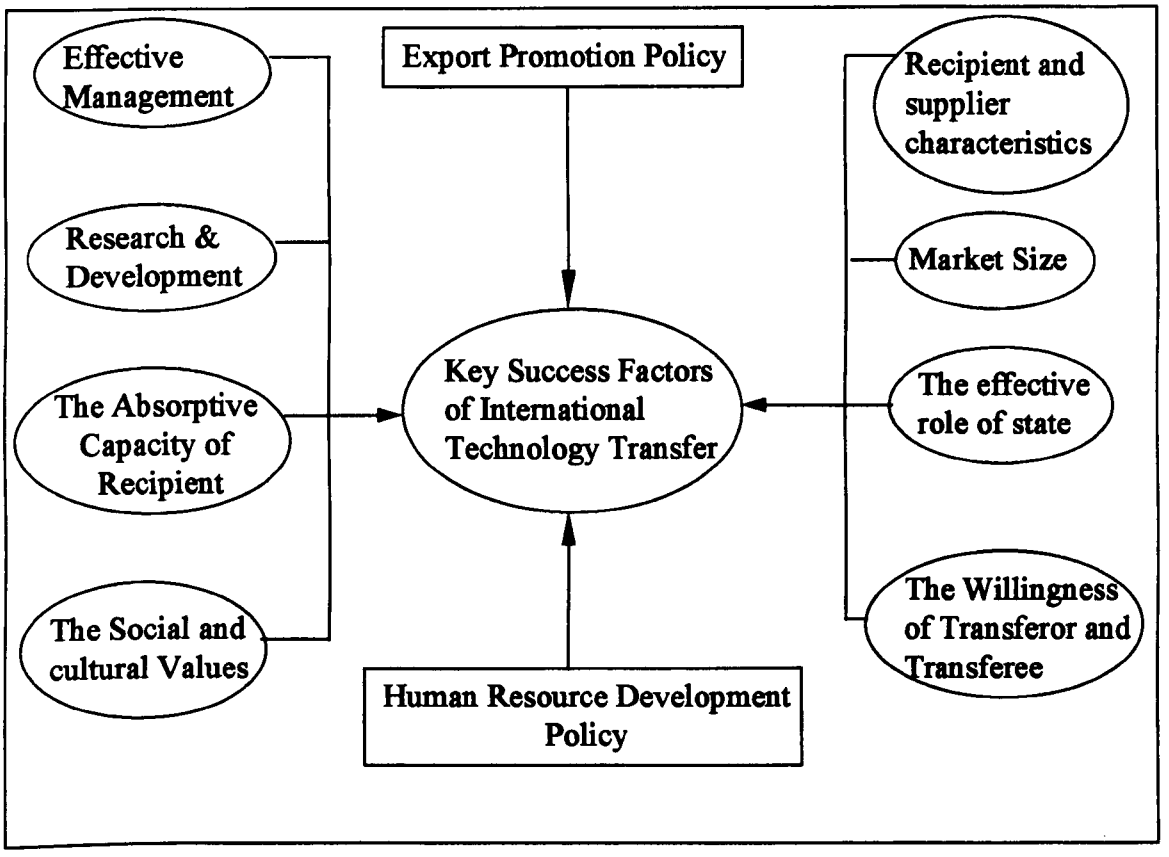


Figure 3.10 The Key Success Factors For International Technology Transfer

Source: Salami, R. and Reavill, L.R.P. " International Technology Transfer- The Key Success Factor for the Industrialization of Less Developed Countries", in Proceeding of the Technology Transfer and Innovation Conference, London: 1996, pp: 158-163.

3.12.9 The Human Resource Development Policies

The adoption of efficient Human Resource Development programmes can also be among the most crucial factors for a successful international technology transfer. Although the role of HRD policies will be discussed in detail later in the country studies analysis, however, due to its great importance it seems also necessary to explain it briefly here. The existence of the well-educated and high skilled labour force seems to be essential for a country to assimilate and absorb the foreign technologies and technical know-how more effectively. As the experiences of some East Asian first and second-tier NICs in particular S. Korea and Taiwan shows, it was massive investment in education and training and development of their human resources that enabled them to strengthen their technological capability and closed the gap with technologically advanced country very quickly. Therefore, LDCs should place more

emphasis on designing various HRD programmes including the expansion of education and training at all levels both quantitatively and qualitatively in particular in the higher education in order to increase their university graduates especially in science and engineering. This would allow them to increase the numbers of technicians, engineers and scientists which are required for efficient adaptation of imported technologies to their local conditions as well as promotion of their indigenous technological capability.

3. 13 SUMMARY AND CONCLUSIONS

As already discussed in the theoretical framework of international technology transfer, there has not been a precise theory that can be applicable entirely to the conditions of LDCs. Similarly, having analysed the conceptual issues of technology transfer mechanisms, one may not find a direct answer to the question of which mode of ITT is more appropriate for the successful acquisition of foreign technology. However, as the experience of some LDCs shows, the major source of technical and managerial knowledge for these countries in their early stage of industrial development was the MNCs direct investment particularly in the form of the wholly and majority owned subsidiary. As the level of industrial and technological capability in many of these countries developed, they adopted some restrictive policy measures to control the dominant and monopolistic role of MNCs. Since the 1960s and 1970s, LDCs employed some less packaged methods of ITT, including joint ventures (share ownership and control); licensing agreements (the ownership and management responsibility with the host country, but with the supervision of the licensor); franchise contracts (sale of the use of the brand name and technical and managerial support); management contracts (supplying management personnel together with technical and managerial training for the local personnel); know-how and patents agreement (supply of knowledge and skills of production and the rights for manufacturing certain products); turnkey contracts (supply of a complete factory to the recipient with the whole responsibility of the supplier), and the subcontracting (the provision of the technical assistance to the subcontractee).

However, as noted earlier in detail, the choice of an appropriate method for ITT depends on some important factors such as the stage of development and the absorptive capacity of the recipient country, the national and trade policy of the host nation, the nature of

technology being transferred, and the motivation and strategy of the supplier of technology. Moreover, technology transfer mechanisms can be classified through different categories such as direct and indirect, commercial and non-commercial, formal and informal, internal and external, market mediated and non-market mediated, packaged and unpackaged. However, the major distinction of these classifications would be the degree of packaging and control employed by the foreign supplier of technology. Therefore, the most appropriate channel of technology transfer would be the one in which the recipient can effectively acquire the complete package of technology and the know-how and managerial and marketing skills needed for the assimilation of the technology to its local condition. In other words, it seems preferable for LDCs to choose a rather packaged form of technology transfer, while they develop their technological capability through education and training of their human resources, and significant R&D activities. Finally, it should be noted that the success of a technology transfer to a large degree relies on the appropriate choice of technology transfer mechanisms. Therefore, adequate attention should be paid by recipient countries to choose the method that enables them to take maximum advantage of the imported technology. This, as mentioned earlier, also depends on the indigenous industrial and technological capability of recipient country.

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CHAPTER 4:

THE EXPERIENCE OF INDUSTRIALISATION AND TECHNOLOGY TRANSFER IN SOME SELECTED COUNTRIES

4. 1 INTRODUCTION

It is believed that the experience of industrial and technological development in some successful counties particularly most East Asian Newly Industrialised Countries (NICs) may have many valuable lessons for other LDCs. The importance of the East Asian countries as a model for other developing countries can be attributed to their remarkable performance and their successful experience of industrial and technological development over the past three decades. These countries which include the first-tier NICs, known as tigers or dragons, namely Korea, Taiwan, Singapore and Hong Kong, along with the second generation of NICs, Thailand, Malaysia and Indonesia, have experienced an average annual growth rate of GNP per capita of near 7 per cent during the period between 1965-1990 and have also obtained 73.5 per cent of developing countries' manufacture exports in 1990 [1].

The diversity of these countries in some overall economic indicators such as per capita income, natural resources and the process of their industrialisation, can be helpful for other developing countries with similar characteristics to pursue their development strategies. Although there are some differences in the stage of development, size of economy, resource endowment etc, the industrial and technological development experience of these countries has been of interest to most Less Developed Countries (LDCs), in particular those which attempt to promote their technological capability through the same pattern of rapid industrialisation. The experiences of some other successful countries, such as Mexico and Turkey, will also be examined in order to identify and establish the vital success and possibly limiting factors of their industrial and technological development. The experiences of these specific countries can also be valuable for LDCs such as Iran who share a relatively common characteristics with them.

In the following, each country is separately studied within the context of its experience of industrial development and technology transfer. This case study needs to be undertaken to identify the critical success factors and also some of the limiting factors of these countries

which in turn can be useful for other LDCs with a relatively similar level of development. However, it should be noted that the analysis of Singapore and Hong Kong among the East Asian first-tier NICs are excluded in our survey mostly because of their small size as city states which distinguishes them from their counterparts.

4. 2 REPUBLIC OF KOREA

It is common and rather necessary for every research investigating broadly the experiences of some successful countries to refer to S. Korea as a remarkable and outstanding example of rapid industrial and technological development during the past few decades. It is generally believed that the development experiences of some of the most successful East Asian economies may provide useful lessons for the other countries which are currently undergoing the transition process. Among the East Asian first-tier Newly Industrialised Countries (NICs), South Korea is usually chosen by other developing countries as the most favourable model. This is mainly because of its very rapid transition from a low-income Less Developed Country (LDC) into a modern industrialised country in less than thirty years. Moreover, one may find several common features between the Korean post-World War two period and the current conditions of many LDCs who wish to pursue the same pattern of transition that it happened to Korea in the past.

South Korea (Korea) is covered the area of about 98,913 square kilometres after a devastating war in 1950s which led to a division of Korea into two parts in the north and south. Most area in the south is consisted of mountains with only about 20% of farmland. However, S. Korea exercised a rapid postwar reconstruction period when significant progress was made in rebuilding its industrial infrastructure and moving towards economic and industrial growth. Much of the industrialisation policies during the 1950s and early 1960s in S. Korea was concentrated on the protection of a strong domestic industrial base capable of producing goods as a alternative for importing products. This import substitution policy was also associated with a substantial aid of about $ 3 billion from U.S. in 1950s, assisted the country to keep the relatively stable macroeconomic environment required for a successful transition to an outward-oriented economy in early 1960s.

While S. Korea continued to develop some of the import substitution-industries such as fertiliser and cement manufacture in the 1960s, it also placed more emphasis on the expansion of some export-oriented and labour intensive industries. The 1960s can be

considered as the take-off stage of industrialisation in Korea, as many industries established ranging from chemicals and electronics to automobiles and electrical and electronics equipments. The Korean government formulated a series of Five-Year Economic Development Plans since 1962, aimed at obtaining rapid economic growth rate. As a result of the implementation of the first and second development plans during the period between 1962-72, the average annual growth in per capita income in Korea was a remarkable rate of 6.8% [2].

It is argued that the industrial sector was engine of the Korea's growth during the 1960s. While the share of the manufacturing sector as a proportion of GNP was less than 14%, this figure increased to more than 20% by 1970 [3]. Korea's first and second development plans emphasised more the expansion of manufacturing exports through the acquisition of foreign technologies. The share of manufactured products in total exports increased from 17.6 % in 1962 to 76.1 % in 1970 [4]. It can be said that the adoption of a strong export-promotion policy in the early 1960s encouraged and facilitated the rapid acquisition of foreign industrial technologies, together with their adaptation and assimilation to suit Korea's local conditions. However, the number of foreign technology agreements was rather limited in the 1960s and there were about 320 agreements during 1962-72 valued $10 million. Furthermore, it is believed that Korea's outward-looking strategy contributed significantly to the overall economic and industrial performance of the country and its contribution rose from about 10 % in the 1960s, reaching to over 20% in the first half of 1970s [5].

The Korean government established a number of supportive institutions for the development of science and technology, such as the Korean Institute of Science and Technology (KIST) for multidisciplinary research and development activity, Ministry of Science and Technology (MOST) as a central government policy making and Korea Advanced Institute of Science (KAIS) in order to educate and train a large number of technicians and engineers needed for efficient absorption of foreign technologies. The government in Korea was also efficiently managed to expand the huge infrastructural projects including chemicals, petrochemicals, and iron and steel industries which paved the way for a successful transition to more capital and high-technology intensive industries during the 1970s and 1980s. The Ministry of Science and Technology (MOST) enacted several laws and regulations for promotion of science and technology, such as the law for the promotion of technology

development of 1972, to provide financial support to private industry for technology development; the Engineering Services Promotion Law of 1973, to promote local engineering firms and the Assistance Law for Designated Research Organisation of 1973, to expand the fiscal and financial incentives for R&D centres [6].

Korea's economy entered a new phase of growth in the 1970s, when the third and fourth development plan were implemented. These plans placed more emphasis on building and strengthening the industrial and technological foundation and capability of the country through developing some selected industries including machinery, metals, chemicals and petrochemicals, shipbuilding, and electronics. Therefore, a large number of heavy and capital-intensive technologies were transferred to the country mainly through the imports of machinery and turn-key installations. The Korean government implemented a Heavy and Chemical Industries drive (HCI) in the mid-1970s, aiming at a shift towards manufacturing of heavy and capital-intensive industries from production of labour-intensive and light industries which could be more competitive in the international market. Furthermore, the national security issues regarding withdrawal of large numbers of U.S. troops from the region and also China's re-entry into the international community made the S. Korean decision makers put more emphasis on the development of defence-related industries which in turn required the establishment of the heavy and chemical industries [7].

As a result of various policy measures including tax exemption and financial credits in the context of Heavy and Chemical Industry (HCI) drive, the manufactured exports rose from 24% in 1973 to 46% in 1979 and accounted for more than half of Korea's exports in 1984. On the other hand, the HCI imports fell from 39% in 1974 to 24% in 1980 [8]. Following the economic crisis of late 1970s, the Korean government adopted a series of stabilisation, liberalisation and privatisation policies in order to keep a stable macroeconomic environment needed for further industrial and technological development. A new general industrial promotion law replaced the previous individual industrial promotion laws in July 1986 [9]. This new law limited the government intervention and removed some restrictions on foreign investment to manufacturing sector. Thus, the 1980s can be distinguished from the two previous decades in substantial declining in government intervention. Since 1980s, the government interventions were limited only on such activities as restructuring the distressed industries, formulating the national technology development policies, and the expansion of exports. Therefore, like its successful export promotion policy, Korea's liberalisation policy

can be regarded as a model for a successful liberalisation [10].

Moreover , from the early 1980s, Korean technology development focused on new and more advanced technology-intensive industries including bio-technology, computers, semiconductors, and telecommunications. Therefore, it can be said that Korea achieved a certain level of self-sufficiency in manufacturing labour-intensive and light industries and a limited dependence on foreign technology in the heavy and chemical industries in 1980s [11]. The Korean exports increased by $ 30 billion during the period between 1980-1987, due to the implementation of further effective export incentive measures such as effective depreciation of its exchange rate in mid-1980s and a large trade surplus with the U.S. [12]. It should be noted that since the implementation of the trade liberalisation policy in the 1980s, some export subsidies generously provided by the Korean government for exporters were reduced. However, the government continued to encourage exports of manufacturing products through tariff exemptions and removing the import restrictions for imports of raw materials used in export production, and also offering long-term credits to finance exports of ships, industrial plants and heavy machinery [13]. Moreover, the manufactured exports consisted of about 96% of total exports in 1984, which was the highest of any country in the world [14].

It is argued that during the process of the export expansion, Korea acquired substantial amounts of technology and know-how mainly through imports of goods embodying new technology. According to some statistics, the Korean government made about 3,073 technology import agreements during the period between 1962-1984, including $ 1,043 million in royalty payments [15]. Thus, Korea is evaluated as having a most favourable environment to receive foreign advanced technology. Korea also transferred foreign technology through the other channels including licensing, foreign investment, and some informal methods such as technical assistance, foreign training of local personnel and reverse engineering. There were about 1,840 licensing and 1,249 foreign investment cases occurred between 1962-81, which mainly went into such industries as chemicals, machinery and electronics [16].

Types of Industries	1985	%	1990	%	1994	%
Food and direct consumption	1,259	4.2	2,290	3.5	2,570	2.7
Crude materials and fuels	1,374	4.5	1,719	2.6	3,753	3.9
Light industry products:	11,173	36.9	25,149	38.7	25,742	26.8
Textiles	6,627	21.9	13,938	21.4	16,337	17.0
Footwear	1,524	5.0	4,023	6.2	1,488	1.5
Others	3,022	10.0	7,185	11.1	7,917	8.2
Heavy industry products:	16,467	54.4	35,859	55.2	63,946	66.6
Chemicals and chem. products	575	1.9	1,743	2.7	4,903	5.1
Metal goods	3,328	11.0	5,662	8.7	7,782	8.1
Machinery and equipment	1,377	4.5	6,056	9.3	10,325	10.8
Electronic products	2,907	9.6	10,233	15.7	18,170	18.9
Others	8,289	27.4	12,165	18.7	22,766	23.7
Total	30,282	100.	65,014	100.0	96,011	100.0

Table 4.1 Korea's Manufacturing exports by type of products in Million dollars

Source: OECD, 1996.

Despite using various channels of technology acquisition in Korea, the importation of technology embodied in machinery and equipment remained as a major channel with about 21 times that of other means of technology transfer in terms of value during the period between 1962-1986 [17]. As is shown in the table 4.2, there is close relation between technology imports (TI) and capital good s imports (KI). The sharp increase in TI in 1978 was because of the implementation of HCI drive which led to importing massive technologies in order to promote heavy and chemical industries. For most major industries such as textiles, chemicals, shipbuilding, automobiles, electronics, heavy machinery, and iron and steel, technology was transferred through purchase of equipment. This embodied form of technology transfer was supplemented by the acquisition of design, joint ventures, licensing and the hiring of foreign experts. No systematic approach to technological capability development is evident. Different enterprises have followed different strategies. For example, in shipbuilding, designs are supplied by clients who purchase them overseas; in the electronics industry, licensing is widely practised. In the automobile industry, one enterprise (Daewoo) went into a joint venture with General Motors, while another (Hyundai) produced Fords under licence. More recently, Hyundai has gone back to a joint venture with Mitsubishi for body design technology [18]. However, there were some heavy restrictions in the use of technological licensing in some industries where local technological capability is consider to be advancing. It is also argued that the choice of production technology has depended more on market and export demand than long term technology

policies [19].

Period	Technology imports		FDI		Ratios (TI:FDI)		Capital goods imports	
	Payment ($ m)[A]	Cases [B]	Amount (m $) [C]	Cases [D]	[A]/C] (%)	[B]/[D] (%)	Amount (m$) [E]	[E]/total imports
1962-66	0.8	33	47.4	39	1.7	0.85	486.0	18.9
1967-71	20.4	285	218.6	350	9.3	0.81	2,668	30.8
1972-76	96.5	434	879.4	851	11.0	0.51	8,106	27.3
1977-81	451.4	1,225	720.5	244	62.7	5.02	25,685.6	27.7
1982-86	1,184.9	2,078	1,767.5	365	67.0	3.68	46,572.8	32.0
1987-91	4,359.4	3,471	5,634.7	1,622	77.4	2.14	111,499.4	36.4
1992-93	1,797.0	1,240	1.938.8	506	92.7	2.46	61,184.3	37.0
Total	7,906.1	8,766	11,207.6	4,177	70.5	2.10	256,200.3	33.5

Table 4.2 Technology Transfer to Korea, 1962-93

Source: Bank of Korea, Korea Industrial Technology Association (KITA), 1996.

The Korean government also planned some extensive programs for the education and training of human labour in order to promote their capability of absorbing and assimilating foreign technology. Human resource development policies have been a major and crucial element of the Five-Year Economic Development Plans which provided various programs for promoting education at all level. For example, the most recent Seventh Five-Year Economic and Social Development Plan (1992-1996) aimed at extending the compulsory years of schooling from the primary school level to the middle school level by 1996. As of 1993, the enrolment rate was 100% for primary schools, 96.3% for middle schools, 90% for high schools, and 44.8% for tertiary education [20]. Moreover, in a further attempt to raise the quality of education in Korea, in June 1995 the Korean government announced new regulation which aimed to increase competition among schools at all levels in order to make educational system more responsive to changing demands for education by giving them more autonomy and diversity. In addition, the number of enrolments in colleges and universities has almost tripled since 1980. In order to meet the growing demands of the industrial work force, the number of public training institutes which introduced vocational training has increased to about 87 at the end of 1993 [21].

In order to promote the receptivity of foreign technology, the government in Korea adopted various policy measures including designing specific training for upgrading the skills of the labour force, training a large number of engineers and technicians, increasing the number of

research and development institutes to about 1200 in 1991, establishing science and technology parks, and through the financing of technology development programmes and institutes [22]. Moreover, the Korean government has recently formulated a challenging national R&D program, known as HAN project in order to promote the indigenous technological capability and industrial competitiveness with a total investment of about $ 4.6 billion 56% of which make by public and 44% by private sector.

In early 1990s, the Korean economy faced with slowing down in its high growth rate during the past decades mainly because of the stabilisation programs and growing protectionism against international technology transfer which led to lessening of Korea's competitiveness in the world market . The growth rate decreased from about 9% in 1991 to 4.7 % and 3.8% in 1992 and the first half of 1993 respectively [23]. As a recent report about Korea's economy indicates, "1990s have been a period in which S. Korean manufacturers of labour-intensive goods have either moved up market (clothes manufacturers placing greater emphasis on quality and style) or shifted production to countries such as Thailand, or, most recently, Vietnam (in the case of many of the footwear companies), or gone out of business" [24]. Therefore, the declining rate of the growth and exports has made the Korean decision makers to emphasise on establishing a sound institutional framework, to insure the regain their previous competitiveness in the world market [25]. Since the election of President Kim in 1993, the new government in Korea has formulated new industrial policies aimed at improving the competitiveness of rising industries. Moreover, additional policy measures have also been undertaken to facilitate technological innovation in the private sector [26].

Having surveyed the success factors of Korea's industrial and technological development, one can generally refer to some factors such as the Confucian ethics (Song, 1990 [27], Nam 1994 [28], US aid in the late 1950s and early 1960s (Edwards,1992 [29]; Haliday,1987 [30]), the effective and supportive role of state (Amsden,1989 [31]; Wade, 1992 [32]; Westphal 1990 [33]; Choi, 1994 [34], Smith 1995, [35]), the role of large industrial enterprises known as Chaebol (Singh 1995 [36], and a set of appropriate industrial and technological policies (Pilat,1994 [37]; Chang, 1993 [38]; Kuznets, 1994 [39]; Koo 1995, [40]). This includes an early transition to export promotion policies from previous import substitution and also the policies which encouraged and facilitated the importation of modern technologies and strengthening its local technological capability. Moreover, Korea's human resource development policy has also played a significant role in providing the high-

skilled labour force needed for the absorption and assimilation of foreign technologies. One can also add Korea's efficient macro economic policies which enabled this country to have the relatively stable economic situation required for successful development.

However, it should be noted that the Korean success can not be only the result of a single factor, but a combination of inter-related factors and supportive government policies. It can be said that the successful experience of Korea in its rapid industrial and technological development can offer valuable lessons for other developing countries. Some of the Korea's success factors can be attributed to its own specific capabilities including high-skilled labour force and well-developed infrastructure and therefore may not be replicated by the other LDCs with different characteristics. As Robert Lucas (1993) also noted "simply advising a society to follow the Korean model is like an aspiring basketball player to follow the Michel Jordan model" [41]. The Korean experience may be unique in the sense that it was supported by a set of specific capabilities, but this does not mean that it is irrelevant for other countries with relatively different histories.

Therefore, without doubt, Korea's industrial and technological policies in past decades which led to its very rapid growth can imply useful lessons for the decision makers in the other developing countries. As indicated earlier, the technological development strategy pursued by Korea in the process of its industrialisation has been the introduction of appropriate technology from developed countries for assimilation and improvement while simultaneously promoting the development of a domestic technological capability. This can also be considered an effective technology transfer policy for the other developing countries that intend to follow the same pattern of industrialisation and technological development. Korea's experience in the past few decades shows that the effective absorption and assimilation of foreign technology is necessary for a successful expansion of exports. In other words, an adequate supply of appropriate technologies is an essential factor that enables industry to produce goods and services for the international markets. Korea's science and technology development policy also suggests the development of capacity for the proper selection, assimilation and adaptation of imported technologies [42]. This, as the Korea's experience shows, can be achieved through designing some regular programmes for training the labour force and upgrading their skills, increasing the research and development activities, selecting the most appropriate channel for transferring technology based on the national demands and capability, and establishing some institutions to formulate and support

national science and technology policies.

The importance of strong outward-looking, market-oriented, and export promotion policies in the rapid economic and industrial development of Korea also suggests that the adoption of an export-oriented strategy is regarded as a crucial element for a developing country which intends to build up a modern industrial base through obtaining foreign exchange needed to finance transferring modern technologies. As Korea's experience in the adoption of strong export promotion policy indicates, this strategy encouraged the Korean local firms to invest heavily in technology transfer activities in order to get access to high and advanced technologies which enable them to compete in the international market. The adoption of an effective export-oriented policy also led to the acquisition of technological capability in existing simple and labour-intensive industries in Korea's early stage of industrialisation and also establishing of new modern and capital-intensive industries in the later stage. Furthermore, expansion of exports also accelerated the process of catching up technologically by allowing imports of goods embodying new technology. Therefore, pursuing an outward-oriented and export promotion policies can be generally viewed as an effective incentive that accelerates the accumulation of human capital and foreign technology [43].

Despite the significant effect of the export expansion in the rapid industrialisation of Korea, this strategy has been criticised by some authors who blamed it as a cause of technological dependency [44]. They believed that the emphasis on export-oriented production often led to the importation of a substantial amount of foreign inputs needed for producing intermediate goods. In 1990, 22.4 per cent of goods manufactured in Korea were based on foreign technology (foreign parts and inputs needed to produce manufactured goods), compared to 6.2 per cent in Japan, and 1.6 per cent in U.S. Also of total Korea's total exports in 1990, 55 % were based on foreign technology [45]. It should also be noted that despite the significant effect of the export promotion policy in the Korea's rapid industrial and technological development, however, in a very highly competitive international market environment and existence of many strong competitors, this strategy may not be easily implemented by some LDCs which lack the competitive advantage to compete in the world market.

It is believed that industrial development in Korea has also been influenced to a great extent

by the guidelines of the Five-year Economic Plans since the early 1960s. The series of consistent five years development plans assisted Korean decision makers to formulate flexible and efficient short and long-term development policies in order to achieve the high rate of economic growth and industrial and technological development. A constant upgrading of the industrial and technological infrastructure through the introduction of a substantial amount of foreign technologies together with the promotion of local technological and managerial capabilities, were among the main strategies in the context of the science and technology policies in the Korea's five-years development plans. A significant point in the process of policy making is that on the one hand Korean policy makers usually adopt a top-down approach, which despite several groups including many experts and economists, and representatives of the private and labour sectors are consulted in the designing of the five-year development plans and annual budgets, decisions are made quickly at the very top level. The top-down decision making seems to be necessary for Korea to catch up with the advanced technologies in a short period of time and with a lesser costs. On the other hand, Korean decision makers favour the "trial and error" approach which enable them to either admitting the policy if successful or withdrawing it in the case of achieving unsatisfactory results.

Korea's experiences in liberalisation and implementation of Heavy and Chemical Industrialisation drive may also have some useful implications for other LDCs. As the experience of S. Korea shows, the private sector should be encouraged to finance its own research and development activities. Moreover, high priority and more investment should be allocated to those R&D activities involved in the adaptation and assimilation of foreign technologies rather than on initially adopting and creating them. Although the state played a very effective role in leading Korea towards attaining a high growth rate in particular in its earlier stage of industrialisation, however, much of the Korea's success can be attributed to its efficient liberalisation program or the freeing of market from government control. Moreover, despite different point of views about whether Korea's experience of the Heavy and Chemical Industrialisation drive during the 1970s and 1980s was successful or not, it can be generally said that much of the significant export performance of the 1980s can be regarded to a large degree as a result of the implementation of HCI drive in the previous decade. For example, the implementation of HCI program enabled Korea to become the world's second largest shipbuilding power and world's third biggest producer of advanced

semiconductor memory chips and a major exporter of construction and engineering services, steel and automobiles by the late 1980s [46].

Korea's human resource development policy and heavy investment in the education and training of its labour force can also be considered as another important factor contributing its success. The fact that Korea had the highest number of the secondary students by the late 1970s as a percentage of the total post-secondary age population; the highest number of scientists and engineers per million people; and the highest number of researchers among the other NICs, indicates to the large amount of investment which has been allocated to the development of its human resources by the Korean decision makers [47].

Country	Degrees	Total	Science	Engineering	Engineering Science
Korea (1993)	Master's Ph.D Ph.D/Master's	6,874 1,189 0.17	2,381 489 0.21	4,493 700 0.16	1.89 1.43
United States (1989)	Master's Ph.D Ph.D/Master's	52,267 14,620 0.28	13,985 8,929 0.64	38,282 5,691 0.15	2.74 0.64
Japan (1990)	Master's Ph.D Ph.D/Master's	16,101 2,804 0.17	2,984 835 0.28	13,117 1,969 0.15	4.40 2.36

Table 4.3 The Master's and Ph.D degrees in science and engineering among Korea, U.S. and Japan

Source: OECD, 1996.

Total expenditures for education amounted to 13.3 per cent of GNP in 1984, including both private (6.9 per cent) and public (6.4 percent) spending. This is much larger than the Japanese figure of 5.7 per cent in 1982, and the American figure of 6.7 per cent in 1981. [48]. The percentage of high school graduates advancing to colleges or universities in Korea has been the second highest in the world after United States in 1990 [49]. Moreover, as indicated in the table 2, having compared the number of master's and PhD degrees in science and engineering, one can find that the ratio of PhD to master's degrees is nearly equal to that of Japan and slightly lower than with the United States [50].

According to other statistics, Korea's adult literacy rate (93.7 per cent), was almost as high as Japan (99.7 per cent) for 1985 and more than twice as high as India (43.5 per cent), is

one of the most important elements in assimilating foreign technologies [51]. Moreover, the increasing number of Korean graduates studying abroad and returning home has also played an important role in transferring technical and managerial skills into the country. Therefore, the promotion of Korea's technological capability to a large extent has been achieved by its effective human resource development, as well as technology transfer policies and increasing research and development activities. The large stocks of scientists, engineers, technicians and skilled workers enabled Korea to assimilate and absorb imported technologies more efficiently. Furthermore, Korea's heavy investment in development of its human resources accelerated the country's rapid growth rate of industrial and technological capability from the early stage of the industrialisation. Korea's significant expansion of education at all levels, has been accompanied by increasing public and private research and development expenditure as a percentage of the GNP which reached to 2.3 % in 1993 from 1.7% in 1988 [52]. The share of private investment in R&D activities increased from 20% in 1975 to 80% by 1990. This rapid increase in the share of private R&D expenditure in Korea is mainly due to the necessity of the Korean firms to increase their R&D activities which enable them to absorb and assimilate modern and complex technologies more effectively. In addition, some Korean firms started to undertake their own technology innovation, such as in the development of some electronic components and products [53].

Despite relatively high R&D expenditure as a percentage of GNP and the existence of a large number of scientists and engineers, Korea needs to allocate more investment on the R&D activities in order to catch up with the more advanced countries. Therefore, the Korean government has formulated a long-term plan known as "Science and Technology toward the 2000s", which aimed to increase R&D investment to 5% of its GNP by the year 2001. According to this plan, the number of scientists and engineers will reach 30 persons per 10,000 of population and about 150,000 scientists and engineers will be engaged in research and development by the beginning of the 21st century [54]. Therefore, it can be said that, in a country like Korea with its limited land and natural resources and high population density, it is skill and brainpower which will provide the base for national development [55].

As indicated earlier, the government played a very crucial role in the Korea's rapid industrial and technological development. The government in Korea adopts a set of appropriate policy

measures in order to accelerate the pace of transition to an industrialising country. The government intervened very efficiently in the creation of an adequate industrial infrastructure and a stable macroeconomic environment needed for promotion of indigenous technological capability and effective absorption of the imported technology. It is argued that the Korea's successful adaptation of foreign technology has been to a large degree as a result of the supportive role of the state through introduction of various policy measures including heavy investment in R&D activities, and formulation of effective regulations and law [56]. A significant characteristic of the Korean government is its adoption of market friendly policies which can be categorised in three aspects of promoting of exports; its supportive role of more efficient industries; and its relatively small degree of price distortions [57]. The other important aspect of Korean government, as mentioned earlier, has been the flexibility and adaptability of policy making. The Korean government has been very flexible in the case of changing the policies very quickly when they were found to be ineffective. This flexibility assisted Korea to overcome such crises as the two oil price shocks of 1973 and 1979 which caused serious financial problems for the Korean government. The authoritarianism has also been another specific characteristic of the Korean government, in particular in its early stage of industrialisation when General Park Chung-Hee ruled the country during the period between 1963-1979 [58].

It is argued that Korea used the lessons of the Japanese experience very effectively in formulating its own policies in the past. The industrial and technological development approach in both Japan and Korea is similar in their process of catching up with the more advanced countries through promotion of technological capability and industrial infrastructure. Moreover, the government played a very important role in the process of industrialisation in both countries through effective mobilisation of capital, planning sector development, and controlling the corporate investment pattern [59]. Despite the replication of Japanese model in many aspects of Korea's industrial and technological development policies, there were some important differences. For instance, although both Korea and Japan followed the same pattern of industrialisation in their early stage of industrialisation, however, in the later stage, Japanese policy moved away from state intervention earlier and quicker than it happened in Korea, focusing instead on information sharing and co-ordination, and on indirect, functional support for new activities [60]. A survey by the Korean Advanced Institute of Science and Technology (KAIST) regarding the level of

Korean technological capability shows that the average time lag in the development of technologies between Korea and Japan is four years. It also indicates that Korea is five years behind the world leaders in advanced technology in comparison with average time lag of 10-15 years in late 1970s [61].

In sum, Korea's industrial and technological policies can offer useful implications for policy makers in other developing countries. Despite several general features in Korean experience that can be applied to the other LDCs, however, it seems difficult for some LDCs to replicate the Korean model. This is mainly because the conditions that fuelled Korean rapid industrial and technological development may not exist in many LDCs. As indicated earlier, some of the Korea's success factors such as its institutional characteristics including high level of education and well-developed infrastructure, etc seem to be yet unique to Korea.

4. 3 TAIWAN

The successful experience of industrial and technological development in Taiwan, as another first-tier East Asian NIC, has shared several common features with South Korea. Having looked to the successful experience of Taiwan in the last four decades, like S.Korea, Taiwan adopted an import substitution policy in its early stage of industrialisation which emphasised the promotion of an indigenous industrial infrastructure and self-sufficiency. However, Taiwan switched to the export promotion policy earlier than S.Korea in the late 1950s aiming at the expansion of exports, in particular manufacturing exports to achieve industrial and technological development and increase its foreign reserves. The share of manufacturing products to total exports increased from 9.3 % between 1952-55 to 44.1% between 1961-65 [62].

Most of Taiwan's industrial exports in the 1960s consisted of textiles, garments, footwear products. In the 1970s, export promotion continued to be major drive of Taiwan's industrialisation policies which were followed by the Heavy and Chemical Industrialisation drive in mid-1970s. However, the implementation of the HCI drive is believed to be slightly different from that of S.Korea. While the HCI drive was considered as a method to promote the competitiveness of Korea's manufacturing exports, Taiwan used it more for strengthening its existing industries. Moreover, while S.Korea concentrated more on the development of its basic materials such as iron and steel and petrochemicals, in Taiwan it

was machinery industries that led to the shift of industrial activities toward the HCI drive of 1970s. It is also believed that heavy industry in Korea has been twice as capital intensive as heavy industry in Taiwan [63].

In 1980s, Taiwan entered the second stage of export promotion through continuing the implementation of various export incentive measures including tax rebates, low interest export loans, and further expansion of export processing zones [64]. As a result of these policy measures, Taiwan's trade surplus reached $ 15.6 billion in 1986 and its foreign exchange reserves exceeded $77 billion at the end of 1987 [65]. By early 1988, Taiwan also ranked sixth in the world in terms of product value, accounting for almost 4 % of total world production. Taiwan's major exports in 1986 included electronics products (15.7%), garments (13%), textile products (10.2%), metals (5.3%), and other manufactures (10.8 %) [66]. Like S.Korea, Taiwan also implemented liberalisation policies in the 1980s aiming at privatisation of infrastructure services. However, unlike the experience of Korea in privatising wide range of services, the process of privatisation in Taiwan was slow due to the lack of private sector participation in infrastructure services. In the early 1990s, the Taiwanese authorities formulated the six-year National Development Plan to provide the country with the modern industrial infrastructure needed to promote the indigenous technological capability and its overall productivity. The plan invested a total of $ 303 billion for 775 projects including a high-speed railway, highway expansion, petrochemical plants, infrastructure for heavy industries, and the development of science and technology. The plan also projected to increase GDP per capita from U.S. $ 8000 in 1990 to U.S. $ 14000 in 1996 and the total exports of U.S. $ 122 .8 billion in 1996 [67].

Having surveyed the overall success factors of the Taiwan's rapid industrialisation, one can refer to some general factors such as the U.S. and Japanese aid in the period between 1950-1965 (Tsai, 1995 [68]), the Confucianism ethic [69]; Brick, 1992 [70]), the relatively well-developed infrastructure established during the Japanese colonial period (Brick,1992; Tsai,1995), the effective and supportive role of government (Pang,1992 [71]; Tsai 1993 [72], Chu 1994 [73], Yu (1995) [74]; the appropriate industrial policy including an early switch to export-promotion policy (Kuo, 1983 [75]; Chou, 1985 [76]; Lin, 1994 [77]), and the intensive human resource development policies (Lin 1994; Dollar and Sokoloff 1994). As mentioned earlier in the case of Korea, it is not only a specific factor which led to their success, but a combination of the above factors that resulted in their significant prosperity.

However, various authors have emphasised one particular factor as most effective and important for the rapid industrialisation of Taiwan. For example, in a survey of industrial policy, productivity growth, and structural change in manufacturing industries in both Taiwan and S.Korea, Dollar and Sokoloff (1994) believe that a rapid accumulation of physical capital, human capital, and technology has been the key element of their success [78]. Chu (1994) in his study of the role of state in the development of Taiwan's petrochemical industry argues that despite the significance impact of market mechanism on Taiwan's successful experience, the state played a leading role in fostering the rapid growth rate of the country. He concludes that the success of Taiwan and other NICs can mainly be attributed to the use of both market mechanism and state intervention [79]. Tsai (1995) also refers to the effective development and utilisation of human resources as the most significant factor of Taiwan's success [80]. Kuo (1983) on the other hand, refers to the adoption of export promotion policy as a major contribution to rapid development of Taiwan [81].

One can see that there is commonality in many success factors of Taiwan and S. Korea's rapid industrial and technological development. However, there have been slight differences in some aspects such as the methods of technology transfer, the role of the state, and the scale of their industrial enterprises. Like Korea, much of technology has been transferred to Taiwan through importing capital goods and machinery. However, while S. Korea pursued restrictive policies towards Foreign Direct Investment at an early stage of its industrialisation, Taiwan encouraged the flow of FDI through the open door policies and introduction of various incentives for foreign investors including tax rebates, reduction of custom duties, profit repatriation and establishing EPZs [82]. Taiwan has also employed licensing agreements, imitation, technology cooperation agreements and international subcontracting as the other methods of acquisition of foreign technology [83].

Moreover, while the government intervention in both countries has played a significant role in developing adequate infrastructure needed for strengthening their rapid industrial and technological development, it is argued that the government in Taiwan has been less interventionist, and more moderate compared with the Korean government. The government in Taiwan has also more actively encouraged the decentralisation of industrial activities, which enabled Taiwan to a maintain a more labour-intensive growth pattern than Korea, achieving higher employment rates and distribution of income [84]. The state in Taiwan also seemed to manage the processes of foreign technology acquisition in such a way as to

maximise the impact of this technology on the local economy [85]. Moreover, while in S. Korea the government has tended to enforce its policies on larger-sized enterprises, the Taiwanese state exercised less direct control over private firms and has intervened in key industrial sectors through a large number of small-scale firms.

It is argued that the export promotion strategy has been instrumental in both Taiwanese and Korean successful experience of industrial and technological development. As indicated earlier, Taiwan changed its previous import substitution policy sooner than S.Korea. Since adopting an export-oriented policy in the late 1950s, the Gross National Product (GNP) and industrial manufacturing of Taiwan has grown by average annual rates of 8.9 per cent and 13.4 per cent respectively. The share of manufactured products in total exports increased from 28 % in 1960 to 77 % in 1970 and reached to 95.9 % by 1993 [86]. It can be said that the existence of abundant and cheap labour force in both S. Korea and Taiwan has played a very important role in the expansion of exports in their early stage of industrialisation. However, while S.Korea emphasised more on the use of abundant labour as the major input factor of export promotion policy, Taiwan attributed to higher degree of skill and capital intensity in its export products. This is mostly due to the appreciation of Taiwan national dollar against U.S. dollar in 1980s, which resulted in a higher wage increases in Taiwan in comparison with S. Korea. Moreover, as indicated earlier in the case of S.Korea, the significant export performance in both countries in their early stages benefited from the appropriate environment in the world economy during the 1960s and 70s. Therefore, with the very competitive international market in recent years, it seems difficult for some LDCs as a new comers to replicate and follow the successful experiences of Korea and Taiwan's export promotion policies.

The Human Resource Development policy (HRD) has also played a vital role in Taiwan's success. The Taiwanese authorities paid great attention to design various programs for promotion of high-level education and skills and training scientists and engineers needed for successful assimilation and absorption of imported technologies. The heavy investment in education at all levels has been the core of Taiwanese policy makers with allocation of about 15% of central government budget to the education. In addition to increasing rate of public expenditure per student which amounted to NT $ 16,000 at the primary and NT $ 26,600 at the secondary level in 1986, the vocational education and training has also been expanded considerably in order to meet the increasing demands of industry sector [87].

The importance of vocational education within Taiwan's overall educational policy led to an increase in the number of students in vocational high schools which has been twice that of students in academic high schools in 1991-92 [88]. Moreover, Taiwan has one of highest number of graduates in science and technology, which the ratio of S&T graduates to total graduates increased from 43.3% in 1972 to 57.4% in 1992 [89]. Furthermore, the total expenditure on R&D activities has increased from 0.48 % of GNP in 1978, to 1.65% in 1990, which grew at an average annual rate of 12.1% [90]. Taiwan also set up the Hsinchu Science-based industrial park followed the development of high-tech industry at Silicon Valley in the U.S. in order to attract more foreign investment and high-technological and managerial skills [91].

Having compared the success factors of S.Korea and Taiwan, it can be seen that while for S.Korea, foreign capitals (heavy foreign borrowing), the big business conglomerates, and state interventions have been among the main factors of its success, in Taiwan, foreign direct investment, small and medium enterprises and its appropriate development policies have played a key role in its success. As is mentioned earlier in the case of Korea, Taiwan's model of rapid industrial and economic development can also have valuable lessons for other developing countries. However, it seems difficult for other less developed countries to duplicate Taiwan's development strategies, since every country has its own institutional and cultural characteristics and a unique set of factor endowments. Nevertheless, while Taiwan's experience is unique, being the result of a number of different factors, its development process presents features that may be applied to other LDCs trying to build up their economies. Thus, it can be said that many of Taiwan's success factors and experiences can be very useful for the other less developed countries.

LDCs can learn from the development experience of Taiwan that the government of a country must have long-range and flexible plans which can serve as a blueprint for gradual and evolutionary development in order to make a direct effort to the rapid development and modernisation. The fact that Taiwan and S.Korea adopted and adapted successfully the Japanese model of industrialisation shows that the other developing countries can replicate this model for their own countries. Moreover, it should be noted that a number of countries in particular those of second-tier East Asian NICs have been able to follow successfully the Taiwanese and Korean model of technological and industrial development. This will be discussed in more detail later.

Some policies such as heavy investment on the development of the quality and quantity of its human resources, promotion of the export industries, the significant role of the state in choosing appropriate policies and strategies and strengthening its technological capability by transferring technology, are among the most important and vital policies which might be relevant to most, if not all, developing countries. Taiwan's experience also showed that, in order to strengthen technical capability, LDCs should invest heavily in the restructuring of the industrial and technological infrastructure; import massive foreign technologies together with allocation of high expenditure as a percentage of GNP in R&D activities. Like S.Korea, the Taiwanese policy makers have emphasised on designing a technology development strategy which is based on the building up a self-sufficient industrial and technological infrastructure through heavy investment in industrial research and development activity and promoting the absorption level of imported technologies. Therefore, Taiwan's experience in formulating an overall national science and technology policy may suggest that in order to design an appropriate national technology strategy, LDCs' policy makers should pay special attention to such important aspects as the upgrading infrastructural and overall R&D capabilities through introducing various financial incentives and supportive measures including establishment of EPZs and industrial parks and adopting appropriate mechanisms for importing foreign technologies.

Yu (1995) argues that LDCs may be able to draw useful implications from Taiwan's experience. In his view, the key elements of Taiwan's success which can have some important lessons for other developing countries are: the strong and efficient role of government (policy making is best done by a group of experts, advisors and administrators); reasonable economic strategy; effective use of foreign capital and technology; attracting foreign investment; adopting export-oriented strategy and effective human resource development policy [92]. Another lesson which can be learned from Taiwan's development experience, as Tsai (1993) has noted, is that in the absence of an already established democratic political system, an authoritarian regime, particularly a "soft" authoritarian regime like that of Taiwan, might assist a country in ensuring the stable political and social environment necessary for industrial and technological development. Such a regime should be prepared to use its authority to encourage economic growth. In other words, authority and power should only be the means to economic development and political modernisation, not an end in themselves [93]. However, it is argued that some differences in the

development strategies of Korea and Taiwan during the past decades can be attributed partly to a relatively difference in their political systems. While most industrialisation policies in the early stage (1962-1979) in Korea were directed by a strong military ruler with a relatively democratic nature, there has been a one party structure in Taiwan with a relatively soft authoritarian nature.

The successful experience of Taiwan in its rapid industrial and technological development also shows that Less Developed Countries (LDCs) should not rely on policies which only aim at protecting selecting industries, but they should also choose a directed market approach which allows for development to take place in all sectors and leads to substantial productivity and growth rates, technical diffusion, increased employment, and thus to a balanced share of income and to a political and economic stability [94]. Taiwan's experience is thus most directly relevant to countries willing to accept the social and political consequences of growth and willing to allow an economy that, while mixed, is primarily market-oriented [95]. Taiwan's experience also suggests that, for establishing national programs of some strategic technologies aiming at commercial applications, an overall development framework to upgrade the infrastructure and general capabilities is needed.

Finally, the Taiwan case shows that, under certain circumstances, it is possible for a less developed country to move up the technological ladder from the primary stage of technology importation to the advance stage of technology production and innovation. In conclusion, the successful development experience of Taiwan shows that a society with limited resources, and a dense population, would be able to achieve significant results in the industrialisation process through long-term planning and concerted effort. Having considered Taiwan's experience of very fast transition to a newly developed country and assuming that the very rapid growth rate of East Asian countries such as Taiwan continues in the future, as Brick (1992) predicted, there likely will be a shift of economic power away from Europe and North America to the western Pacific by the middle of the twenty-first century [96].

4. 4 MALAYSIA

Malaysia can be ranked among the second-tier East Asian NICs with an abundant natural resources including rubber, palm oil, tin, petroleum and natural gas. However, having

considered some of its current economic and industrial indicators, such as an annual average growth rate of GNP (9 %) in the early 1990s, the share of manufacturing in GDP (31.5%), the share of export-oriented to total manufacturing (50%), and per capita income ($ 2,182), Malaysia can be categorised as a first tier Newly Industrialised Country (NIC) [97].

	1970	1980	1985	1990	1991	1992	1993
GDP ($ billion)	4	24.5	31.2	42.7	47.1	58	64.4
GDP growth rate (%)	4.5	7.4	-1.1	9.7	8.7	7.8	8.5
Total exports ($ billion)	1.7	12.9	15.4	29.5	34.4	40.7	47.1
Manufacturing exports (% of total exports)	13.4	22.4	32.8	58.8	64.9	68.9	74.3

Table 4.4 Some important macroeconomic indicators of Malaysia during period between 1970-1993

Source: Bank Negara Malaysia, Quarterly Bulletin, Dec 1993,

Like many other LDCs, Malaysia adopted an import-substitution strategy in its early stage of industrialisation, which involved assembly, packaging and producing of goods and products previously imported from abroad. Import substitution has also been conducted by introducing protectionist measures such as high rates of tariffs and quotas with the main objectives of supporting infant industries, replacing import of consumer goods with domestically produced materials, and creating employment opportunities for its labour force. However, it is argued that IS policies led to inefficient utilisation of local resources, and a saturated domestic market and therefore failed to create a manufacturing sector capable of competing in the international market [98]. Malaysia shifted to an export promotion policy with the introduction of the Investment Incentives Act in 1968, which was associated with the introduction of the government's New Economic Policy (NEP) in the early 1970s. This was followed by the Industrial Co-ordination Act (ICA) of 1975, aiming at such broad objectives as increasing income and employment of all Malaysians, accelerating the process of restructuring the Malaysian economy, and developing the labour-intensive manufacturing exports.

Following the adoption of the export promotion policy, the Malaysian government implemented various policy measures mainly through establishing Free Trade Zones (FTZs) in order to raise manufacturing exports. Exporters have been exempted from custom duties in these zones for importing components and equipment needed for producing

manufacturing exports [99]. As a result of these policy measures, Malaysia experienced a period of favourable economic and industrial growth with manufacturing value added mainly in food-processing, electrical machinery and textiles grew with an annual average growth rate of 11% during the period between 1971-1975, and the share of manufacturing in GDP increased from 12.2% in 1970 to 14.4 % in 1975 [100]. Moreover, the total exports grew with an average annual rate of 18.4% and the share of manufacturing exports in the total export value almost doubled in the 1970s [101]. While Malaysia relied mostly on the export of the processed natural resources such as tin, rubber, and palm oil in the early stage, after 1970s, the food processing, textiles and electrical and electronic products accounted for the majority of its export growth [102].

Due to a decline in Malaysia's economic performance in the early 1980s which was mainly as a result of world recession in that time and a sharp decrease in the price of Malaysia's major export products including rubber, tin, palm oil and petroleum, the new government in 1982 adopted some specific policies and plans for regaining export competitiveness in the international market. Therefore, privatisation and liberalisation policies became important components of the new strategy since 1983, with the main objectives of increasing the role of the private sector through reducing the role of government in direct economic activity, increasing the quality, efficiency and productivity of the manufacturing products, and assisting the national goal of redistributing wealth in the economy [103].

Moreover, with the implementation of the heavy industrialisation drive which replicated the Korean HCI drive of 1970s, a large number of heavy and capital-intensive industries including integrated steel mills, petrochemical complexes and the automobile industry were established. However, despite several common features between the Malaysian heavy industrialisation drive with that of S.Korea in 1970s, there have been some major differences in their objectives and implementation. For example, as indicated earlier in the case of Korea, the main objective of the Korean HCI drive was creating new bases for the diversification of manufacturing products in order to increase their competitiveness in world market, while Malaysia's heavy industry activity was focused on the domestic market in order to achieve two not very compatible objectives of accelerating the pace of industrialisation and redistributing national income to all Malaysians [104]. Moreover, while in Malaysia small-scale public enterprises mainly involved the implementation of heavy industries, in Korea, the drive was led by the large conglomerates known as Chaebl [105].

It is also argued that Malaysia followed the Japanese and Korean model of industrial and technological development through the adoption of its "look-east" policies in early 1980s. The main reason for the Malaysian look east policy is believed to be because of sharing several common features with these countries in particular in the cultural and traditional values which encouraged productivity, hard work, and financial discipline as prerequisite for their successful economic and industrial growth. [106]. Moreover, a sharp increase in the amount of tuition fees for overseas students in UK universities which had a large number of Malaysian students in the early 1980s, caused policy makers in Malaysia to retaliate by moving their trade activities towards Japan and East Asian NICs from UK and western countries. The highest share of Japan as a major supplier of technology in Malaysia can be also attributed to Malaysia's look east policy. The close cultural and economic linkage with the other East Asian countries like Japan and S.Korea assisted Malaysia to adapt, assimilate and absorb their technologies more easily and quicker than other foreign technologies.

However, as Edwards (1992) argues, there were some differences within a socio-political and historical context of the S.Korea and Malaysia which may make it difficult for the Malaysian policy makers to replicate the Korean Model. For example, there was a relatively well-developed industrial infrastructure in the post colonial period in S.Korea in comparison with that of Malaysia after its independence in 1957. Moreover, the ISI in Korea was adopted earlier than Malaysia, and despite the nearly equal GDP in 1965, the share of industry sector was 18% in comparison with 9% in Malaysia. Furthermore, the geo-political condition of S.Korea varied remarkably from that of Malaysia. While Malaysian society consisted of different ethnics, Korea benefitted from homogeneous society. Therefore, Malaysian state has not had the same autonomy as that of S.Korea. In addition, while the main factor attributed to the successful export performance of Malaysian manufacturing exports was the establishment of Export Processing Zones (FTZs), exports from S.Korea were mainly build up from a base of producing for a protected domestic market [107].

Among the other industrial policies which have been implemented by the Malaysian government in 1980s, one can refer to the Industrial Master Plan (IMP) for the period between (1985-1995), with the new long-term objectives, such as increasing indigenous technological capability through the further utilisation of the country's comparative advantage and development of its resource based industries. It is argued that the

introduction of IMP enabled industries in Malaysia to identify their strength and weaknesses. Some of the major constraints in the process of Malaysia's industrial and technological development have been recognised, such as heavy dependency on the import of components and parts required for manufacturing the products, or technological dependency; lack of adequate indigenous technological capacity; shortage of engineers and technicians; and inadequate incentives for technological development.

Following the introduction of the Promotion of Investment Act in 1986, various incentives and policy measures were implemented including investment tax reduction, allowing 100% foreign equity ownership, and incentives for research and development, aiming at promoting private and foreign investment activities [108]. These policy measures had some significant impacts on the Malaysia's overall economic and industrial growth performance in the late 1980s and early 1990s, in particular remarkable increase in the manufacturing exports which reached to a total of $ 34 billion in 1993 and exceeded the IMP export target [109]. In 1991, the National Development Policy (NDP) replaced the New Economic Policy (NEP), with the main objective of making Malaysia a fully industrialised country by the year 2020. This objective known as "vision 2020" is supposed to be achieved by implementing a number of strategies including more investment in R&D activities (increasing R&D expenditure per GNP to 2 per cent by the year 2000), further support policies for human resource development, attracting more FDI, and continuing the promotion of indigenous technological capability through the diffusion and assimilation of foreign technologies. The sixth Malaysian plan (1991-1995) was also formulated to focus on the promotion of the general level of national productivity specially through accelerated scientific and technological development [110]. Moreover, the current Malaysian plan (1996-2000) emphasises more the strategic and high-tech industries including automated manufacturing technology, advanced materials, bio-technology, electronics, and information technology.

However, it can be said that a large amount of effort needs to be taken in order to overcome some problems and constraints in achieving the vision 2020. As yet, there are some specific points which are prerequisite for Malaysia in reaching the level of industrialised nations. Special attention should be paid for promoting the level of absorptive capacity of foreign technologies which is far behind that of advanced countries and even NICs. This requires the allocation of a substantial amount of investment in R&D activities which was only about 0.8 % as a percentage of GNP in 1989 compared with 1.4% and 2.1% for Taiwan and

S.Korea respectively. Moreover, Malaysia lagged behind the other first-tier NICs in the number of technicians and engineers. Therefore, it needs to be a significant increase in the number of institutions for technical and vocational training in order to train adequate skilled engineers and technicians needed for closing the gap. Furthermore, in order to keep its manufacturing competitiveness in a very competitive international market, it seems essential for Malaysia to strengthen the introduction of strong export policy measures towards the manufacturing of those products which it has the most comparative advantage. This in turn depends on the efficient allocation of the Malaysia's abundant natural resources. Malaysian comparative advantage in many technology-intensive products seems more developed than that of other East Asian second-tier NICs such as Thailand and Indonesia [111].

In sum, having surveyed the success factors of Malaysian economic and industrial development during the past three decades, one can refer to some general reasons such as its rich endowment and natural resources (in its early stage of industrialisation), adoption of export promotion industrialisation policy, the existence of adequate infrastructure and industrial facilities in particular its labour-intensive industries such as electronics and textiles, the high level of FDI, and the role of government in directing the industrialisation process through a set of effective industrial and technology development strategies. The overall stability of socio-political and macroeconomic environment despite the existence of different ethnic, cultural and religious composition of its society has also played a vital role in the Malaysia's success and can be a model for inter-racial co-operation and harmony for other LDCs [112]. Moreover, as Dr Mahatir Mohammad the Malaysian Prime minister since 1981 stated, the privatisation policies in 1980s and the close cooperation between government and industry through the "Malaysia Incorporated" concept are among other reasons behind the Malaysia's success story [113]. He also noted that Malaysia's future depends on the improved productivity and the ability to sell more and more goods in the world market [114]. Therefore, one can generally say that like the first-tier NICs such as Korea and Taiwan, Malaysia's experience of industrialisation may also have valuable lessons for other developing countries in particular for those with similar characteristics.

The industrialisation of Malaysia was mainly conducted under the government guidance within the framework of the successive development plans and policies including NEP (New Economic Policy), IMP (Industrial Master Plan) and NDP (National Development Policy). Therefore, it can be concluded that despite the open nature of the Malaysian economy, the

state has played a critical role in creating the required infrastructure for industrial development, providing facilities for private firms, and utilising the country's vast natural resources. As in other Southeast Asia NICs such as Korea and Taiwan, the government has had an important role in the achievement of a strong and efficient manufacturing sector in Malaysia. Therefore, Malaysia's experience of industrialisation especially in 1960s and 1970s suggested to other LDCs the need for a direct and supportive role for government in the establishment of industrial projects and formulation of set of appropriate policies for achieving industrial development.

As indicated earlier, the existence of extensive natural resources in Malaysia, in particular a significant amount of rubber, tin, palm oil and timber contributed to its success through its substantial revenue generation needed for financing development projects particularly in the early stage of industrialisation. However, it is argued that Malaysia did not utilise these resources more efficiently as most of these raw materials were exported to other countries such as S.Korea and Japan in order to be processed into higher value added products. It is also believed that the existence of abundant natural resources can be regarded as a constraint in the implementation of full-scale export-oriented industrialisation from the early 1960s; a strategy which was adopted so vigorously by such resource-scarce countries as S.Korea and Taiwan [115]. Furthermore, the Malaysian economy was seriously affected by a sharp decline in the price of petroleum, palm oil and timber in 1985, when its growth rate fell to 1% from over 7% in 1984. Moreover, more concentration on some specific and resources-based, labour-intensive industries such as textiles and electrical appliances industries of the expense of neglecting the other industries led to a relatively imbalance structure of employment and manufactured exports.

It can be said that the massive flow of foreign direct investment and technology, have accelerated the pace of industrial and technological development in Malaysia. Many technologies have been transferred into the Malaysia through foreign investment and imports of capital goods and machinery mostly from Japanese multinationals. Moreover, other methods of technology transfer including turn-key, technical assistance, know-how and joint venture agreements have also been used by the Malaysian firms. Despite some important effects of foreign technology and investment on the promotion of Malaysia's industrial structure, however, most industrial projects carried out by foreign multinationals involved more the assembly-based industries, contributing little in transferring high value-

added technologies into the country. Moreover, multinational companies and some foreign firms which invested in the Malaysian FTZs, used relatively little local materials (about 5%) for manufacturing the products [116]. However, since the mid-1980s, as Malaysia started to emphasise more the high level technologies in order to close the gap with technological frontiers, multinational strategy has also shifted towards relocation of their industrial projects in Malaysia through subcontracting contracts to decrease their cost of production. Therefore, considerable training programs have taken place by MNCs for Malaysian labour force in order to improve their productivity and absorptive level needed for promoting the competitiveness of their products.

As mentioned earlier in the case of Korea and Taiwan, due to its heavy dependence on the foreign parts and components, the technological dependency has been much higher in Malaysia than these two countries. This is mainly because of lack of a supportive, capital good industry to provide locally produced materials and components. For example, as the world's largest producer of tin, Malaysia has no refining industry to support inputs of its leading manufacturing industry. Moreover, the government regulations and legislations on technology transfer have not been utilised effectively to identify the more appropriate technologies for the local conditions of the country, partly because technology transfer has been processed by administrators lacking the necessary technology background [117]. It should be noted that, as a result of government efforts to reduce the dependency on imports of foreign inputs and components required for the manufacturing of the products, the technological dependency has recently decreased in some specific industries such as the manufacturing of Malaysian national car "Proton Saga" with about more than 60% of its parts are produced locally [for further information please refer to the appendix].

Among the other most important success factors of Malaysia's industrialisation is its overall soci-political and macroeconomic stability which accelerated the flow of foreign investment and technology in to the country [118]. As indicated earlier, despite being a multi-ethnic and cultural society, apart from racial riots in May 1969, Malaysia enjoyed a socio-political environment required for the successful implementation of industrial and economic development policies. As in the other East Asian NICs, Malaysia has also emphasised human resource development policies in order to promote the quantity and quality of education and training of its labour force. However, it should be noted that unlike Korea and Taiwan which possess a large number of engineers and technicians, Malaysia still lagged behind them in

its level of engineers, technicians and skilled-labour. Despite a relatively large number of educated labour, this is not adequate enough considering its long-term objective to become an industrialised economy. It can be said that the shortage of qualified technicians and engineers in Malaysia has remained a major constraint for more effective assimilation and absorption of foreign technology.

In an attempt to overcome Malaysia's shortcomings of high-level and skilful managers, technicians and engineers, the government increased significantly the investment in education and training, in particular in science and engineering and vocational training. For example, the overall expenditure on development of education and training represented a 46 % increase in the sixth development plan (1991-1995) over the level in the previous plan [119]. Moreover, as indicated earlier, the Malaysian government is projected to increase research and development expenditure as a percentage of GNP to 2% by the year 2000 in order to promote the indigenous technological capability. A number of industrial and technology parks have also been established, aiming at enhancing the interaction and collaboration between R&D institutes, universities and private firms; encouraging the development of high-technology industries; and commercialisation of research results [120].

As indicated earlier, like the successful experience of Korea and Taiwan, Malaysian experience of industrialisation can also have useful lessons for other LDCs. As Malaysia followed several industrial and technological development patterns of those of Korea and Taiwan under its look-east policy, it can be said that other LDCs can also follow some particular aspects of Malaysia's experience of industrialisation. Thus, Malaysia shares in several common success factors with those of Korea and Taiwan. These include the role of government in formulating and directing a set of appropriate policies, early shift to an export-oriented strategy from previous import substitution policy, human resource development policy and technology acquisition and development strategy. However, there are also some differences. For example, as indicated earlier, like Korea and Taiwan, the government in Malaysia has also played a key role in the process of its industrialisation. However, the degree of government intervention was less than that of Korea and Taiwan. While government in Malaysia has not been authoritarian as in that of Korea and Taiwan, it has also not been weak and uncertain, as in some less developed countries and thus directed successfully the industrialisation process of the country.

Malaysia also shifted from its previous import substitution policy to the export promotion policy later than that of Korea and Taiwan. Moreover, unlike Korea and Taiwan which are resource-scarce countries, Malaysia as a resource-rich country relying more on the export of its resource-based industries in the early stage of export promotion. Furthermore, there were some differences in the methods of technology transfer in these countries. While, in Korea, many technologies have been transferred through imports of capital goods and machinery, and licensing agreements, Malaysia acquired foreign technologies more through FDI, technical assistance and joint venture agreements. Unlike the Korean and Taiwanese successful experience of the Heavy and Chemical Industry drive in the 1970s, Malaysia's effort to establish and expand heavy industries was relatively unsuccessful, particularly in its first stage in the 1980s. This is mainly because of the world recession of the early 1980s which resulted to a sharp decline in Malaysia's foreign exchange earnings from exports of its resource-based industries such as tin, palm oil and petroleum. Therefore, Malaysia had to finance most of its heavy industries through external borrowing and foreign debt due to the capital-intensity nature of most heavy industries. Moreover, due to a relatively small size of market with about 14 million people in early 1980s, it has not been easy for many heavy industries to operate at a minimum efficient scale of operation [121].

Therefore, Malaysia's relatively unsuccessful experience shows that LDCs should develop a relatively modern small-scale industry base together with preparing an adequate source of skilled human labour required for efficient absorption of heavy and capital-intensive technologies. Moreover, LDCs may also learn from Malaysia's relatively unsuccessful experience in expansion of heavy industries that whenever government intervention is found to be ineffective in the implementation of heavy industries, private enterprises should also be involved in the process.

4. 5 THAILAND

Thailand is another fast growth economy in Southeast Asia with an average real growth rate of 7 per cent over the past three decades. Like its neighbour Malaysia, Thailand is also a resource-rich country with various agricultural and mineral resources which put this country among the world's leading exporter of rice in 1970s, and the second and third largest producer of tungsten and tin. As in the case of Malaysia, Thailand has achieved most of the

criteria which are required to join the ranks of the first-tier NICs and becoming the fifth tiger, since about 1988. Some of these indicators include the period of its double-digit GDP growth rate 11% and 13% in 1988 and 1989 respectively, its share of industrial sector per GDP 32%, and the share of manufactured exports in total exports of 58% in 1988 [122]. However, some other elements, in particular its social indicators such as enrolment in education, per capita GNP and income distribution were not adequate enough and needed to be improved.

It can be said that Thailand pursued relatively similar industrial policies compared with those of Malaysia. For example, Thailand began the industrialisation program by choosing the usual pattern of import substitution aiming at creating an industrial sector producing for the domestic market. Following its capability to meet the local needs to some extent and the saturation of the domestic market with Thai- made products, the industrial policies in Thailand shifted to export promotion policies in the early 1970s. Various export incentives have been given to Thai producers such as tax exemptions and low interest loans and credits, in order to encourage them to export their products. These effective measures and incentives resulted in a significant increase in Thailand exports and particularly manufactured exports. For example, exports of goods grew from 18% in 1965 to 27% of GDP in 1985, and manufacturing exports grew eighty-six times during the period between 1965-1985 [123]. The exports accounted for 25% of Thailand's GDP in early 1980s, which as a result of various export incentives including tax exemptions, reduction in customs duties, and low interest loans, this figure rose to nearly 40% during the latter half of 1980s [124]. The manufactured exports increased from 10 per cent of total exports in 1971 to 66 per cent of total exports in 1988 [125].

It is also believed that Thailand's favourable policies, along with its adequate infrastructure and low cost of labour led to a massive relocation of export industries from Japan and the East Asian NICs, and also attracted a huge inflow of foreign investment. These among other major factors have affected its success in expanding exports [126]. Moreover, the adoption of EPP accelerated the industrialisation of Thailand through some internal factors including implementation of the government's effective policy measures, stable macroeconomic and financial policies, maintenance of strong currency despite its devaluation, establishing Export Processing Zones (EPZs) and also some external factors such as the US aid during the early stage, and the impact of Japan and the first-tier East Asian NICs in providing Thailand both

a source of foreign capital and investment and the effective models of an export-oriented strategy [127].

Unlike Malaysia, which implemented a heavy industrialisation drive in the 1980s, heavy industries have been relatively underdeveloped in Thailand. The latter half of the 1980s witnessed a remarkable economic and industrial growth performance in Thailand with an average two-digit GDP growth rate of 13% and 11% which were among the highest growth rates in the world in 1988 and 1989 respectively. This is mainly due to Thailand's significant export performance and particularly manufacturing exports which amounted to 58% of its total exports in 1988, comparable with 72% of that of Singapore at the same year [128]. Moreover, a large amount of foreign direct investment flowed into Thailand in the late 1980s, making Thailand an appropriate base for the relocation of export-oriented industries by Japan and East Asian first-tier NICs. It is argued that the existence of a low-waged, educated, trainable, disciplined and hardworking labour force enhanced Thailand's attractiveness for FDI and also promoted its comparative advantage for exporting manufacturing products.

As indicated earlier, the significant economic and industrial achievements in the late 1980s smoothed the way for Thailand to join the rank of East Asian first-tier NICs. However, some other elements in particular its low level of engineers and scientists, and imbalance income distribution and infrastructure facilities were among the major indicators which need to be developed. The Thai industrial sector in the 1980s had a higher proportion of light industries, particularly food processing, beverages, leather and rubber products and textile industries. Thailand also lagged behind other East Asian first and second-tier NICs in science and technology education. Several statistics and figures indicate the lack of qualified human resources at all educational levels in Thailand which is also considered to be as a major constrain on the development of technological capability. For example, despite a relatively high literacy rate of more than 86% in 1980, and the rate of school enrollment at primary level of 97% in 1985, the rate of secondary school enrollment was only 30% in the same year [129].

This 30% was one of the lowest in East Asia compared with 94 % in S.Korea, 91 % in Taiwan, 53 % in Malaysia, 71 % in Singapore and 68 % in the Philippines [130]. According to another statistic, the number of scientists and technicians per 10,000 of the population

was only 14 for Thailand, in comparison with 524 for Korea, 256 for Singapore, 78 for Indonesia. It is estimated that by the year 2000, Thailand's shortfall of engineers will range between 10,000 and 30,000 [131]. Moreover, the inadequacy of R&D expenditure as a percentage of GNP which has never exceeded about 0.5%, in comparison with 1.4% in Taiwan and 2.1% in Korea and 0.8% in Malaysia in 1990, has also led to the low absorptive level to adapt the foreign technology to Thai local conditions. Moreover, most R&D activities are conducted by the public rather than private sector, mostly due to the lack of positive measures and incentives from the government to encourage them to invest in research and development.

Therefore, it seems essential for Thai policy-makers to design special programs for upgrading the quantity and quality of the national educational standard, particularly at the secondary and higher education levels in order to meet one of the most important criteria needed to become a first-tier NIC. Thailand's significant economic performance of the late 1980s is continuing in the early 1990s and GDP per capita reached $ 2,388 in 1994, indicating an average annual growth rate of 7.4%. The significant export performance which was the engine of Thai economic growth particularly since the latter half of 1980s, amounted to $ 44.5 billion in 1994, contributing to more than 40% of GDP, and manufacturing exports consisted of over 81.1% of total exports by value in the same year [132]. However, with a current situation of a very competitive international market, some specific science and technology development programs seems to be crucial if Thailand wants to sustain its high growth rate of GDP and manufacturing exports. These programs and policies should focus on areas such as promoting the skills of its labour force through increasing their education and training, expansion of numbers of scientists and engineers through an increase in the number of institutions for higher educations, and enhancing indigenous technological capability through continuing acquisition of technological know-how, the development of local industrial infrastructure, and allocation of more R&D expenditure as a percentage of GNP.

It is argued that industrial and technological development policies in Thailand followed more the Taiwanese model of industrialisation. This is mainly due to the similar cultural background, the existence of a large Chinese community in Thailand and their close geographical location. Therefore, unlike Malaysia which adopted the Korean Model, and relatively neglected the development of an efficient local supply base of parts and

components and suffered from high dependency on foreign parts and components, Thailand has established a relatively strong industrial base which is less dependent on the importation of foreign parts and components. In 1988, Taiwan allocated the highest share of Foreign Direct Investment (FDI) and technology to Thailand with about 28.6 % of total foreign investment. Taiwanese investment in Thailand has been more concentrated in labour intensive industries such as footwear, electrical appliances, ceramics, food processing, textile and toys, due to Thailand's cheap labour, as well as the similar cultural background and the existence of a large Chinese community [133]. It is argued that Thailand had become more or less a large export processing zone for assembling the components and parts imported mainly from Japan and Taiwan [134].

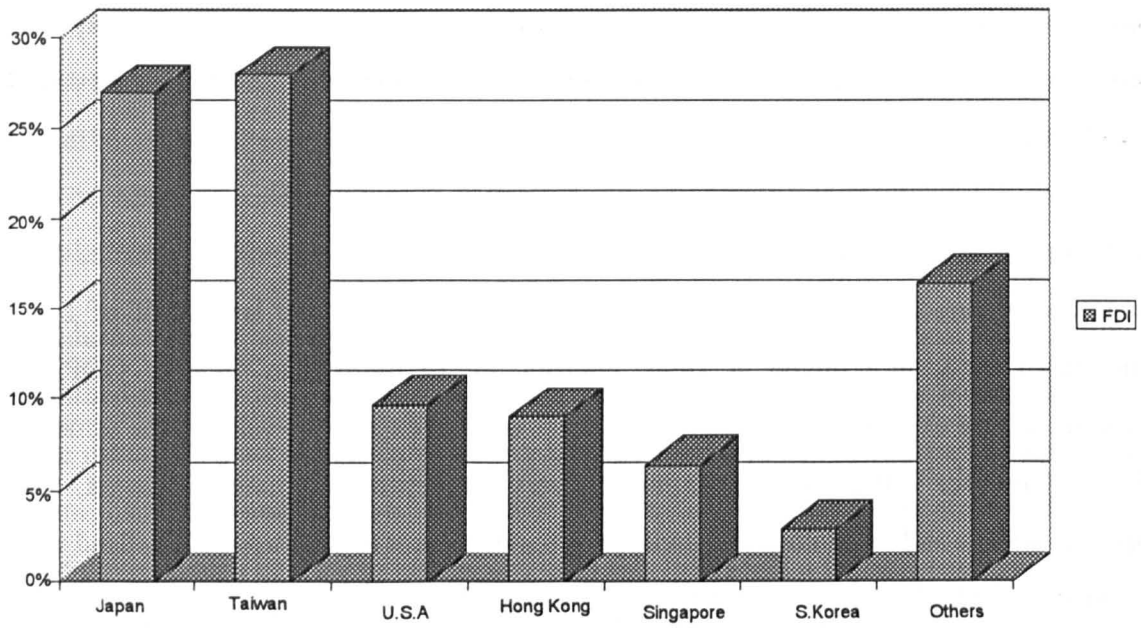


Figure 4.1 Foreign Direct Investment in Thailand in 1988

Source: UNIDO, United Nation Industrial Organisation (1992)

Despite the significant role of foreign investment in the industrial development and transferring technology and managerial skills in the latter stage of Thailand's development, it is believed that most technology has generally been transferred through other channels such as technical assistance agreements, licensing, joint ventures, and purchase of machinery and equipment, in the earlier stage of its industrialisation [135]. For example, compared with Malaysia, FDI played a less important role in Thailand particularly in its early stage of industrialisation. For example, while FDI amounted to about $ 1350 million in Malaysia in 1974, this figure was $ 550 million for Thailand for the same year [136]. Moreover, much

of FDI flow in the early stages has been concentrated in production for its local market and depended heavily on imports of machinery and equipments.

Thailand has adopted open-door policies towards technology transfer, and Thai firms are free to enter into any kind of technology transfer agreement. The importance of technology transfer, in particular high-level and modern technologies, has increased in the 1990s as Thailand is faced with several new competitors such as Vietnam and China in many labour-intensive and simple-technology industries. In 1993, the country spent 14,248.40 million bahts on direct purchase of technology of which 10,408.20 million bahts were for royalty and brand-name fees, and 3,840.2 million bahts were for technology fees [137]. In a recent survey of Thai overall technological capability in the industry sector undertaken by Thailand Development Research Institute (TDRI), the average capability levels were found to be highest in agriculture, bio-technology-based industries, and lowest in the field of electronics [138].

The successful experience of Thailand in rapid transition from an agriculture economy to a Newly Industrialised Country (NIC) can be attributed to some specific factors such as its strong export promotion policies, its rich natural resources, its effective state role in directing the industrial development process, its relatively stable political and macroeconomic conditions and the massive flow of FDI and technology. Moreover, Thailand's effective liberalisation and structural adjustment policies and government's open-door policy towards technology transfer have also been among important elements of its industrialisation experience [139]. Therefore, it can be seen that Thai success factors are very similar with those of neighbouring Malaysia. Moreover, it can be generally said that Thailand's overall experience of industrialisation may also have useful implications for other LDCs, as one can find several common characteristics between Thailand and other LDCs.

Having compared Thailand's industrialisation experience with that of Korea and Taiwan, it can be found that Thai's industrial and technological development has been accelerated with a much greater involvement of foreign investors and MNCs in particular in the later stage, compared with the case of Korea and Taiwan. Moreover, like the case of Malaysia, the degree of government intervention in Thailand has been much lower than those of first-tier NICs such as Korea and Taiwan. The successive governments in Thailand have been the least interventionist in comparison with other East Asian Countries [140]. The role of the

Thai state, like that of Malaysia, has been concentrated more in the provision of infrastructure, introducing some effective policy measures for promoting the flow of FDI and formulating a set of national development plans. In other words, the government has played a more passive role in the industrialisation of Thailand than in Taiwan and Korea. The Thai state has legal control over natural resources and it uses its power to determine how natural resources are to be exploited. Thai government has also been effective mainly in creating favourable conditions for attracting foreign investment. Despite the relatively unstable politics in Thailand, the relationship between state and private sectors has been very stable [141]. Therefore, one can say that while the direct and substantial involvement of the state was critical in the success of Korea and Taiwan, in Thailand on the other hand, it was the limited government intervention which influenced its success.

It is believed that a significant economic and industrial growth performance of Thailand since the second-half of 1980s, has presented a new model of development for other LDCs based on successful implementation of market-friendly and correct liberal economic policies [142]. As Warr (1995) has also noted," explanations for the Thai miracle will probably be found in Thailand's relatively open economic policies with respect to the rest of the world, its relatively free internal markets for goods and for factors of production, and in the relative steadiness and predictability of government macroeconomic policy" [143]. Furthermore, the gradual shift towards export promotion policies through various incentives for exports from the 1970s, and Thailand's stable macroeconomic conditions which enhanced the confidence of local and foreign investors, are among other factors which also contributed to the success experience of Thailand. Compared to the negative growth rate of some developing countries during the post second oil shock period, it is clear that the maintenance of macroeconomic stability was a crucial necessary factor that enabled the occurrence of the rapid growth experiences in the late 1980s. A constant and stable Thai baht against dollar and yen during the last 30 years as well as a low inflation rate have been the most important aspects of Thai macroeconomic stability. As pointed out earlier, Thailand's relatively political stability, its social openness and tolerance, its freedom of markets, and its good record in social development, may also be considered as other success factors.

As Simon (1996) argued, the industrialisation experience of Thailand has benefitted from the successful experience of East Asian first-tier NICs in two ways. Firstly, as indicated earlier, the significant flow of foreign investment from Taiwan and S.Korea in the late 1980s

which relocated labour-intensive industries in Thailand to take most advantage of Thai cheap labour and a relatively suitable infrastructural base and abundant natural resources, led to a substantial transfer of capital, and to a lesser extent know-how and managerial skills. Secondly, many Thai policy-makers have been influenced by the motivation made by several seminars and conferences about the success of East Asian first-tier NICs [144]. However, Thai authorities and economic planners have recently faced a major decision: whether to encourage a NIC's (Newly Industrialised Country) type of strategy based on manufacturing exports from the urbanised central region, which will probably require increasing dependence on foreign investment and technology especially from Japan and East Asian first-tier NICs, or follow a NAIC's (Newly Agro-Industrialised Country) type of strategy based on agro-industry exports, which will mean less overall rapid growth but an improvement in rural conditions as well as self-sufficiency and less dependency on the foreign inputs. It seems that selecting one of these strategies may not be an ideal choice for Thailand in the long-term, as each one has its own advantages and disadvantages. Therefore, a combination of both strategies may be an appropriate choice for Thai authorities, as Thailand needs to challenge some of its weaknesses such as shortages of adequate engineers, technicians and skilled-workers; imbalance distribution of income and facilities particularly in the rural areas.

4.6 INDONESIA

Indonesia is another Southeast Asian resource rich country which is also classified as a second-tier NICs with a total population of about 200 million living in more than 13,000 islands. Although Indonesia is known as a latecomer in the process of industrialisation comparing with other East Asian first-tier and second-tier NICs, according to a recent prediction (Economist, October 1-7, 1994), it will be the fifth largest economy in the world by the year 2020, thanks to its large amount of natural and human resources and a relatively high GDP growth rate. The industrialisation of Indonesia started much later than other Southeast Asian countries, because it took a longer time for the country to obtain a stable macroeconomic and political situation. Indonesia pursued an Import Substitution Industrialisation (ISI) policy during the period between 1965-1985 financed largely by oil incomes and foreign aid and loans and directed through protection of domestic industries. The first stage of ISI policy assisted the country to develop an indigenous small-scale

industry which was heavily protected by high tariffs, import quotas, and various subsidies [145].

Indonesia entered the second stage of an import substitution industrialisation process in the 1970s, emphasising more the expansion of intermediate and capital goods. The import substitution industrialisation strategy of the 1960s and 1970s was also accompanied by importing a substantial amount of foreign technologies into Indonesia, much of which replaced older technologies. Like the other oil-producing countries, the sharp increase in oil prices in October 1973, resulted in a substantial increase in its oil revenues, and enabled Indonesia to invest more in improving the infrastructure and general education needed for better acquisition of foreign technologies. The intensive transfer of technology also led to rapid modernisation of both labour and capital intensive industries in Indonesia during the 1970s. As a result of the relatively successful implementation of an import substitution policy, Indonesia achieved an annual average GDP growth rate of 7.9 % during the period between 1973-1981[146]. According to another figure, the rate of growth in manufacturing during the period 1967-81 increased 14 fold, which was mainly concentrated in the construction, transport and communication industries [147].

However, it is argued that the second phase of import substitution policy in 1970s, which encouraged the expansion of heavy and capital-intensive industries, resulted in creating a wide gap between the technological requirement and the absorptive capacity in Indonesia. As Kakazu (1992) noted, Indonesia's technological capability could be much stronger if the country had adopted technologies that would have utilised its relatively abundant human resources [148]. It should also be noted that due to continuing implementation of inward-looking and protectionist measures, manufacturing exports during 1970s were almost negligible, and only constituted 3% of total merchandise exports [149].

Like the other East Asian countries, in particular its neighbouring Malaysia, Indonesia faced a decline in its average GDP growth rate to about 4.2 % in the early 1980s, mainly because of the general world recession in this period and also fluctuations in the oil prices. Despite this reduction in Indonesia's GDP growth rate, it can be said that Indonesia responded very quickly by adoption of a series of effective deregulation and liberalisation policies. This included an effective devaluation of Indonesian Rupiah in March 1983 which was accompanied by tight monetary and fiscal policies to avoid rising inflation, tax reforms, and

cancellation a large numbers of uneconomic investment projects [150]. The Indonesian government began to develop labour and resources-intensive industries during the period between 1982-86, through its direct intervention, which resulted in the export of a substantial amount of product from its resources-based and labour-intensive industries, such as plywood, timber and footwear products. For example, Indonesia has become the largest supplier of plywood in the world since 1984 [151].

The rapid decline of oil prices in the mid-1980s eventually forced Indonesia to shift from its previous import substitution policy to an export-oriented policy, emphasising more the promotion of non-oil exports, particularly manufactured products. Following the adoption of the export promotion policy, the Indonesian government introduced a series of policy measures including an effective currency devaluation, export incentives such as tax exemptions and tariff reductions, the liberalised foreign investment code, privatisation, and deregulation policies. These have helped to secure an average annual increase of about 29% in non-oil exports during the late 1980s [152]. The share of manufacturing exports in total export increased to 28% in 1988 and reached to 48% in 1992. Due to its abundant natural and human resources, much of Indonesian manufacturing exports were labour-intensive industries (such as garments, textiles and footwear) and resource-based industries (such as plywood, cement, leather) which accounted to 62% and 26% of total manufacturing exports respectively in 1992 [153].

Despite the important role of the state in the implementation of a set of effective policy measures, it is argued that the private sector contributed more than 70% of total GDP growth during 1983-1991 [154]. It can be said that Indonesia as a latecomer into a very competitive international market, faced some major problems in promoting its manufactured exports. Some relatively high costs of industrial products due to continuing some of its protectionist measures such as import licensing arrangements, and a low level of labour productivity, were among the major constraints of expanding manufacturing exports [155]. Furthermore, the heavy dependency on the exports of its mineral resources including petroleum was considered as another main restraint in the process of expanding Indonesia's manufacturing exports. However, as mentioned earlier, Indonesia managed to reduce its heavy dependancy on oil-revenues through the implementation of effective policy measures aimed at expansion of non-oil exports and in particular manufactured exports. Non-oil exports increased with an average annual rate of 29% during the period between 1986-1990,

from $ 6.7 billion in 1986 to about $ 14.3 billion in 1990. Much of this growth was because of a diversified base of manufacturing products which constituted more than half of total non-oil exports in 1991[156]. The increased importance of manufacturing exports which were valued at $ 14 billion in 1992 and accounted for 41.1% of total exports resulted in overtaking the value of oil exports for the first time, with export revenues of $ 10.7 billion which accounted for 31.4% of total exports [157].

Indicator	1984	1992
Oil output/GDP (%)	21.5	13.0
Non-oil manufacturing/GDP (%)	8.9	17.5
Oil exports/ total exports (%)	73.2	31.4
Non-oil manufacturing exports/total exports (%)	18.2	51.7
Oil revenue/domestic government revenue (%)	65.2	32.3
Foreign Direct Investment approvals ($ billion)	1.3	10.3

Table 4.5 A comparison between some major indicators of Indonesian Economy
Source: Ramli, R. "Expansion of the Indonesian Export Sector: Past experience and current prospects", 1995.

Indonesia has entered into a new phase of its export promotion policy in the early 1990s, as its manufacturing products should compete with those of other East Asian first and second-tier NICs along with some newcomers such as China, Vietnam and others. Despite the improvements in some technology-intensive industries such as aircraft manufacturing and shipbuilding industries, Indonesia still lacks a strong scientific, engineering and managerial base together with skilled workers on which to build high value-added industries. Therefore, Indonesia should expand its high-technology activities in order to be more competitive in the world market. This requires designing an appropriate technology development strategy as a part of the country's overall economic development plan, in order to formulate long-term science and technology programmes for development of its indigenous technological capability. The Indonesian Minister of State for Research and Technology, Prof. Habibie, who is Indonesia's longest serving Cabinet member after the President, is believed to be the major person in designing and launching several S&T development programmes in Indonesia in the past decade. His plans for technological development of Indonesia include: acquiring modern technologies by assembling foreign designed aircraft under license; strengthening local technical skills through establishing more technical training institutes; and providing competence in basic science and technology at the same level with the advanced industrial nations [158].

The Indonesian government has generally used two strategies to accelerate the development of technological capability. Firstly, to promote private market mechanisms for technology development through open-door policies towards technology transfer, providing incentives for private investment in technology research and development, and encouraging private investment for the expansion of research and development activities. The second strategy is to invest in technological development through selective strategic interventions, and establishing institutions for education and training the high-skilled workers and technicians required for the assimilation and absorption of advanced technologies [159]. Moreover, in order to promote the level of its competitiveness, the Indonesian government has recently introduced further policy measures to attract more FDI and technology, by allocating more financial resources to develop its industrial infrastructure and technical training. For example, there have been 227 new manufacturing projects with a total value of over $ 2.5 billion by February 1993, including 18 chemical plants and 28 metal plants [160].

Despite significant expansion of industrial infrastructure and manufacturing exports, Indonesia's indicators of technological capability show that Indonesia needs to improve in many science and technology aspects in order to close the gap with the technological-frontier countries. Although Indonesia is at the lower level of many educational indicators compared with other East Asian countries, due to its larger size, its scientific and industrial infrastructure is relatively larger than that of some smaller countries in the region. For example, Indonesia's literacy rate of about 81.6% is lower than that of Thailand with 93% in 1990 but is higher than that of Malaysia with 78.4% in the same year. Moreover, Indonesia allocated only 0.9% of its public expenditure as a percentage of GNP to education, which was very low compared with that of Malaysia with 19.6% and Thailand with 21.1% in 1992. In terms of the number of R&D personnel per million of the population, while this figure was 181 persons in Indonesia, Malaysia and Thailand had 327 and 104 researchers per million of their population respectively [161].

The Indonesian government also encouraged the flow of foreign investment into the country in order to attract high technology and managerial expertise. Various measures have been introduced to encourage both domestic and foreign private investment. For example, one can refer to the recent privatisation programme announced by the Indonesian government during late 1993 and early 1994 in which the shares of several state-owned companies were

sold on the domestic and foreign capital markets. In addition to being an attractive place for foreign investors, mainly because of rich natural resources, cheap labour and large market size, the government in Indonesia also introduced some other incentives such as tax exemptions and establishing export-processing zones (such as Golden Triangle in Batam-Singapore-Johor) in order to attract more foreign investments. As a result of these effective policy measures, the flow of FDI increased from $ 1.5 billion in 1987 to more than 10 and $ 8 billion in 1992 and 1993 respectively, mostly concentrated in export-oriented manufacturing industries [162].

Despite an important contribution of foreign investment in the flow of foreign technology and managerial expertise in to the Indonesian manufacturing sector, other methods of acquisition of foreign technology such as importing capital and intermediate goods, joint ventures, licensing and subcontracting agreements, have also been used. According to a survey of technology transfer through Multinational Companies (MNCs) in twelve manufacturing companies in Indonesia, the degree of local technological effort for achieving indigenous technological capability in Indonesia has been greater in the case of national companies which have purchased technology through licensing agreements than in the case of joint ventures between MNCs and Indonesian private or state-owned enterprises [163]. There have not been formal controls over, or monitoring of, technology transfer in Indonesia. However, The Agency for Assessment and Application of Technology (BPPT) is responsible for providing consulting services to government agencies as well as private firms about the compatibility of foreign technologies with the situation in the country. The current Five-year Development Plan [Repelita VI (1995-1999)], emphasises more the development of production technique including an increase in the high value-added manufacturing products capable of competing in the world market, promotion of technical and engineering skills, and enhancement of industrial infrastructure in particular national transport and telecommunication systems [164].

Having surveyed the success factors of Indonesia's experience in the process of industrialisation, one can see several common features in the industrial and technological development policies of Indonesia and other East Asian NICs. These policies include allowing unrestricted imports of technologies embodied in machinery and equipment, adopting an ISI in the early stage of industrialisation which enabled the country to expand

its infrastructure and considerable labour-intensive and resources-based industries, the acquisition of foreign technologies through appropriate selective channels and through limited well-considered government intervention and introducing various export incentive measures in order to expand the export of manufactured products. However, as indicated earlier, Indonesia adopted an export-oriented industrialisation policy later than other East Asian first and second-tier NICs. It should be also noted that like its East Asian counterparts, the government in Indonesia has also played an important role in the industrialisation process through introducing some effective policy measures such as, devaluation, privatisation, deregulation and export promotion policies, which resulted in a significant growth rate of its GDP and manufacturing exports.

Having compared some overall economic and industrial indicators of Indonesia with those of East Asian first and second-tier NICs, it is believed that many Indonesian economic and industrial indicators in the early 1990s were comparable with those of S.Korea in the early 1970s. However, Indonesia which is classified by the World Bank in the lower income group of countries, is lagging behind other East Asian first and second-tier NICs in terms of GNP per capita. For example, Indonesia's GNP per capita of $610 in 1991 can be compared with the same level of Korea in 1957 and Malaysia in 1956 and Thailand in 1970. Assuming Indonesia's average annual growth in GNP to be 5.5% for next 25 years, Indonesia may catch up Korea's current level of GNP per capita in the year 2035 and with Malaysia in the year 2017 and Thailand in 2009. Thus, Indonesia appears to be at least two decades behind Korea, and somewhat less in the case of Malaysia and Thailand [165].

In terms of the size of industry sector, the Indonesian manufacturing sector is relatively smaller than that of S.Korea and Mexico, and little larger than that of Thailand. However, Indonesian experience of technological development has some common features with that Thailand. Both countries have a relatively weak science and technology education systems and a low level of R&D activities in particular in the private sector. Both have adopted very open policies towards acquisition of foreign technologies and FDI. However, due to Thailand's earlier shift to the export promotion policy, it is more open to international market and therefore, access to the high-technologies. Moreover, despite a relatively similar level of educational indicators, Indonesia's technological capability and its absorptive capacity of foreign technologies is at a relatively lower level than that of Thailand. As a major oil-producing country, the Indonesian experience in reducing its dependency on the

oil-revenues may also have useful lessons for other oil exporters countries such as Iran.

4. 7 MEXICO

The successful experiences of industrial and technological development of East Asian first and second-tier NICs have shown useful implications for other LDCs, and it can be said that the experience of Latin American NICs such as Mexico and Brazil can also have valuable lessons for the LDCs. Among Latin American NICs, the case of Mexico can be a good model as it share some common characteristics with Iran. Like many East Asian first and second-tier NICs, Mexico also adopted import-substitution industrialisation policy in its early stage of industrialisation. During the first phase of ISI policy in the 1960s a large number of labour-intensive and consumer-good industries were established which encouraged producing goods for domestic markets or substituted them for the previously imported products. As a result of ISI during the 1960s, the manufacturing sector grew at an average rate of 9%, of which the growth rate in consumer, intermediate and capital goods industries were 6.3%, 8.4% and 12.8% respectively [166]. During the second stage of ISI policy which began in the late 1960s, some problems such as shortages in the production of basic industrial inputs led to a sharp increase in the imports of raw materials, intermediate and capital goods, and therefore caused imbalance of payment and trade deficit. Moreover, the increase in protectionist measures as a result of IS policy also caused an inefficient manufacturing sector to develop. This was unable to compete in the international market and therefore was considered as a major obstacle to manufactured exports. The importance of import substitution as a development strategy began to decrease because of its inability to reduce Mexico's dependency on imports and create employment opportunities for Mexican workers.

Like the other oil exporting countries, the sharp increase in oil prices during 1973 and 1979 caused an expansion of Mexico's oil revenues and therefore led to the accelerated GDP growth rate of more than 8% during this period. However, non-oil manufacturing exports increased only slightly as a percentage of GDP from 1.1% to 1.4% between 1975 and 1980 [167]. Following the debt crisis in 1982, Mexico changed its previous inward-looking and IS policies to the outward-oriented and export promotion policies. As Whiting (1991) has noted, the transition towards a more open and liberalised economy after Mexico's 1982

crisis can be attributed to some important reasons such as reducing the heavy dependency of the Mexican economy on oil; increasing the efficiency and quality of manufacturing products capable of completion in the world market; promoting the country's indigenous technological capability; and reducing state-intervention through implementing privatisation and liberalisation measures [168]. Sklair (1992) also refers to two general reasons for adopting an export-oriented industrialisation policy in Mexico. Firstly, opening up the country as much as possible towards attracting foreign investment and technologies. The second reason is to create as many as jobs as possible for the Mexico's large human resources [169].

Following the adoption of EP policy which was also accompanied by the stabilisation and trade liberalisation policies, the Mexican government introduced some effective measures such as lowering trade barriers, relaxing of import restrictions, reducing import tariff schedules, and various incentives for the expansion of non-oil exports, including greater access of credits for exporters; easing the restrictions for importing the inputs required for the manufacturing the products for exports; and removing obstacles from attracting more foreign investment through the introduction of new guidelines for attracting FDI in 1984. For example, the proportion of tariff exemptions for imports was raised from 21% in 1982 to 42% in 1983 [170]. Since shifting toward more outward-looking and export-oriented policies, Mexico has also adopted a technology transfer strategy emphasising more on adaptation, absorption and diffusion of the foreign technologies, aiming at promoting its indigenous technological capacity and therefore increase its level of competitiveness in the world market. Moreover, the government decision to join the General Agreement on Tariffs and Trade (GATT) in late 1985 is believed to be a very important step in linking the Mexican economy to better access to the MNCs stocks of investment and technologies. Furthermore, other important components of stabilisation and adjustment programmes in the 1980s included, real devaluation of the exchange rate, and the reduction by more than 40% of the number of public enterprises [171].

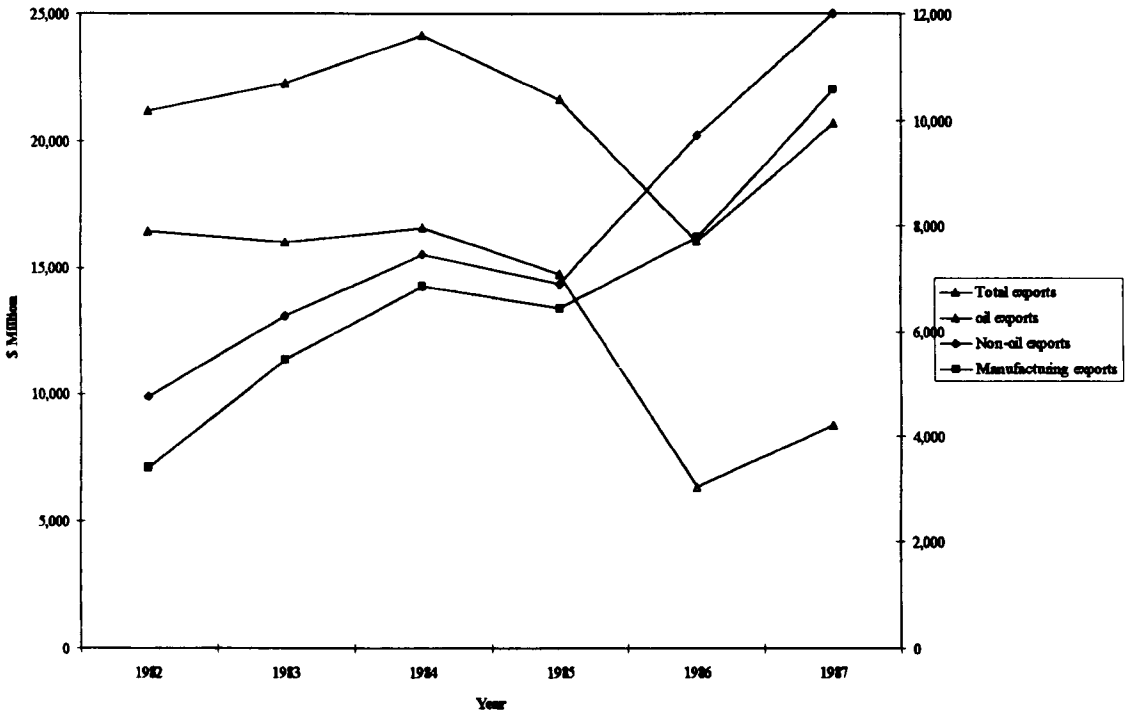


Figure 4.2 The composition of Mexican exports during the period between (1982-1987)

As a result of these effective policy measures, non-oil exports increased from $ 7 billion in 1985 to $ 14 billion in 1988 and $ 16 billion in 1990 [172]. While non-oil exports were 22% of total exports in 1982 and manufacturing exports constituted to 16% in 1982, these figures increased to 58% and 51% respectively. Therefore, non-oil exports grew more than two and a half times, while manufacturing exports tripled [173]. However, it should be noted that much of Mexico's success in exports of manufacturing products has been due to government promotion of labour-intensive firms known as Maquiladora which acted as Mexican export processing zones (EPZs). It is argued that Maquiladoras were mainly established by the US MNCs in order to relocate some of their labour-intensive assembly operation to take most advantage of the cheap labour costs in Mexico [174]. The government in Mexico supported the Maquiladoras through providing some infrastructural facilities such as land, roads, and public utilities together with establishing special industrial parks for the Maquiladoras. Mexican capitalists and professionals have also played an important role in the maquiladora sector mainly by setting up industrial parks, providing services, and acting as subcontractors. The Mexican government also introduced various incentive measures such as allowing sale of up to 40% of their products in the local market to increase the number of these firms, in particular in the other areas in Mexico away from the American border. Therefore, with a rapid increase in the number of Maquiladoras

around Mexico, the importance of these firms as the second largest source of foreign currency after oil exports and the creation of about 160,000 jobs in the mid-1980s became more evident [175]. Moreover, the Maquiladoras have had an effective impact on the training and education of Mexican workers [176].

	1985	1986	1987	1988	1989	1990
Imports	13.2	11.4	12.2	18.9	23.4	29.8
Exports	21.7	16.0	20.7	20.6	22.8	26.8
Petroleum	14.8	6.3	8.6	6.7	7.9	10.1
Manufactured exports (A)	5.0	7.1	9.7	11.5	12.5	13.9
Trade balance	8.5	4.6	8.5	1.7	-0.6	-3.0
Tourism (net)	1.1	1.2	1.5	1.4	1.4	1.5
Maquiladora exports	5.1	5.6	7.2	10.0	12.5	15.2
Maquiladora exports (net) (B)	1.3	1.3	1.6	2.3	3.0	3.6
[B]/[A]+[B]	20.6	15.5	14.2	16.7	19.4	20.6

Table 4.6 The overall trade indicators of Mexico and the impacts of Maquiladoras on trade ($ billion)

Source: Institute of Developing Economies, 1995.

Despite several general advantages of Maquiladoras, these firms had some disadvantages such as dependency on the US market for both the imports of required inputs and also exporting their products; weak linkages with domestic producers and markets; and a lack of adequate infrastructural facilities which caused some serious environmental pollution [177]. Moreover, due to the assembly nature of most of these firms, they operated as self-contained units, and therefore made little contribution to the transfer of high-level technologies, and to the development of indigenous technological capability in Mexico. In addition to the above points, large quantities of parts and equipment required by these firms were imported from abroad. As for example, the share of local materials employed by maquiladoras varied around 1.5% during the period between 1975-80 [178]. However, more recently, in the early 1990s, the number of Maquiladoras increased very rapidly and reached about 2000 by 1992, employing almost 500,000 workers. These second wave of Maquiladoras involved more in production of sophisticated and high value-added products such as assembly of automobiles and advanced electronics. Therefore, it can be said that more high-level and advanced production technologies have recently been transferred into Mexico through the second wave of Maquiladoras involving highly standardised assembly-line techniques.

The Mexican government launched a series of national modernisation programs for promoting science and technology, the educational system, and small and medium industries, for the period between 1990-1994, aiming at strengthening its industrial infrastructure, as it entered into an agreement with U.S. and Canada known as the North American Free Trade Agreement (NAFTA) in 1992 [179]. The main policy change included in these programmes in terms of technology modernisation was an entire deregulation of technology transfers which removed many government controls and interventions in technology transfer activities of industrial firms in Mexico. However, the government role was limited to providing some incentives for the promotion of local technological capability, such as a favourable tax regime to upgrade technology, long-term loans, establishing technology parks, and specific centres to enhance the stronger links between universities and manufacturing firms and the industries [180].

It is argued that the foundation of NAFTA has had some important effects on Mexico's economy. Among the positives impacts of NAFTA, one can refer to the relocation and transition of most US and Canadian factories to Mexico in order to utilise its low cost of labour which led to the acceleration of industrial restructuring in Mexico. The other important advantages of NAFTA for Mexico can be the flow of American and Canadian direct investment together with technical and managerial expertise into the Mexico. Moreover, the prospect of a free trade agreement with Canada and U.S. has also provided a good opportunity for Mexico to show its capability as an appropriate base for attracting FDI. In other words, a free trade agreement with US and Canada would increase the foreign investors' confidence in Mexico. The short and medium-term impacts of NAFTA would be an increase in Mexico's efficiency and productivity levels, due to removal of trade barriers, resulting from the anticipation of the benefits of NAFTA [181].

For Mexican authorities, NAFTA can also be seen as a first step towards wider trading agreements including other Latin American countries [182]. However, some negative aspects of NAFTA can be noted such as; its damaging effects on Mexican agricultural products because of the high production costs and low productivity level of Mexican agriculture compared to those of the US; its harmful impacts on the Mexico's small-scale firms by importing low-price products; and its effect on rising wages of Mexican labour due to the increasing demand for them, which in turn would lower the level of competitiveness

of Mexico's manufacturing products against its rivals in East Asia [183].

Having looked at the most important success factors of the industrialisation experience in Mexico, one can refer to the effective role of the state in the utilisation of Mexico's abundant natural and human resources, in encouraging foreign investment and technologies, and in promoting industrial infrastructure in Mexico; the role of Mexico's FTZs known as Maquiladoras in fostering manufacturing exports and creating employment opportunities for Mexico's large labour force; the significant impacts of the export-oriented industrialisation policy which was accompanied with a series of policy measures including trade liberalisation, stabilisation and privatisation programmes; and the overall effects of NAFTA on Mexico's economy. However, some of these success factors can be attributed to Mexico's special geographical location. These include the significant impact of NAFTA in the modernisation of the industrial infrastructure and overall economic performance of Mexico, and the contribution of the Maquiladoras in the expansion of non-oil exports, and flow of FDI into Mexico.

Moreover, the massive flow of FDI into Mexico has also played a very important role in the early stage of its industrialisation. Mexico has been among the developing countries that have received largest amount of FDI in past years. While much FDI in the 1960s and 70s was import-substituting oriented aiming at investment in domestic industries such as automobiles, electronics, chemicals and processed foods, more recent flows of FDI into Mexico contributed more to the growth of non-oil exports in the late 1980s. The government of Mexico has enacted several laws and regulation since 1970s including "Law to Promote Mexican Investment and Regulate Foreign Investments" in 1973, and "Regulations of the Law to Promote Mexican Investment and Regulate Foreign Investment" in May 1989. Various effective policy measures have also been introduced to attract as much FDI as possible, such as allowing foreign investors to own 100% of enterprises valued up to $ 100 million, establishing FTZs, and providing adequate infrastructure facilities required by foreign investors. It can be said that one of the most important factors for high FDI in Mexico has been Mexico's comparative advantage in low cost of production and its proximity to U.S and Canada. In other words, Mexico has been a more attractive host for FDI more because of its position as a major source for supplying manufactured products to the US markets [184].

FDI has also been a major channel for transfer of technology and managerial and technical expertise into Mexico and promoting the local industrial infrastructure in Mexico. Despite the importance of FDI as a major source of acquiring foreign technology, there have been other methods of technology transfer into Mexico, including contractual agreements, payments for the use of patents, licenses and technical assistance agreements. The use of each channel relied more on the nature of ownership of the firms involved in the technology transfer (domestic or foreign) and the degree of its importance to a particular manufacturing sector in Mexico. According to a survey comparing the process of acquiring technology in some 102 firms in three countries (Ireland, Spain, Mexico), most Mexican firms involved in electrical and electronics, chemicals and pharmaceuticals, and the manufacturing of machinery acquired foreign technology through informal channels such as direct personal contacts and in the form of documentation of some sort, half of that being trade journals. It has also been found that research institutes in Mexico contributed very little as a source of new technology. Despite developing a relatively reasonable technological base in the universities and research institutes of the countries surveyed and in particular Mexico, there has not been a close cooperation between them and industry [185].

It can be said that developing and expanding the quantity and quality of its relatively large human resources has been an important part of Mexico's industrial and technological development strategy. Since 1960, the Mexican government has also made considerable efforts to expand its national educational system through heavy investment at all educational levels, and establishing various institutions for the on-the job and vocational training. Moreover, the government in Mexico proposed a project called " Programme Mexico", to allocate funds to academic institutions in order to train human resources and to carry out research in technical are as 56% of academic institutions participated in this programme in early 1988, recovering some $ 40 million, more than 80% of which was for electronics and information services [186].

Having compared the science and technology indicators of Mexico with its other Latin American counterparts, Mexico has had an intermediate position regarding some major indicators such as its R&D expenditure as a percentage of GNP of about 0.6 in 1985 [187]. Moreover, due to its substantial investment in education, the educational level in Mexico has been higher than that of Brazil for the period between 1960-1980. As an example, one can refer to the literacy rate of 81% in Mexico in 1977 which was among the highest in Latin

American countries [188]. Despite some significant improvements in the level of its educational indicators, however, it should be noted that Mexico still lags behind other major Newly Industrialised Countries (NICs) in terms of technological capability. Therefore, Mexican authority should increase their efforts in order to close the technological gap through intensive science and technology programs such as a higher allocation of R&D expenditure as a percentage of GNP, establishing more science and technology parks, and increasing the number of institutions for higher education and technical training.

Having compared the overall industrial and technological policies of the newly industrialised countries in Latin America such as Mexico and Brazil with those of Southeast Asia such as S. Korea and Taiwan, despite several common features in their experiences of rapid industrial and technological development, there have been some major differences such as their market size and the role of the government in directing industrial and technological development policies. The Latin American NICs, particularly Mexico, have considerably larger domestic markets than the first-tier Southeast Asian NICs. The large domestic market in the Latin American NICs including Mexico resulted from a relatively longer period of import-substitution policy in these countries in comparison with their East Asian counterparts. Moreover, the government role in the industrialisation and technological development of NICs in Southeast Asia (such as Korea and Taiwan) has been different in comparison with that of Latin American NICs (such as Brazil and Mexico).

As discussed earlier in the case of Korea and Taiwan, the government in these countries has played a key role in the economic and industrial development of these countries. Government intervention in these countries did not interfere with the market mechanism, but rather complemented it. While the state in East Asian NICs played an effective role in promoting their industrial competitiveness through adoption of some policy measures such as heavy investment in enhancing their technological infrastructure and R&D activities, in contrast, the Latin American state intervention has been far less effective in promoting the competitive level of their manufacturing exports. The government in Latin American countries in particular Mexico concentrate less than their East Asian rivals in investing on new and high-level technologies which in the current very competitive situation is considered to be a main element for success in the international market. The state in Latin American NICs including Mexico has also been highly interventionist in industrial and technology policy making. Moreover, state-owned enterprises in Mexico have been of major

importance of in the economy, especially in energy, transportation, communications, and fertilizers. However, the government's privatization program moved rapidly to transfer state enterprises to the private sector.

Having compared the educational system in the NICs of Southeast Asia with that of Latin American countries, the Asian NICs have very highly educated populations and the secondary level education in the Latin American countries including Mexico has been on average one-third lower than that of East Asian counterparts. For example, the percentage of tertiary students in engineering in S. Korea has been at least double the figure for the Latin American NICs [189]. Comparing the method of technological acquisition, the Latin American NICs including Mexico have relied to a larger degree on foreign direct investment in particular in the earlier stage of industrialisation than East Asian first-tier NICs. The Asian NICs, on the other hand, have generally adopted fairly liberal policies regarding FDI. S. Korea has probably had the most restrictive FDI policy and has used other methods such as technology licensing and joint ventures as the major source of the foreign technology acquisition. However, some Latin American NICs, have faced tremendous problems in the transferring of technology through foreign direct investment because of the depressed state of their internal markets. Moreover, while the East Asian first and second tier NICs have used various methods of technology acquisition in particular technology licensing and capital goods imports, the Latin American NICs including Mexico made much less use of all channels of technology transfer except FDI. Therefore, it can be said that despite these different characteristics in some aspects of the industrialisation experience of the Latin American countries with that of East Asian first and second-tier NICs, however, as the comparative assessment of their experience shows, LDCs can learn useful lessons from several success factors of these countries.

4. 8 TURKEY

Turkey which is located in one of the most strategic geographical areas of the world, with the area of 779,452 km square, and has been a republic since 29 October 1923. Unlike some of the developing countries in East Asia such as Indonesia and Malaysia, Turkey is not a resource-rich country, with only about 246,000 km square land used in agriculture, and some minerals such as coal, chromites and copper. During the post second-world war

period, and in particular since the early 1960s, Turkey has experienced a rapid GDP growth rate with an average annual growth rate of nearly 10% during 1962-1967. Industry sector has been the engine of this growth [190]. Like many other developing countries, the industrialisation in Turkey began with the similar pattern of import substitution aiming at creating a strong industrial base through adopting the protectionist policies including high tariffs and quantitative import restriction, to produce for the domestic market and replacing the previously imported products with the locally produced goods. During the first stage of import substitution in Turkey in 1960s, the imports of nondurable consumer goods were replaced by domestic production so that the share of consumer goods in total imports decreased to only 5% [191].

Turkey entered into the second stage of import substitution aiming at replacing the imports of intermediate and capital-intensive products. However, because of the high cost that producing many capital-intensive products such as petrochemicals and steel had created, the implementation of ISI in Turkey faced some difficulties, such as increasing inefficiencies and imbalance of payments. Therefore, despite the initial success of ISI policy in the early stages, in the later stages it failed to produce the manufacturing products that can compete in the world market. Moreover, as a result of ISI policy, the Turkish manufacturing sector was heavily dependent on imports of raw materials and inputs. For example, one can refer to the Turkish automobile manufacturing sector, which alone needed $ 700 million in direct imports (or about 20 per cent of total Turkey's non-oil imports) for its assembly production in 1979, while total automotive exports did not exceed $ 7 million [192]. Therefore, by the late 1970s, Turkey encountered a serious financial crisis which led to the slowing down of the average annual growth rate of manufacturing products to 5.2% during the period between 1973-79 from that of 10.2% in 1960-73 [193]. Moreover, the GDP growth rate declined from 3% in 1977 to - 0.7% in 1979 [194].

Since 1980, the government in Turkey adopted a package of stabilisation, liberalisation and export-oriented programmes in order to improve the balance of payments, and promote the country's international competitiveness. Some effective policy measures have been implemented including a real devaluation of the Turkish Lira by 33%, introducing various export incentives such as export tax rebates, removing the quotas from imports of inputs required for manufacturing for exporting products, transportation and energy subsidies, and low interest loans to exporters [195]. Moreover, different international organisations such

as the International Monetary Fund (IMF), the World Bank and the Organisation for Economic Cooperation and Development (OECD) supported these programs through granting substantial financial aid and loans [196]. As a result of these effective policy measures, the inflation rate decreased to 37% in 1981 from 107 % in the previous year, and the average growth rate of GNP which was negative in 1980 increased to more than 4% in 1981 [197].

The shift to the export-promotion from the previous import substitution policy in the early 1980s also led to a significant export performance, in particular manufacturing exports. The total value of merchandise exports increased from $ 2.9 billion in 1980 to $ 10.3 billion in 1987 with an annual average growth 22.3%. Moreover, the share of manufacturing products in total exports increased from 36.8% in 1980 to 79 % in 1987, with an average annual growth rate of 38.2% during the same period [198]. As indicated earlier, some effective export incentive measures, in particular the real depreciation of Turkish Lira, export credits and tax rebates were among the major elements contributing to Turkey's significant export performance since the 1980s. The other important factor that led to Turkey's successful export performance in the early 1980s, was the creation of a huge excess capacity as a result of the crisis of the late 1970s which had depressed industrial outputs. This capacity utilisation particularly in private industry stood at 51% in 1980 [199]. The strategic location of Turkey and access to the European Community and Middle Eastern countries markets along with use of some high-tech methods of production such as Just-In-Time (JIT) and Computer Aided Design (CAD) have been the other important elements of Turkey's success in the expansion of its exports [200]. Moreover, additional measures were taken to increase the attractiveness for foreign investors, including easing some previous restrictive regulations on flow of capital and investment as well as relaxation of capital and exchange market controls [201].

	Real GDP growth (%)	Debt/exports ratio (%)	Investment/GDP ratio (%)	Export volume increase (%)
1981	3.6	280.2	21.5	68.7
1982	4.5	222.2	20.3	24.1
1983	3.9	231.3	19.6	13.9
1984	6.0	217.6	19.6	23.1
1985	5.1	223.4	20.5	9.9
1986	8.1	288.4	23.2	-2.3
1987	7.4	265.4	25.5	29.3

Table 4.7 Some selected macroeconomic indicators for Turkey (1981-1987)

Source: World Development 1990.

Despite the significant overall export performance in early 1980s, however Turkish exports faced a sharp decline in 1986 due to some external factors, mainly the sharp decline in oil prices in the mid-1980s which affected Turkey's exports to oil producing countries as well as some internal factors such as inadequate private investment in manufacturing and the decision made by the Turkish authorities to remove government subsidies on industrial exports [202]. Therefore, the government in Turkey adopted some further measures including reintroducing tax rebates and additional tariff cuts for imports of raw materials required for producing manufacturing goods for exports, and preferential credits for industrial enterprueners and exporters, in order to recover the sharp decrease of its industrial exports in 1986. Following the implementation of these measures the overall exports reached to $ 12,960 million in 1990 and the share of manufacturing exports in overall exports rose to 78.2% by the late 1980s. However, due to the appreciation of the exchange rate in 1989-90 and therefore an increase in imports in particular capital goods, Turkey faced a current account deficit in 1990 [203]. It is generally argued that to sustain ability for a rapid expansion of exports in Turkey in the future to a large degree depends on its capability to diversify the manufacturing exports as well as its macroeconomic and political stability, and also its ability to upgrade the level of competitiveness through introducing more high and modern technologies into the country.

During the early 1990s and with the implementation of Turkey's Sixth Five-year Plan (1990-1994), Turkey continued the export promotion policies aiming at promotion of the private sector as well as further liberalisation of the economy through reducing protection on imported goods and attracting private and foreign investment. The main quantitative objectives of the sixth plan included an average annual growth rate of 7%for GDP, and 15% for exports which exceeded $ 22,000 million by the end of 1994 [204]. The strategy of the Seventh Plan published in April 1993, also aimed at sustaining the increasing growth rate of exports, in particular industrial exports, through raising their competitiveness and productivity, with more emphasis on a free-market mechanism. It is argued that Turkey's overall economic and industrial performance in the early 1990s, considering its significant improvement in the industrial infrastructure and indigenous technological capability, can be compared with Spain and S. Korea a decade or two decades ago, which may have experienced a similar stage of rapid industrial and technological development, and joining

the ranks of newly industrialised nations [205]. However, due to the financial crisis in 1994 which resulted from macroeconomic imbalances and increasing rates of inflation, the Turkish government has recently introduced a comprehensive stabilisation programme in order to keep the stable macroeconomic environment needed for further industrial and technological progress.

It can be said that the experience of Turkey's industrialisation has also had many common features with those of East Asian first and second-tier NICs as well as Latin American NICs. Like many of these countries, the Turkish state has played a very important role in directing a set of effective policy measures which led to its successful transition to an open-market export-oriented economy since 1980. As indicated earlier, following a serious financial crisis in late 1970s, the Turkish government adopted a series of programmes and policies including structural adjustment, stabilisation, trade liberalisation and export-oriented policies which supported by the conditional assistance from international organisations such as IMF (International Monetary Fund) and World Bank. However, in comparison with East Asian States, the Turkish state has been less supportive of private sector activity and also was less successful in attracting substantial private investment for industrial activity. As Onis (1995) indicates, "The Turkish state is an overextended or an overloaded state in comparison with its East Asian counterparts, which is identified as a key constraint on the continued success of export-oriented industrialisation strategy in Turkey" [206]. The state in Turkey has also been characterised to be a highly centralised, and a weak state in terms of its capability to generate tax revenues and impose fiscal discipline [207].

However, it is argued that the government in Turkey played a significantly larger role in the implementation of an import substitution strategy in its early stage of industrialisation in comparison with many other countries that followed the same pattern of industrialisation. The share of the state sector, in manufacturing industry and in total investments, was around 40% and 50% respectively during the 1960s and 1970s [208]. Moreover, one of the most important factors which distinguished the Turkish and East Asian experience of ISI in the early stages of their industrialisation has been the lower degree of state autonomy and the insufficient degree of co-operation or collaboration between the state and private sector in Turkey which led to frustrating the development process and to the crisis of the late 1970s [209]. The relatively successful experience of Turkey in developing its import substituting industries shows that the expansion of a strong local industrial base is an important

prerequisite for a successful transition to an export-oriented economy.

Like the East Asian first and second-tier NICs, the government in Turkey formulated some specific programmes for the developing its indigenous technological capability through the acquisition and assimilation of foreign technologies. The Turkish authorities adopted various incentive measures to attract foreign investment and technology including introducing open-door policies towards foreign investment, the establishment of industrial FTZs in some industrial areas such as Anatalya and Mersin in 1986, 100% custom exemption for a period of up to five years for the export-oriented investment, and tax rebates on imports of inputs needed for manufacturing exports. The government also attempted to attract foreign investment into infrastructural projects, such national telecommunication and transportation networks [210]. The Turkish government has also given more priority to joint venture projects between Turkish enterprises and their foreign trade partners, to strengthen the development of country's industry, technology and managerial skills.

Following the adoption of these effective measures, the flow of FDI into Turkey increased significantly from $ 325.1 million in 1980, to $ 932 million in 1983, and reached to $ 2.9 billion in 1990, which mostly concentrated on services such as banking, and the manufacturing sector such as chemicals, transport equipment and food processing industries [211]. As Onis (1994) argues, the most important factor behind the increasing rate of FDI into Turkey during the 1980s has been the liberalisation of trade and removing restrictive controls over flow of capital and foreign investment during this period [212]. However, it is also argued that Turkey's success in attracting further FDI mainly depends on the country's macroeconomic and political stability. Therefore, Turkish policy makers should place more efforts for attracting as much FDI and new and modern technologies as possible which is essential for attaining international competitiveness in key sectors of the economy in particular manufacturing sector.

There have been other methods of technology transfer into Turkey in addition to FDI, such as licensing, technical assistance and joint venture agreements. Most of technology licensing agreements have taken place in the manufacturing sector with almost 88% during the period between 1980 and 1992. Furthermore, Turkey also acquired technology through the importation of capital goods and machinery imports which mostly concentrated on motor vehicle industry [213]. The government in Turkey has also established about five technology

parks in different areas including Ankara, Istanbul, Marmara, Izmir and Anadolu in order to strengthen technology-related industries and fostering the development of industry in these areas. Despite these extensive efforts to promote the Turkey's indigenous technological capability through the adaptation and assimilation of foreign technology, it is argued that Turkey's overall industrial and technology infrastructure is still weak and therefore it is essential for Turkish policy- makers to design an appropriate technology development strategy to strengthen its indigenous S&T capability .

One of the major areas of Turkey's weakness is its low level of R&D expenditure as a percentage of GNP which was about 0.3 % in 1980s which has been far below that of other countries. Moreover, most of industrial research and development activities has been carried out by a number of public institutes such as Turkish Scientific and Technical Research Council (TUBITAK) and Maramara Research Centre (MRC) which lacked the specialisation to adapt foreign technology to local conditions. Therefore, increasing public and private expenditure for more research and development activities and more coordination of R&D activities between universities and industries, as well as developing an effective system of industrial standards and quality control, are among the major government programmes to promote local technological capability.

Another important element emphasised in the Turkish national development plans is the key role of human resource development policy in strengthening the country's industrial and technological capability. The rapid process of industrialisation since 1980 necessitated the need for skilled human labour with professional and technical knowledge. Hence, the government in Turkey increased the number of vocational and technical schools from 1,356 in 1983-84 to 1,963 schools in 1990-91 [85]. According to the United Nations Human Development Index (HDI) based on literacy rate, life expectancy and real per-capita GDP, Turkey was among the top ten countries in terms of improvement over the period 1960-92. However, by 1992, Turkey ranked 68th (71st in 1990) among 173 countries. This improvement in ranking was due to above-average economic performance, as Turkey lagged in education outcomes [214].

Despite the quantitative expansion of Turkish education system in the primary-level education, only 26% of the relevant age group were registered at secondary-level in 1988 and the figure for tertiary-level was at the lower level of 12% in the same year which put

Turkey at the bottom of the table in comparison to OECD countries [215]. In order to solve these problems and generally improve the national education system, the Turkish government has adopted some specific programs through the national development plans, including necessary measures to raise the quality of national education, further increasing of the schooling rate at all educational levels, developing technological education at the primary and secondary level, emphasising an overall technical and vocational education and improving the quality of science and engineering in higher education.

It can be said that other LDCs can also draw useful lessons from the experience of Turkey in a relatively successful industrialisation, as Turkey itself used several policy measures from the successful experiences of East Asian NICs. One may find an interesting parallel between the Turkish experience of post 1980 and that of S.Korea in the post 1964 period in terms of introducing several similar export incentives in order to expand the manufacturing exports. Despite the adoption of similar package of policy measures which were previously implemented in many East Asian NICs such as S.Korea about two decades earlier, however, Turkey's degree of success as a latecomer in the international market could not be matched with that of East Asian NICs during late 1960s and 1970s. This is mainly because of the world recession of the early 1980s which made a difficult condition for a late-comer such as Turkey to compete in the international market.

Moreover, a comparison of Turkey and some late industrialising countries in Latin America such as Mexico shows some major differences in the implementation of the policy measures as well as the degree of their success. For example, while the post 1982 stabilisation and economic reforms in Mexico were accompanied by an extreme import compression policy, Turkey experienced the reverse import liberalisation policy which was mostly because of its heavy dependence on imports of intermediate and capital inputs for its manufactured exports. In sum as suggested by Yeldan (1989), it seems that an appropriate development strategy for Turkey's future is to continue the current export promotion policy along with a primarily domestic demand-oriented industrialisation strategy. This strategy is based on the expansion of the domestic market through emphasising more the agriculture sector, and also production of basic intermediate and capital goods together with domestic production of associated technologies, and aimed at improvement of income distribution, employment and social welfare, particularly in rural areas [216].

4. 9 SUMMARY AND CONCLUSION

As the experiences of the selected countries in their rapid industrialisation shows, despite having different characteristics, there is commonality in the success factors of these countries. The government of most countries under the survey, in particular East Asian first and second-tier NICs, have adopted a set of appropriate policies which mainly led to their rapid industrial and technological development. These policies include the adoption of a strong export-orientation industrialisation strategy, the massive investment in development of their human resources, education, technical training, and infrastructure, and the development of their indigenous technological capability through selective appropriate methods of technology transfer. Moreover, the state in these countries has also played a vital role in directing these policies through providing an effective and supportive policy environment for successful implementation of these policies. The government of many of these countries intervened very efficiently in developing an adequate industrial and technological infrastructure as well as creating a stable macroeconomic condition required for faster and easier assimilation and absorption of imported technologies. However, as explained earlier, the degree of intervention has been varied among these countries and has mainly relied on the nature of the political system as well as the type of development strategy in these countries. For example, the market-friendly approach of many East Asian first and second-tier NICs has helped them to accelerate the overall growth rate through the adoption of open-door policies towards acquiring more foreign investment, and technologies which strengthened their indigenous technological capability.

Although the success of these countries can not only be a result of a single factor, it seems that the adoption of an export-promotion industrialisation policy along with the acquisition of foreign technologies have contributed most to their industrial and technological development. As explained earlier in detail, the very rapid growth rate of exports and particularly manufactured exports in these countries has accelerated their overall growth rate which supports the idea that the EPP has been among the major factors contributing to their success. On the other hand, these countries have to be very efficient in the acquisition and absorption of foreign technology in order to remain competitive in the international market, which in turn needs a massive investment in their technical human resources in all levels. In other words, the adoption of an appropriate technology transfer strategy which focused on the effective acquisition, assimilation, and absorption of foreign technology as well as

promoting the indigenous technological capability can be considered as a vital prerequisite for a country to be successful in the international market. Therefore, it can be said that the faster export grows, the more rapidly new technology embodied in foreign machinery and equipment can be imported, and visa versa.

The huge investment in human resource development also enabled these countries to acquire technological capability rapidly and increase the level of competitiveness and productivity in these countries by making effective use of their technological base. The main policy measures for development of the human resources in these countries included: designing some regular and effective programmes for training the labour force and upgrading their skills; increasing R&D expenditure as a percentage of GNP; and establishing and expanding specific institutions for vocational and on-the-job training. The expansion of a relatively skilled labour force as well as high level scientists, engineers and technicians can also be considered as an important criteria for effective assimilation and absorption of foreign technologies. However, as explained earlier, each country has been at a different level in terms of the quantitative and qualitative improvements of its educational system. It can be said that the higher the level of educational indicators, in particular in the secondary level in a country, the higher the level of technological capability of that country would be. For example, the existence of large numbers of scientists and engineers in S. Korea, mainly as a result of its heavy investment in all levels of the educational system, in particular in higher education, enabled this country to close its technological gap with the technological leaders easier and more quickly than its counterparts.

As already recognised, almost all the selected countries have extensively transferred foreign technologies through various methods, in particular FDI, and importing capital goods and machinery. However, although FDI has played a major role in the transfer of foreign technologies and managerial expertise in almost all these countries, other channels of technology acquisition such as licensing, joint venture and technical assistance agreements have also been employed by those countries with a relatively higher level of industrial and technological capability. In order to attract more the flow of foreign investment and technology to their countries, many of these countries have adopted effective incentives such as expansion of FTZs, removing restrictive measures, and introducing incentive measures for foreign investors such tax rebates and free custom duties. A few of these countries in particular those with a relatively higher level of industrial infrastructure,

formulated and designed a well-defined technology transfer and development strategy emphasising more the strengthening of their indigenous technological capability as well as transferring high-level technologies.

As indicated earlier, other LDCs can draw valuable lessons from the successful experiences of these countries. Because several common factors contributed to the success of these countries, other LDCs can follow their pattern of rapid industrial and technological development. However, it should be noted that all or some specific conditions which accelerated the success of these countries may not exist in the present time. For example, the transition to an export-oriented industrialisation strategy from the previous import substitution policies in some first tier East Asian NICs took place at the time that many other countries still followed the inward-looking and protectionist policies. However, in a currently very competitive international market, it would be very difficult for a late-comer to achieve similar export performance that countries such as S.Korea and Taiwan attained in the early stage of their industrialisation. It should also be noted that due to unique and significant performance of East Asian countries, other developing countries usually tend to replicate their model in order to achieve the same rapid industrialisation path. Therefore, it seems necessary for the policy makers in other LDCs to study very carefully the experience of these countries in rapid industrial and technological development.

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CHAPTER 5:

THE KEY SUCCESS FACTORS OF EAST ASIAN FIRST AND SECOND TIER NICs

5. 1 INTRODUCTION

The process of industrial and technological development in some selected countries has been discussed in detail in the case study survey. As indicated in the previous chapter, the significantly successful performance of some Newly Industrialising Countries (NICs) in East Asia can be distinguished from the experience of the other countries. As many other developing countries try to follow their model of rapid industrialisation, it seems necessary to analyse their success factors much more in detail. Moreover, the successful experience of East Asian countries in industrial and technological development can have valuable lessons for the other developing countries in the other parts of the world.

The importance of the East Asian countries as a model for other developing countries has mostly been attributed to reasons such as a very rapid growth rate in comparison with the other countries, successful experience of industrial and technological development, and their substantial share in the world's economy and population. During the period between 1970-1990, East Asian exports grew 16.7% annually, reaching $699 billion, and its imports grew 16.4% annually, reaching $ 654 billion in 1990. The East Asian share of exports also reached 21.0 % of the world total in 1990, up from 11.3% in 1970 [1]. East Asia accounted for just over 17 per cent of world production in 1980.This is expected to increase to over 28 per cent at the end of century. East Asia is also accounts for one-fifth of world trade, a larger share than North America, and this is expected to increase to one third of world trade by the year 2000 [2]. The four Asian tigers (Korea, Taiwan, Singapore and Hong Kong), with under 2 per cent of the total population of the developing world, have almost 7 per cent of its GDP, close to 20 per cent of its GDP, and nearly 60 per cent of its manufactured exports [3]. The second generation of NICs (Thailand, Malaysia and Indonesia) have also experienced a very rapid growth rate with favourable industrial policies, macroeconomic and political stability together with low labour costs, which led to a flow of massive foreign investment, and provided the transfer of technology into these countries that the first-tier NICs had to acquire through other methods [4].

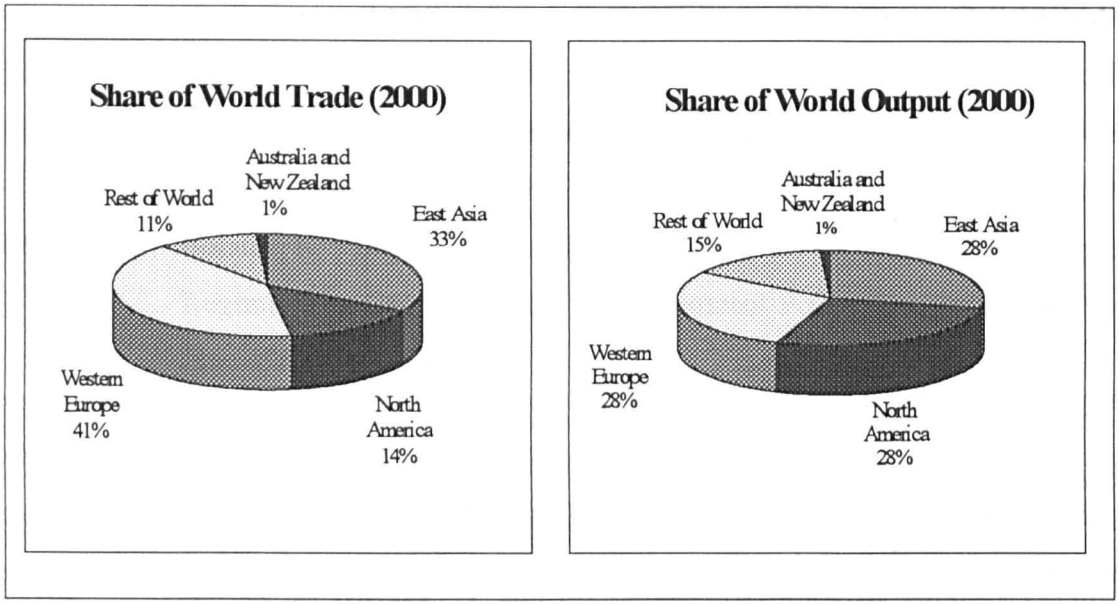


Figure 5.1 The Share of East Asia in World Trade and Output by the year 2000
Source: Garnaut, R. et al (1995).

The other point which one can consider, is the diversity of these countries in some overall economic indicators such as per capita income, natural resources and the process of their industrialisation, which can be helpful for other developing countries with different characteristics to pursue their development strategies. As Amsden (1994) noted, it is quite reasonable to advise LDCs to adopt a variant of the East Asian model. She also believes that the main reason behind this is that East Asia has had some of the highest growth rates of output and productivity in the world during the last decades and therefore may provide useful guidance for other developing countries [5]. The importance of the East Asian NICs can also be attributed to their key role as currently the world centre of international market and trade. Although there are some differences in the stage of development, size of economy, resource endowment etc, the industrial and technological development experience of these countries has been of interest to most Less Developed Countries (LDCs), in particular those which attempt to promote their technological capability through the same pattern of rapid industrialisation. Moreover, the analysis of the industrialisation experience of East Asian NICs may assist the policy makers in other LDCs in an understanding of the development process. The success of the East Asian countries, as Krugman (1994) noted, shows that there is a major diffusion of world technology in progress, and western nations are losing their traditional advantage. He also believed that the significantly successful performance of East Asian NICs can also demonstrate that the world's economic centre of

gravity will inevitably shift to the Asian nations of the western Pacific [6]

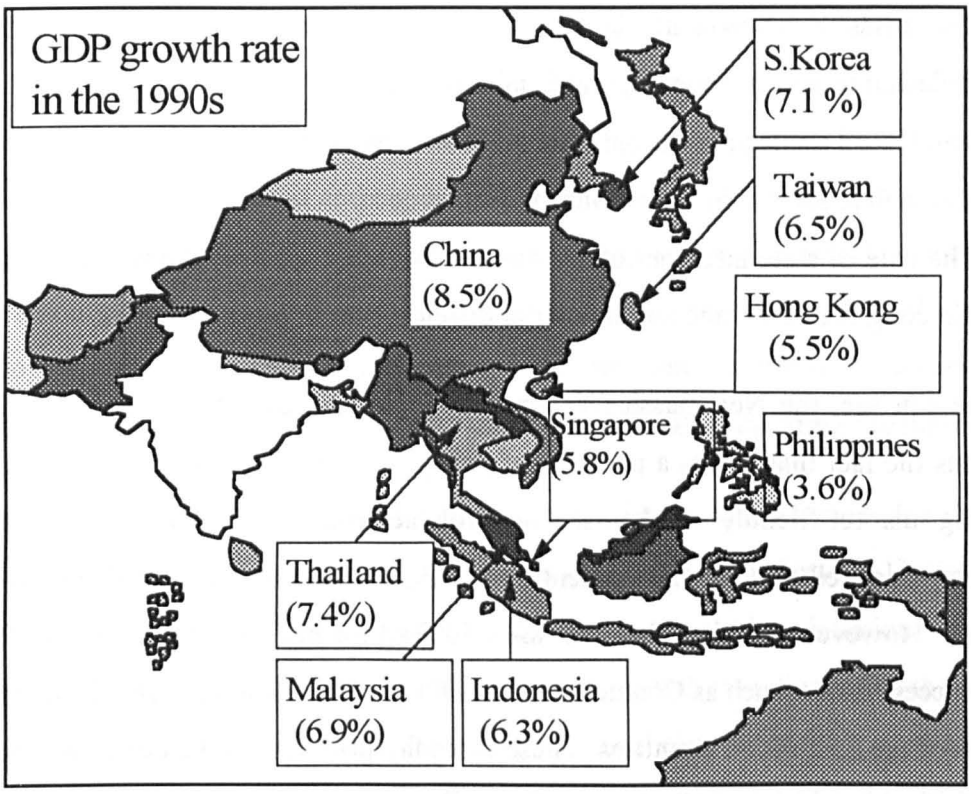


Figure 5.2 East Asian first and Second-tier NICs

5.2 THE MOST IMPORTANT SUCCESS FACTORS OF EAST ASIAN NICs

Having surveyed the success factors of these countries in rapid industrial and technological development, it is widely recognised that the core of development success in East Asia has been a set of appropriate policies mainly focused on macroeconomic stability, human resource investments, promoting industrial and technological capability and outward orientation, which to some extent were quite different from the experiences of most other developing countries. However, it is noteworthy to review different views about the success factors of these countries.

Neo-classicalists believe that the rapid and successful development of the East Asian countries can be contributed to the following reasons [7]:

1. Relying on an open economy with free trade in goods and services and a free flow of capital investment, technology.
2. Adoption of aggressive export-orientation strategies has been a key factor contributing

to their success.

3. The massive investments in development of their human resources, education, technical training, technology and infrastructure.
4. Providing a stable political and macroeconomic environment which enabled the private and public sectors in these countries to succeed.
5. The role of state intervention by supporting rather than supplanting the markets, in directing the economic and industrial development in these countries.

As one can see, the Neo-classicals' view about the success of East Asian NICs again confirms the fact that it was a package of policy measures in these countries and mainly adopting market-friendly mechanism towards acquisition of foreign investment and technology as well as heavy investment on human capitals that contributing more in their success. However, the Neo-classicals are criticised for not considering many other East Asian success factors such as Confucian ethics. Hill (1993) has noted three factors affecting success of the East Asian countries. These three factors have been an effective role of the state with a stable and flexible policy environment, conservative macroeconomic management, and the outward orientation policies of these countries. However, the most important element of the East Asian countries, as he pointed out, has been their pragmatic, outward looking policies [8]. The very rapid growth rate of exports and particularly manufactured exports which resulted in the rapid pace of the overall growth performance in these countries can be considered as evidence for the significant role of export-promotion policies in their success. Henderson (1993) has also referred to six elements for the success of the East Asian countries [9]:

1. The historical contexts and conjunctures out of which their transformative processes emerged.
2. The role of foreign aid (both military and civil), and particularly from the United States.
3. Direct investment by transnational corporations.
4. The significance of a regionally unique economic culture based in Confucianism.
5. Repressive labour systems that ensured supplies of cheap labour.
6. The important role of free markets and state policies.

Henderson's view about East Asian success concentrated more on some other factors such

as foreign aid in their earlier stage and the existence of a Confucian ethic which encouraged discipline and a hard working labour force. According to a survey of the World Bank (1993), there are some general features of East Asian countries' policies and strategies that can be applied for future development in other developing countries. Firstly, their very significant outward orientation and export promotion policies which have made them key players in the international market. Secondly, their massive and efficient investment in human resources which played a major role in the development of their industrial and technological capability. Thirdly, the vital role of state and government policies which directed these economies to a very rapid rate of growth through supporting the market [10].

Another World Bank survey (1993) refers to some key success factors for the rapid economic and industrial development of East Asian countries as follows [11]: Firstly, the macroeconomic stability in these countries such as a relatively low inflation rate which provided an appropriate environment for achieving high growth rate. Secondly, the creation of a broad base of human capital which has been an essential element in their rapid economic and industrial development. Thirdly, the efficient financial system which led to high saving and investment rates in these countries. Fourthly, policies which encouraged the absorption of foreign technologies in total factor productivity. Fifthly, their government policies as being "market friendly" such as a very successful export promotion policies which led them to compete in the world market. Finally, the successful creation in these countries of institutions which implemented the above policies is emphasised in both surveys of the World Bank. The most important reason behind the East Asian success story can be the adoption of effective policy measures including outward looking strategy, designing specific programs for developing indigenous technological capability, and expansion of a well-skilled and qualified workforce. A recent survey by Simone and Thompson (1995) has referred to a combination of four characteristics as the main success factor for Asian Pacific countries [12]:

1. Market economy with free trade policy.
2. Special circumstances (such as well-developed infrastructure, well-educated human labour and US and Japanese aid) which are unlikely to be easily duplicated.
3. A shared Confucian heritage emphasising hard work, frugality, hierarchy, and harmony, and
4. It is the consequence of economic planning by a strong state in close collaboration

with a market-driven, export-oriented economy.

Hobday (1995) also refers to some important aspects in success of East Asian NICs including their macroeconomic policy, industrial orientation and technological development strategies and programmes [13]. A continuous and sustainable macroeconomic stability, with low inflation rates and high saving rates assisted these countries to create an appropriate environment for long-term planning and development. Moreover, the adoption of an export expansion strategy has accelerated the acquisition and absorption of foreign technologies to increase the level of productivity and competitiveness in the world market. The massive investment on the development of an appropriate educational and technological infrastructure in each of these countries was also an essential element for their industrialisation. As was shown in the previous chapter, each country designed some specific programmes for enhancing the educational level as well as upgrading the skills of its labour force. The government in these countries established many institutes and polytechnics for vocational and technical training to promote their absorptive capacity for assimilating the new and modern technologies. Finally, the efficient role of government intervention as well as its flexibility in changing the policies whenever found to be ineffective assured a continuous and rapid industrialisation in these countries.

A recent cross-country study by Easterly (1995) shows the significant effect of the four dragons' (S.Korea, Taiwan, Hong Kong and Singapore) appropriate policies as a major success factor. Easterly's quantitative and statistic regressions in investment, education, and low budget deficits indicated that the four tigers were above average in these areas. He added that the good policies make success likely sooner or later. For example, private investment has been exceptionally high in all of the Four except Taiwan. The public expenditure on education has also been high in all of the four NICs except Hong Kong. He suggested that "policy makers should be convinced by looking at cross country evidence that it is a lot better to make miracles feasible through good policy than to make them impossible by bad policy" [14].

Therefore, the success of these countries can not be as a result of a single factor but combination of a set of strategies directed by the effective role of government in these countries. As explained in detail in the country study, despite some different characteristics in these countries such as the size of market, the level of industrial and technological

infrastructure, the level of technology absorption, the level of technicians and engineers, and the level of macroeconomic and political stability, they could manage to improve many of these economic and industrial indicators through the adoption of a common pattern of rapid industrialisation based on strong export promotion policy, accompanied by massive and efficient transfer of foreign technologies and supported by the supportive government programmes in supplying a large numbers of skillful labour force. As the most critical factors contributing to the success of these countries have already been identified, it seems essential to analyse the role of each factor in the rapid industrial and technological development of these countries.

5.2.1 The Role of Government

As indicated earlier, it is widely acknowledged that the government has played a very important role in leading these countries towards a rapid industrial and technological development. The government of most East Asian NICs accelerated the pace of industrialisation through the adoption of various policies, including an early transition to an export promotion policy from the previous import substitution, an appropriate technology transfer policy based on the massive acquisition of foreign technology and development of local technological capability, liberalisation and privatisation policies, and human resource development policy. The government in these countries also provided adequate infrastructural facilities, created an appropriate and stable macroeconomic environment, supported the private industrial firms in their export activities through giving them low interest loans and financial credits.

As Wade (1994) noted, the governments in East Asian NICs acted a supervisionary role in encouraging private firms to promote their level of productivity and competitiveness [15]. He also refers to the S.Korean and Taiwanese governments as leadership states due to their significant role in investing substantially in certain key industries through specific incentives and administrative measures in order to promote their export performances in the international market. Ng and Pang (1993) argued that the quality of intervention was a critical factor in S.Korea's success in industrial policy [16]. They also point out that the governments in some of the East Asian second-tier NICs have allocated extensive resources to developing particular industries. For example, the Indonesian government actively concentrated in the development of an aircraft manufacturing industry while Malaysia

invested in heavy industries and particularly the automobile industry. The government in these countries also concentrated on developing their resource-based industries especially in the early stage of their industrialisation with public enterprise participation, such as mining, petroleum and gas. Amsden (1993) on the other hand, refers to the market-friendly nature of East Asian governments as an important aspect of their success. She argues that the market-friendly approach of government in these countries enabled them to have a stable macroeconomic situation as well as a high share of international trade in GDP, and heavy investment for the expansion of their human resources [17].

The state in many East Asian NICs has also played a critical role in the successful transition from the import substitution to the export-oriented industrialisation policy. The state set the developmental targets; allocated and distributed the required resources; promoted and regulated foreign investment, and protected local firms against foreign competition during the import substituting industrialisation phase, and provided them with several export incentives such as tax and tariff rebates, and establishing FTZs, during the export-oriented industrialisation period [18]. Therefore, the East Asian experience shows that active and selective government intervention in the process of industrialisation can result in significant achievements. However, it should be noted that the conditions that made intervention successful in these countries may not be applicable in other developing countries, or other LDCs might not want to replicate the East Asian experience of government intervention [19].

The governments in most East Asian NICs, with the efficient cooperation and support of the private sectors, conducted effective macro industrial and technological policies through the massive investment in the accumulation and acquisition of foreign technologies, and upgrading the skill of their labour force. However, some resource-rich and second-tier East Asian NICs such as Malaysia, Indonesia and Thailand, adopted a relatively moderate policy of acquiring foreign technology due to the availability of resources in these countries. These countries accelerated the acquisition of foreign technologies more through attracting a massive flow of foreign investment with associated know-how and managerial skills. The government in second-tier NICs played a very active role in creating favourable conditions to encourage the flow of FDI and technology through introducing various incentive measures such as tax exemption and tariff reductions. However, the state in these countries played a relatively passive role in terms of developing an indigenous technological capability

through increasing the R&D activities.

It is generally argued that the East Asian states have been stronger and more efficient than states in other developing countries. For example, in Latin America, the state was not strong enough in creating a stable macroeconomic environment needed for successful implementation of industrial and technological development policies. However, as indicated earlier, in East Asia, the strong state is seen as a key in achieving rapid industrialisation [20]. Another important characteristic of government in the East Asian countries is their authoritarian nature, to which can be attributed the strong state intervention in formulating and implementing the overall policies in the direction to foster rapid industrial and technological development. As Hofheinz and Caldar (1982) argued, East Asian countries' success is based on political systems that seem better suited to economic competition. The authoritarian nature of East Asian political systems can be attributed to their stability, flexibility and a high degree of respect for hierarchy and discipline [21]. Another specific criteria of an authoritarian government is that it can facilitate the transition from a traditional economic and social order to a modern dynamic economy [22]. One can say that most East Asian countries have experienced some form of transition of power or social and economic restructuring [23]. Although government intervention has played a major role in the industrialisation of East Asian countries, the future direction of their policy orientation, is mainly towards private investment and open, competitive markets.

5. 2. 2 The Role of Export Promotion Policy

As indicated earlier, it is widely believed that the early transition to an export-oriented industrialisation policy has been among the key factors contributing to the success of these countries. The exports and in particular manufacturing exports acted as an engine of growth in these countries. As is shown in the previous chapters, as each of these countries shifted to the export promotion policy from the previous import substitution strategy, there was a sharp increase in the growth rate of that country. Therefore, one may find a close relationship between the expansion of exports and overall growth performance in these countries [24]. As Lee and Naya (1988) argued, the adoption of an export promotion industrialisation policy created an appropriate atmosphere for achieving high growth rates in these countries [25]. Booth (1995) also believes that the rapid growth rate in the East Asian countries has mainly relied on their continued growth of exports, which in turn

depended on their capability to compete in the international market. She argues that, these countries efficiently moved out of export industries where they no longer have competitive advantage and into the sectors where they can rapidly compete in the international market [26].

The adoption of an outward-oriented and export expansion policy enabled these countries to allocate their resources efficiently in order to be able to compete in the international market. Hicks (1989) also believes that the success of East Asian NICs was owed to a large degree to the early shift from import substitution to export promotion policies [27]. The export performance of these countries shows that they initially relied on export of labour intensive products and then after an increase in real wages, these countries lost their comparative advantage in labour intensive manufacturing product. Therefore, they shift to export of more capital and technology-intensive products. Moreover, each country has developed its own areas of specialisation. For example, in the computer industry, S. Korea concentrated more on semi-conductors, Taiwan on monitors, Singapore on hard disk drives and Hong Kong on peripherals [28]. It is also argued that export promotion policies can bring higher growth rates than import-substitution policies. This is because an economy based on export expansion has a great opportunity to grow than one based solely on the expansion of limited domestic market. Moreover, export-oriented policies are generally associated with more efficient economies, and have higher rates of investment and increasing capital intensity [29]. The outward-looking policies can also overcome the limitations of the domestic market. Although the Import Substitution Policies have been a base for a transition to successful export promotion policies in these countries, it is believed that ISI has discouraged the adoption and dissemination of industrial technologies appropriate for labour intensive economies such as Indonesia. The import substitution strategy gives little incentive for adapting foreign technology to local conditions and to achieve maximum efficiency. Therefore, one can say that the key to the export success of the East Asian NICs has been their early rejection of import substitution policies in favour of outward-looking policies through the removing the major barriers against exports [30].

The adoption of an outward-looking and export promotion policies enable a country to share technologies and ideas from around the world. Furthermore, an export-oriented policy encourages the expansion of industries with a comparative advantage by concentrating resources in a country's most productive industries. The export-promotion policies have also

accelerated the rapid acquisition of technological capability in these countries. This is mostly due to their competition in international markets which force them to invest more in technological effort. Exports acted as an effective device for encouraging investments in technology in these countries in order to promote the level of productivity and competitiveness. Technological innovation undertaken in response to foreign competition has also provided a continuous stimulus to growth for these countries [31]. Moreover, manufactured export growth provided a dynamic base for technological upgrading in these countries. As Smith (1995) argues, expansion of exports accelerated the process of catching up technologically and closing the technological gap with technological leaders through allowing imports of goods embodying new technology and by increasing overseas contacts and thus access to new ideas on production, technological and managerial skills [32]. As Grabowski (1994) has also noted, the faster exports grow, the more rapidly new technology embodied in foreign-produced capital can be imported [33].

Therefore, it can be said that the rapid growth of manufactured exports in the East Asian countries provided a strong mechanism for their rapid productivity growth and enhancing technological capability. According to a survey by Lall (1990), examining the experience of ten developing countries (the East Asian NICs, Malaysia, Thailand, Brazil, Mexico and Kenya), found that export orientation has been important for building up their national technological capability but not without other ingredients such as human capital development, R&D tightly linked to the production process, a technology strategy, and even protection for technological learning [34].

As discussed extensively in the previous chapter, the rapid growth rate of manufacturing exports in the East Asian countries has been achieved through a number of effective policy measures. Firstly, the package of export incentives including effective depreciation of exchange rate, tax rebates, tariff and custom-duty exemptions for imported inputs needed for exports, low interest rate loans and financial credits for exporters, and establishment of FTZs or EPZs which provided an appropriate environment in promoting the exports in these countries. Secondly, the rapid increase in world demand for exports during the 1960s and early 1970s, and the increasing comparative advantage in labour-intensive manufacturing outputs and later in technology and capital intensive products enabled these countries to raise their shares of manufacturing exports in total exports. Finally, as already indicated, the rapid transition to export promotion industrialisation policies in these countries favoured

new industries with export potential [35]. Moreover, the strong political commitments of East Asian NICs to an export promotion strategy has also been vital for effective and successful implementation of this policy. For example, a system of setting export targets and the practice of holding monthly trade promotions have been among the most important mechanisms which provided some very useful information needed to direct the Korean export drive [36].

Country	Year	Primary product (1)	Semi-manufacturing Products (2)	Manufacturing products (3)	High-Tech products in total exports (4)	Industrial products (2)+(3)	Other products 100 - (1) - (5) (6)
S. Korea	1989	3.3	5.8	90.6	24.4	96.4	0.3
Indonesia	1989	52	29.8	18.2	0.8	48	0
Malaysia	1988	35.3	23.5	40.6	25	64.1	0.6
Thailand	1988	22.9	23.7	49.3	13	73	4.1
Brazil	1987	23.8	30.7	44.5	6.2	75.2	1
Mexico	1989	44.8	14.7	40	7.6	54.4	0.5

Table 5.1 Export composition in Some East Asian and Latin American first and second-tier NICs (%).

Source: Institute of Developing Economies, 1995.

As a result of this series of export incentive measures which created an appropriate environment for the expansion of exports and in particular manufacturing exports, the average share of manufacturing exports to total exports in East Asian countries has increased from 13% in 1965 to 69% in 1993. For example, the manufacture exports consisted of 90% of total exports in S. Korea, 54% in Thailand, 44% in Malaysia and 32% in Indonesia [37]. Table 5.1 shows a comparison of export composition between East Asian and Latin American countries, which has been classified in three main categories: primary products, semi-manufactured products, and manufactured products. For example, in 1989, the export share of industrial products (i.e. semi-manufactured products and manufactured products) were 96.4% for S. Korea and 54.7 % for Mexico respectively. As one can see the share of high-tech products in total exports in some second-tier East Asian countries such as Malaysia with 25% has been even more than that of first-tier East Asian NICs such as S. Korea with 24.4% [38].

Having compared the implementation of an export-oriented policy in the first and second-tier NICs, it seems that the first type of East Asian NICs such as Korea and Taiwan

emphasised more an export expansion policy through providing credits and subsidies for some selected industries in particular capital and technology-intensive industries including heavy and chemical machinery and electrical and electronics manufacturing products. The second type NICs such as Thailand, Malaysia and Indonesia, however, relied more on exports of primary and resource-processed products in the early stages of export-led policy. The processing of primary goods and the production of manufacturing using locally available materials and large labour forces has given a strong comparative advantage to these countries. Moreover, it is argued that in contrast to East Asian NICs, the rate of manufacturing protection up to 1980 has been higher in the Southeast Asian countries. For example, while the effective rate of protection for all manufacturing averaged 13 percent for Korea (1968), and 14 per cent for Taiwan (1969), the protection rate in manufacturing sector ranged from 34 percent for Thailand to 65 per cent for Indonesia. However, after a change to an export-oriented industrialisation policy in these countries, industries receiving protection were pushed to rapidly become internationally competitive [39].

As explained earlier, the transition from import substitution to export promotion policies in both Korea and Taiwan required a reform in exchange rate policy in addition to import liberalisation and export incentives. In Korea for example, one can refer to the major devaluation of 1961 and 1964 along with various measures for the liberalisation of import restrictions and introduction of several export incentives after the devaluation of 1964, which had facilitated the rapid transition to export-led strategy. On the other hand, Taiwan had experienced this transition in the late 1950s and early 1960s when a series of measures switching to export orientation were undertaken. These measures mainly included reforms in exchange rate systems, import liberalisation, and export incentives. Firstly, the multiple-exchange rate system was gradually decreased into a single rate system through a real devaluation of its national currency. Secondly, there has been a gradual liberalisation of import controls and restrictions. Finally, the Taiwanese government introduced various export incentives including mainly the establishment of three export processing zones, cheap loans for exports, and further tax exemption for some export products [40].

Therefore, it can be said that most East Asian countries have achieved export promotion policies through the devaluation of their exchange rate as a main instrument of encouraging exports rather than other incentives such as tax credits or export subsides. As already indicated, both Korea and Taiwan adopted export promotion policies in the early stage of

their industrialisation through various export incentives, mainly a unified and realistic exchange rate. Moreover, almost all of the East Asian successful countries have implemented to some extent import and capital flow liberalisation policies [41]. Moreover, the establishment of some Export Processing Zones has also been one of the most important factors in the success of their export promotion policies. Some East Asian countries in particular Taiwan and Malaysia could expand their manufactured products through attracting large foreign investment and technology by these zones. Hence, one can say that foreign direct investment has played a more critical role in industrial development and technology transfer to Malaysia than in its neighbour Thailand.

The adoption of export promotion in second-type newly industrialised countries, however, mainly started from the late 1960s and early 1970s. As an example, in Malaysia the transition to export-led policies began with adoption of some specific policies. These policies mainly included the investment incentive act of 1968 and some export incentives such as tax deductions and credits, and establishment of export processing zones. One can say that Malaysia relied more on export Processing Zones to enhance its manufactured exports, although such zones were not relatively successful in Indonesia. Malaysia has been a successful exporter of manufactures since the late 1970s and there has been an explicit policy of export-led growth. However, unlike the first-tier NICs, Malaysia is still major exporters of primary goods [42].

As discussed in detail in the previous chapter, Thailand is another country in the Southeast Asia which has switched to the export promotion policy since the early 1970s through specific programs. some of these measures included the export promotion act of 1972, flexible exchange rate policy, and various export incentives such as tax rebates on imported inputs needed for manufacture exports and credits for exporters [43]. It can be said that the export pattern in Thailand was more similar to Korea and Taiwan than was that of Malaysia in the early 1960s. Moreover, it is argued that Thailand and Malaysia's recent export pattern can be closely compared with Taiwan's 1980 pattern [44]. The Thai state has also played a key role in providing the infrastructure such as highways, and power stations required for promoting the country's indigenous industrial and technological capability and promoting the quality of its manufacturing exports. However, there has been less direct intervention in Thailand than S. Korea and Taiwan.

Indonesia's experience as a late-comer to export promotion in the mid-1980s may also provide valuable lessons for the other late-comer LDCs. As discussed in detail previously (Indonesia's case study), following the sharp decline in the oil prices in the mid-1980s, Indonesia switched to export-oriented policies from the previous import substitution and inward-looking policies. This has been done through major policy changes, such as exchange rate devaluation, import liberalisation, and reduced restrictions on foreign direct investment. The Indonesian government also took several measures enhance the flow of foreign direct investment, which could bring high technology and managerial expertise into the country. Although Indonesia is known as a late industrialiser due to its transition to export promotion policies in mid 1980s, its pattern of industrial and technological development has had common features with its East Asian neighbours in its export promotion policy, with Mexico and other oil exporter countries as a petroleum economy, and with India in its large domestic market.

Having faced competition from the cheaper products of some other countries in the region such as China and Vietnam, most second-tier East Asian NICs had no choice but to improve the productivity and quality of their products, and increasing technological activities to diversify their manufacturing exports. For example, Thailand was more successful than Indonesia in doing this. Indonesia's experience points to the fact that reliance on cheap labour to fuel export growth is a risky strategy when other countries are able to supply even cheaper labour [45]. As discussed earlier, the East Asian countries adopted export promotion policies in a different period of time. The exports of labour-intensive manufactured products in the first tier NICs such as Korea and Taiwan expanded sharply from the mid-1960s to the early 1970s, substantially contributing to labour employment and economic growth. However, the second tier NICs such as Thailand and Indonesia did not switch to export-oriented policies, after the easy import substitution in final consumer goods was exhausted [46].

Having compared the experience of East Asian countries in the adoption of export-orientation policies with that of the Latin American NICs, one can see that the former has been more successful than the latter. As Sachs (1985) noted, the Latin American NICs failed to take an effective step towards export-orientation in the 1960s because of a historically urban-industrial society which sought protection [47].

Moreover, it is argued that there is a greater incentive to rely on export-oriented industrialisation in resource-poor countries because such countries cannot rely on export income from primary commodities. This can also be a reason for continuing inward-looking strategy in resource-rich East Asian countries such as Indonesia and Malaysia until the collapse in oil prices, which forced them to move towards export promotion policies. It is also generally believed that the adoption of the successful export promotion policies in East Asian countries enabled them to attain higher investment and productivity rates and therefore led to a rapid growth rate. In contrast, the failure to achieve the expansion of exports confined several Latin American countries to severe balance of payment crises which caused the relatively slow growth rate.

One can say that the successful implementation of liberalisation and stabilisation policies in East Asian countries enabled them to achieve the macroeconomic stability needed for a successful export expansion. The reliance on external credit and continuing protectionist and inward-looking policies in the Latin American countries on the other hand, ended up with serious debt-service problems in these countries. The successful stabilisation and adjustment programs of East Asian countries can be another factors for their success in rapid economic and industrial development [48]. This, in long term perspective, may be very important for the Latin American policy makers to make their best efforts to formulate policy measures in order to promote resource allocation and establish a viable pattern of economic and industrial development.

It is also argued that because of the larger size of domestic markets in Latin American NICs such as Brazil and Mexico, the experience of these countries with import substitution strategies has been significantly longer than those of East Asian NICs. Moreover, although the government in some Latin American NICs such as Mexico, played a major role in allocating resources for growth and in encouraging technical change through foreign investment, the state intervention has been far less effective in these countries in strengthening industrial competitiveness than it has been in East Asian NICs. Furthermore, the longer period of import substitution in Latin American NICs which is also believed to be as a result of their strong bias towards protectionist, resulted in high capital investments and high technology costs and led to an increase in the cost of production in these countries. Although the export growth was comparable between the two regions (East Asia and Latin America), the share of manufacturing increased rapidly in East Asia but only slightly

increased in Latin America. This is believed to be an important difference, as there has been an increasing world demand for manufactured exports compared with primary exports [49]. It is also noteworthy that while most of East Asian countries were successful in avoiding excessive appreciation of their exchange rates, Latin American developing countries have mostly suffered from overvaluation and a high degree of exchange rate instability [50].

Latin America	East Asia
Low economic growth (1.6% p.a.)	High economic growth (7.8% p.a.)
High inflation (192% p.a.)	Moderate inflation (6% p.a.)
Heavy debt burden (> $ 400 billion)	Reduced debt (<$ 200 billion)
Slow-down of foreign investment	Major wave of foreign investment
Stagnation or decline in total research and development (< 0.5 % of GDP)	Rapid growth in total research and development (1-2 % of GNP)
Low share of industrial research and development (<30 % of total R&D)	Growing share of industrial R&D (40-50 % of total R&D)
Weak focus on exports/ competitiveness; low electronics exports	Focus on exports/competitiveness; strong electronics exports
Deteriorating higher education; number of engineering graduates per 100,000 population less than Japan	Expanding higher education; no. of engineering graduates per 100,000 population greater than Japan
Very high income disparities	Relatively low income disparities

Table 5.2 A Comparison of some of the main macro-economic indicators between East Asian NICs and Latin American NICs

Source: ACCEDE, " The Benefits of Free Trade: East Asia and Latin America", 1994, P:100

The other major difference between the East Asian and Latin American NICs is that the exports from the former have almost focussed on manufacturing goods, while in Latin American NICs such as Mexico and Brazil, the manufactured products are included less than one- half of their total exports. For example, the annual average growth rate of manufactured exports during the period between 1966-73 increased by 22% and 21% in Taiwan and S. Korea, respectively, compared to 6.4% and 11.8% in Mexico and Brazil. The Latin American NICs, however, have exported a more diversified range of products, reflecting their more abundant supply of natural resources. The East Asian NICs have been shifting their manufactured exports from labour-intensive products to more technology and capital intensive goods [51].

It can be said that one of the most important reasons behind the significant export

performance of the East Asian countries which has also distinguished them from the experience of other countries in the implementation of export promotion policies is the close co-operation of the public and private sector in these countries. As discussed in detail in previous chapters, the government in many East Asian countries have introduced various incentive policy measures for their private firms in order to encourage them in the export activities. The private enterprises of these countries have pursued the priorities of the state more readily than other countries. Therefore, the experience of East Asian NICs in successful implementation of an export promotion policy indicates that it is not export expansion policy itself that led to their success, but rather how a specific country can manage and implement this policy successfully so that it can contribute to the significant export performance of these countries.

Therefore, as has already been analysed, the adoption of outward-oriented, export promotion policies have played the key role in the overall successful performance of the East Asian first and second-tier NICs. Exports have been a leading, and sometimes even the primary, source of growth in these countries as the initial take off came after increasing of their exports, resulted from transition to export promotion policy in the early stage of their industrialisation. However, it is believed that the adoption of an outward looking industrialisation strategy which has brought a significant growth rate for East Asian countries, was not obtained without cost. One can see that most of these countries have depended largely on importing foreign material and inputs from developed countries in order to export their manufacturing products into the international market [52]. Moreover, there are some other critics who claim that the fast growth of exports in Southeast Asian countries (such as Thailand, Malaysia and Indonesia) was mostly because of the international relocation of labour-intensive and assembly-based industries from the NICs (such as Korea and Taiwan) and Japan in these countries which led to heavy dependency on imports of parts and components [53].

It is believed that only a few developing countries seem to be able to sustain the social and political bases required for long-term export-oriented industrial development strategy. One can also add to the above point that the model of national economic growth based on export of manufactured goods has been a partial approach toward the national development of these countries [54]. Furthermore, although the export promotion policy to a large extent has had a contributory effect on the industrial development of East Asian countries, it is

however argued that this strategy can not guarantee overall improvement in a country's income distribution. This depends on many other factors which have probably been favourable in the first- tier East Asian NICs, but much less so in the second-tier East Asian NICs, as many of the second-tier east Asian NICs, in particular Thailand and Indonesia, suffered from imbalance distribution of income and facilities.

5. 2. 3 The Role of Technology Transfer

The experience of the East Asian first and second tier NICs in the importation, adaptation and spread of new technology can also be invaluable for other developing countries. As many other countries tried to replicate their model of technology transfer and development, it seems essential to analyse more in depth their experience of technology transfer and development. The adoption, assimilation and absorption of imported technologies can play an important role in the industrial and technological development of any country. As mentioned earlier, the adoption of an appropriate mode of technology transfer from more advanced economies to developing countries has played a vital role in accelerating their pace of industrialisation. As discussed in the previous chapter, East Asian NICs have made extensive use of many ways of obtaining foreign technology.

However, this does not mean that each of these countries has employed similar method of acquiring foreign technology. While those of second-tier NICs such as Malaysia, Thailand and Indonesia, along with small city-state NICs such as Hong Kong and Singapore have relied on all forms of transferring foreign technologies and in particular FDI, the larger and the first-tier East Asian NICs such as Korea and to a lesser extent Taiwan, have used less FDI in the earlier stage and more on licensing and importing capital goods and more recently on domestic R&D. There has also been a major effort in all of these countries to make maximum use of foreign technology through different modes. One of the strongest similarities among most East Asian first and second tier NICs in the way they acquire foreign technology has been their very high dependence on imported capital goods. There has been a high rate of imports of capital goods in Korea and Taiwan, even though they have also developed very strong local capital goods industries. The second-tier East Asian countries have also transferred a substantial amount technologies embodied in machinery and capital goods.

It seems that due to a relatively high financial resources and technical expertise needed to

enter a costly licensing agreement, it was mostly used by East Asian first-tier NICs including S.Korea andTaiwan as a method for acquisition of foreign technology. Moreover, despite using some methods such as imitation and reverse engineering in some countries with stronger technological capability, as local firms in these countries seek to produce goods requiring more sophisticated technical know-how, copying becomes a more difficult proposition. Thus, for such products licensing may be the most effective means of technology acquisition. Moreover, there has also been more tendency in S. Korea to use turnkey projects and machinery imports in the early stage of its industrial development. In Thailand and Malaysia, foreign direct investment was a major channel for acquisition of foreign technology. The Indonesian firms have mainly received technology through licensing and technical assistance agreements. Training the technical human labour by the foreign firms has also accounted a popular mode of technology transfer in Indonesia. However, Indonesia is considered to have the least level of technical capability among the East Asian first and second-tier NICs due to lack of adequate infrastructure and technical expertise to assimilate and absorb efficiently foreign technology to its local condition.

It is also believed that the rapid growth in technological sophistication of first and second-tier NICs' manufacturing products has been achieved more through the state-managed joint investment and licensing agreements than the whole-owned investment by multinational companies [55]. Therefore, their national technological capability has been strengthened through the absorption of knowledge and technical know-how. As discussed earlier, it is believed that the adaptation and diffusion of technologies and know-how can be achieved more through joint venture than by FDI under the complete control by foreign Multinational Company. This is mainly because under a joint venture agreement, the local partner can learn better the technical and managerial skills embodied in foreign technologies and even it was able to set up a national company, this could not have been done before entering the joint venture. For example, the Korean case of a close working relationship between government and industry in the establishment of technology institutes in the 1970s and 1980s may provide useful implications to the possible replication of that experience elsewhere [56].

As indicated in the country study survey, it seems that some second-tier East Asian NICs such as Malaysia and Indonesia have employed more regulation of technology imports than Thailand. Malaysia, on the other hand, seems to use a higher degree of regulation than

Indonesia through setting up a specific Technology Transfer Unit to examine technology contracts. It should be noted that most second-tier East Asian NICs have also been influenced by the Korean Model of encouraging domestic research, and heavy investment in its education activities to enhance technology transfer. However, fewer of these countries have noted that planning for technology transfer and development requires designing an appropriate specific plan and strategy for technology transfer within the country's overall national development framework as well as an understanding of the country's existing quantitative factor of endowments [57].

As discussed earlier in detail, most second-tier East Asian NICs (Thailand, Indonesia and Malaysia) followed relatively open-door policies towards technology transfer and there were no special legal arrangements regarding technology transfer. For example, there were no restrictive policies and special legal frameworks in Indonesia and Thailand regarding transferring foreign technology. Despite some internal guidelines which were needed for firms wishing to obtain investment incentives by Thailand's Board of Investment, all firms were free to enter into any kind of technology agreement [58]. The Thai government has also taken specific measures to increase bargaining power in the acquisition of technology, through using various effective incentives for foreign investors to attract foreign investment projects, which also brought managerial and technical skills into that country. The open policies towards transfer of technology enabled the country to import a substantial amount of foreign technology in the past years. For example, in 1993, Thailand had spent about $ 550 million on direct purchase of technology of which an estimated $ 400 million was for royalty and brand-name fees, and about $148 million was for technology fees [59].

There has recently been a considerable shift towards more government efforts in expanding research and development activities and technical training in the East Asian second-tier NICs. In Malaysia, for example, the Ministry of Trade and Industry is responsible for ensuring its local firms take most benefit from the inflow of technology. The Malaysian Technology Development Corporation (MTDC) has also been established since 1992 to support private companies through various fiscal and financial incentives in order to commercialise their research results.

As indicated earlier, the Thai government has also tried to play a more effective role in the development of the science and technology of the country. Hence, it has set up an overall

plan for this purpose, emphasising key targets such as the promotion of local technology capability through increase in R&D expenditure as a percentage of GNP and more investment in the development of its human resources. In order to achieve the objectives of the plan, several key measures have been taken, such as the establishment of a Technology Transfer Centre to collect, evaluate, and disseminate foreign technological information for local business and industry. In addition, a number of specialised research centres such as the Thai Institute of Scientific and Technological Research have been established in order to adapt foreign technology to local conditions [60].

As indicated in detail previously, East Asian first-tier NICs such as S. Korea and Taiwan placed more emphasis on strengthening their indigenous technological capability in contrast to second-tier East Asian NICs including Thailand, Malaysia and Indonesia. This is mainly because of the allocation of substantial investment in their national education at all levels, as well as high expenditure in R&D activities as a percentage of GNP. Moreover, S. Korea and Taiwan formulated a well-defined industry and technology development strategy which has been an important aspect of the catch up drive of these countries. This strategy concentrated more on an extensive plan to promote indigenous technological capability through development of research and development, infrastructure, and human resources. Therefore, the government in these countries introduced various measures to promote the numbers of scientists and engineers as well as technicians and skilled workers, to increase the level of absorptive capacity for more sophisticated technology. They also established a strong industrial infrastructure base and also enhanced the level of productivity and competitiveness of manufactured products in particular in some high and advanced technologies and industries [61].

As discussed in the country study in detail, the second-tier East Asian NICs have transferred more technology from Japan and some first-tier NICs such S.Korea and Taiwan. This is mainly because of lower cost due to close proximity, and better appropriateness and adaptability of Japanese and Korean as well as Taiwanese technology to the local conditions of these countries. Moreover, Japan and East Asian first-tier NICs have also gained significant benefit from transferring technology to these countries, such as a substantial earnings as well as development of technological capability through the recognition of their comparative advantage [62]. Choi et al (1989) classified some countries in the Asian and Pacific region to the different groups through focusing on some important industry and

technological characteristics [63].

Group	Major Technological	Countries	Industry Characteristics
I (Characterised by Self-propagating by Dynamism)	- A dynamic S&T base. - Creation of new technology based on advanced sciences	Japan	Brain-intensive (in the process of shifting towards a post-industrial society characterised by knowledge and information
II (Existence of some Dynamism with Potentials for Future Growth through Integrated Approaches)	- A Growing / Diversified S&T base - Improvement of imported technology and some technology generation	S. Korea Taiwan Hong Kong Singapore India China	Technology-Intensive (technological competence in India arising from science and technology development for domestic market, but in cases of other countries from export-oriented development and international competition)
III (Existence of Elements of Dynamism and need for Integrated Approaches).	-Existence of S & T base - Digestion and adaptation of imported technology and some improvement of existing technology	Indonesia Iran Malaysia Pakistan Philippines Thailand	Skill-Intensive and resource rich; more relied on export of resource-based products; relatively cheap labour force
IV (Near Absence of Technological Dynamism)	- Weak S&T base - Some utilisation of technology	Bangladesh Nepal Sri Lanka Vietnam & Pacific Island Countries	Operation-Intensive (early phase of and/or partial industrialisation to meet domestic needs; predominance of agriculture

Table 5.3 Major Technological Focus and Industry Characteristics in the Asian and Pacific Region

Source: Choi, H.S. and Subramanian, S.K. and others " Hybrid of Man and Technology", Asian Productivity Organisation, Tokyo, 1989.

As is shown in Table 5.3, Japan is distinguished from the other East Asian NICs, mainly due to its capability to create new technologies and products, characterised by their high knowledge and technology intensity. The East Asian first-tier NICs along with India can be classified in the second group, because of their capability in improving some existing

technologies and generating some new technologies and products. However, while India has relied more on an inward-looking pattern and self-sufficiency strategy for its industrial and technological development, the East Asian first-tier NICs have adopted the outward-looking and export-promotion industrialisation policy. It is also argued that India has also adopted restrictive policies toward foreign direct investment. The East Asian second-tier NICs, as well as Iran and Pakistan are classified in the third group, which is categorised through their capability in assimilation and adaptation of imported technologies and improvement of some existing technologies.

Having compared the methods of technological acquisition, one can say that the Latin American NICs such as Brazil and Mexico have relied to a larger degree on foreign direct investment in the early stage of their industrialisation, than Southeast Asian NICs. such as S.Korea and Taiwan. For example, relative to its size, Mexico had the largest imports of technology and foreign direct investment of all the NICs. However, one can say that the access to foreign technology for Mexico did not lead to significant indigenous technological capability, as well as the East Asian first and second-tier NICs. The East Asian NICs have also used other methods of acquiring technology such as technology licensing and joint ventures and imports of capital and intermediate goods. One can also say that the East Asian human resource development policies have been more successful in comparison with that of Latin American NICs. For example, the secondary educational levels in Latin American NICs have been on average one-third lower than with that of East Asian NICs.

5. 2. 4 The Role of Foreign Direct Investment

As indicated earlier, almost all of the East Asian first and second-tier NICs (except S.Korea in the early stage of its industrialisation) have adopted open-door policies towards attracting foreign investment which has also been a major source of managerial and technological expertise in these countries. The main determinants that made these countries more attractive to foreign investors, have been due to their faster economic growth, the existence of efficient infrastructure facilities, stable macroeconomic and political stability, cheap and skilled labour force, and the openness of their market [64]. Moreover, the proximity to Japan and sharing several common features with the Japanese cultural condition have been other reasons to attract a substantial amount of Japanese investments [65]. It should be also noted that the early transition to an export promotion and outward-looking industrialisation

policies in these countries has also been a key role to encourage foreign investors to relocate many of their labour-intensive, assembly and export-oriented industries into these countries to take most advantage from their cheap labour and abundant natural resource [66].

East Asian countries have received 8 per cent of world FDI during the period between 1972-1987, and also accounted for 49 per cent of FDI in developing countries by 1987. According to another figure, FDI inflows to developing East Asia increased from about $3 billion in 1986 to $19 billion in 1992, which was from 33 percent of total external resource inflows to 38 percent [67]. Some East Asian countries such as China, Hong Kong, Malaysia, Singapore, Taiwan and Thailand, received an annual average of $ 7.4 billion in FDI [68]. As explained earlier, the high rate of FDI enabled most East Asian countries to develop their financial and macroeconomic stability as well as their technological, managerial and marketing skills. It is also argued that the significant amount of FDI provided these countries a strong linkage to connect with international markets [69]. The flow FDI also created several employment opportunities for these countries and also enabled these countries to utilise their human capital more efficiently by improving their managerial and technical skills [70].

As indicated earlier, among the East Asian first and second-tier NICs, FDI has played a relatively less important role in S. Korea in terms of technology transfer than its counterparts. According to a recent survey by Asian Development Bank (1995), the share of FDI to GDP between 1985 and 1987 has been 1.4% for the S. Korea comparing with 3.3% for Taiwan, 8.7% for Thailand and 25% for Singapore [71]. This is mainly because of S.Korea's restrictive policies and regulation as well as its use of other methods of technology acquisition such as licensing and imports of capital goods and machinery. However, S. Korea has adopted more open policies toward FDI since 1984. Moreover, it is argued that the experience of S. Korea in terms of its low level of FDI in the early stage of industrialisation shows that despite the key role which FDI can play in transferring technology and managerial expertise, it can not be considered as a necessary condition for improving a country's indigenous technological capability. This also requires increasing efforts in R&D activities as well as developing an adequate industrial infrastructure [72].

As discussed earlier in detail, the East Asian countries have adopted various policy measures in order to attract more foreign investment and technical know-how. These include several

incentives to foreign investors including tax exemption and free custom services, allowing up to 100% ownership, establishment of Export Processing Zones or Free Trade Zones and providing necessary and adequate physical facilities and raw materials to facilitate business operations of foreign investors by reducing the production costs. For example, Taiwan introduced up to 20% tax credits to enterprises and MNCs that invest in its automated production equipment [73]. It is also believed that the establishment of investment boards or centres in the Southeast Asian countries, such as the Indonesian Capital Investment Coordination Board (BKPM), the Malaysian Industrial Development Authority (MIDA), and the Board of Investment (BOI) in Thailand were very important to promote, coordinate and monitor FDI. However, some investment boards failed to perform as expected, lacking in expertise and needing changes in decision making processes [74]. Among the various measures introduced for promoting the FDI in East Asian countries, it is believed that a stable macroeconomic environment, an efficient tax system and open markets have contributed more in attracting foreign investment into these countries [75].

Moreover, as indicated earlier, the East Asian first-tier NICs gradually lost their comparative advantage as an attractive base for FDI in the 1980s, due to a sharp rise in real wages, a revaluation and appreciation of their currencies against the U.S. dollar which led to an increase in the cost of the production in these countries, and the emergence of new competitors mainly from the second-tier NICs in the region. Therefore, they decided to expand their investment in the second-tier East Asian countries in the late 1980s. Most FDI acquired by the first-tier NICs of the East Asia such as Korea and Taiwan, has been invested in the manufacturing sector of the second-tier East Asian NICs such as Malaysia, Thailand and Indonesia. Therefore, the bulk of FDI including a package of capital, technology and marketing skills has been attracted by the manufacturing sector in these countries which enjoyed comparative advantage. Moreover, the significant flow of FDI to the manufacturing sector of East Asian countries led to an increase in production capacity in these country. For example, S.Korean firms tended to invest either in labour-intensive industries, such as foodstuffs, textiles, footwear and leather, and wood and furniture, or in resource-intensive products, such as chemicals, nonferrous products, and fabricated metals. The labour-intensive industries accounted for about 54% of the investment in Thailand, 81 % in Indonesia, and 60% in the Phillippines. The share of the resource-based industries has been high in some East Asian resource-rich countries in particular Malaysia [76]

Country	U.S.	Europe	Japan	Asian NICs	Others	Total
China	3121	1068	2173	47001	4761	58124
Indonesia	385	756	798	2490	3290	7719
Malaysia	213	75	257	248	119	912
Thailand	16	35	66	42	74	233
Philippines	88	125	112	93	114	529

Table 5.4 Foreign Direct Investment in Selected Asian Countries, 1993 (Millions of dollars and Percentage increase over 1992):

Source: ESCAP, (Economic and Social Commission for Asia and the Pacific (ESCAP), "Outlook for Trading Opportunities in the ESCAP Region", Paper of workshop held in Jakarta, Indonesia, June 1994.

By the late 1980s and early 1990s, the flow of FDI in these countries increased significantly particularly in export-oriented manufacturing. In 1991 Malaysia, Thailand, Indonesia, and S. Korea were the third, fifth, seventh, and eighth largest recipients of FDI respectively among developing countries, after China and Mexico. As indicated earlier, in addition to relocation of their assembly activity, labour and resource-intensive industries, the East Asian first-tier NICs have also transferred a substantial amount of technology to other developing countries in particular the second-tier East Asian NICs. Moreover, due to their high level of technological capability and industrial infrastructure, some industrial enterprises in the first tier East Asian NICs acted as intermediaries. This indicates that they have been used as a base to modify more advanced and sophisticated technologies for the use of other developing countries. Therefore, other developing countries with lower technological capability find it easier to adapt and cope with those technologies which have already modified in these countries [77].

It is believed that the large share of some Latin American NICs such as Brazil and Mexico in total FDI during the early stage of their industrialisation was mainly concentrated in capital-intensive industries which were heavily dependent on importing foreign inputs and therefore led to the heavy dependency to MNCs. However, much FDI in the East Asian first-tier NICs has been focused on labour-intensive industries and did not result in the same degree of dependency as their Latin American counterparts during the same period [78]. Therefore, it should be noted that although the level of FDI as a share of total output was twice that of their East Asian counterparts in that period (1960s), the former was less

successful in comparison with the latter in developing a relatively self-sufficient technological base, due to some factors such as the long-term inward-looking policies as well as the larger domestic market which caused much of the FDI going to the Latin American NICs to be used for the domestic market rather than contribute for exports [79].

Another important aspect of the East Asian countries is that the investment boom was sustained over a longer period of time in comparison with their Latin American counterparts. It is believed that the sustained investment boom and export orientation have created "a virtuous circular pattern of accumulative expansion" in the East Asian countries [80]. As Petri (1995) has also noted, there has been a "virtuous circle of investment, trade and growth" in these countries. This means that the outward-oriented, export promotion policies and investment policies have led to an expansion of trade and exports and attracted FDI, and this in turn has encouraged government in these countries to sustain policies that are in favour of international linkages [81]. This is mainly because export earnings led to higher investment in these countries, which in turn further resulted in higher exports. One can also say that at the centre of this process is the dynamic role of finance, technology, and know-how which comes with FDI, mostly through multinational companies.

5. 2. 5 The Role of Human Resource Development

As in most studies undertaken about the successful experiences of East Asian NICs indicate, many of these countries in particular the East Asian first-tier NICs have invested heavily in development of their human resources which played a major role in their success. Lall (1993) argues that the industrial success of the East Asian NICs is clearly linked to their capability development based on large investments in education and training [82]. As indicated earlier, one can find a strong linkage between the development of human resources in a country and its indigenous technological capability. In other words, human capital and technology complements rather than substitutes in modern industrial production. It is also argued that the availability of well-educated human resources is more important than the availability of natural resources in industrial and technological development of a country. Each country has to build up its human capital base in order to make effective use of its technological base and strengthen its technological capability. Therefore, one can say that it was East Asian NICs' massive investments in human resource development that enabled them to acquire technological capability rapidly and also led to their rapid industrialisation.

It is also believed that the high levels of investment in technical human capital in the East Asian countries have been an important factor for their effective assimilation of foreign technologies.

It is also argued that East Asian countries managed to utilise their human resources very efficiently through designing specific plans and programs for upgrading their educational as well as skills levels. As discussed earlier, the rapid pace of industrialisation and technological development in these countries necessitate the development of quality as well as quantity of their labour force in order to adopt, assimilate and absorb modern and new technologies more effectively [83]. It is believed that for a country to assimilate modern labour intensive technologies, it is estimated that about 50% of population should have attained a secondary level of education. It is also considered that in order to be able to adopt and even export high technologies, a country needs about 30-40 per cent of college and university enrolment in the 20-24 years age group. However, despite the various attempts by several developing countries only S. Korea has reached such a level [84].

As explained in detail in the country study, almost all East Asian countries in particular the first-tier NICs such as S. Korea and Taiwan have paid attention to the importance of human capital and adopted various policy measures in promoting their educational systems both quantitatively and qualitatively. Therefore, the government in each of these countries has formulated a series of human resource development plans in order to meet the demands for their growing industrial bases. There have been a substantial number of educated and well-trained workers among first-tier NICs since the early stage of their industrialisation in the mid-1960s. The education system in these countries has also developed very rapidly. For example, secondary school enrolments in the S. Korea and Taiwan were approximately at the same level of developed countries by the mid-1980s. These countries combined the high level of education with imported technology and the return of expatriates to produce rapid productivity growth [85].

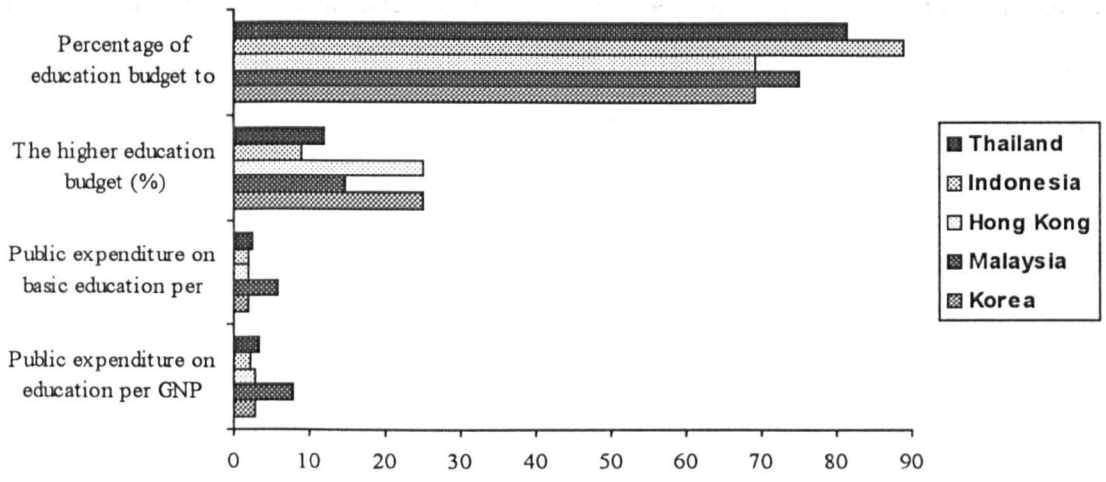


Figure 5.3 A Comparison Share of Public Expenditure on Basic and Higher education in Some of the Successful East Asian Countries

Source: World Bank 1993, P: 199.

There were also high educational levels among second-tier NICs, but far less than that of first-tier NICs. The number of scientists and engineers in proportion to total population are also lower than that first-tier NICs. Among the Southeast Asian second-tier NICs, Malaysia has been more successful in human resource development policy than Thailand and Indonesia, due to a large investment in education and the labour force. As discussed earlier, the low level of skilled workers and lack of adequate technicians and engineers in some countries such as Indonesia and Thailand can be considered as a major restraint to the effective adaptation and dissemination of new technologies in these countries. However, more recently these countries have attempted to improve the level of educational indicators through specific programmes. For example, the Thai government has given specific priority to the national efforts for directing its educational system to supply an adequate well-qualified labour force for its industrial bases by placing emphasis on vocational and technical training. For instance, one can refer to the plan in which a six-year compulsory primary education has been proposed by Thai's state in the early 1980s [86]. Moreover, Thailand has also put especial emphasis on tertiary education, in an attempt to fill wide gaps in secondary and tertiary education.

The public investment has been concentrated more on the expansion of primary and

secondary education in most East Asian countries. At the post-secondary level, public spending has focused on scientific and technological education. Many of these countries also sent large numbers of their students abroad, particularly in some science and engineering fields and technologically sophisticated areas. The overall educational investments in these countries have been well-focused on the acquisition and mastery of technology. Thus, one can say that the high educational and skill levels in most East Asian countries can be regarded among the major factors of their overall success [87]. The high investment of education in Taiwan and S.Korea has been very productive in supporting their economic growth through concentrating on the lower level of education in the early stage of their industrialisation, and later on the higher education. For example, in Korea, enrolment in higher education increased twelve fold during 1945-60, under the simultaneous influence of deliberate government strategy to strengthen higher education and of the Confucian values placing great importance on education [88].

country	Total Capital Stock 1980=100		Technology inflows as a % of GDI (Gross Domestic Investment)			Human resources 1987 or most recent year for which data are available				R&D expenditure as a percentage of GNP
			Capital goods imports	FDI	Technical cooperation	Literacy rate %	educational enrollment			
	1972	1988	1975- 87	1975-87	1975-1987		at second level as % of age group	per 100,000 population		
								Science & Technology 3rd level	Vocational training 2nd level	
Mexico	61	111	21.0	3.5	0.1	90	53	453	1,051	0.6
Turkey	44	156	25.0	0.8	0.5	74	46	222	1,402	0.7
Indonesia	26	177	17.2	1.5	1.1	67	39	16	626	0.3
Malaysia	33	167	34.9	9.0	0.8	70	59	85	122	0.8
S.Korea	21	239	25.7	0.9	0.1	88	89	765	1,970	2.3
Taiwan	-	-	33.2	3.3	-	92	91	795	2,082	1.1
Thailand	49	147	23.6	3.0	1.4	79	30	-	648	0.3

Table 5.5 Investment in Technology and Skills in some successful countries.

Source: United Nations Conference on Trade and Development (UNCTAD) 1991

As we can see in the Table 5.5, S. Korea and Taiwan have achieved the highest levels of educational enrolment in science and technology per 100,000 population, with enrolment ranging from 765 to 795. Taiwan has also successfully formulated its human resource development policies to meet the requirements of different stages of its economic and industrial development. One can also refer to the relatively high literacy rate in Taiwan (92%) and S.Korea (88%) and also the high level of research and development expenditure as a percentage of GNP in S.Korea (2.3) and Taiwan (1.1), as an important factor for the

better assimilation and absorption of foreign technologies. The growing rate of skills and R&D activities in East Asian first and second-tier NICs have also increased the level of their competitiveness and productivity in international market.

As discussed earlier, the level of education and the quantity and quality of engineers and technicians in each country have been the most important factors in the assimilation and improvement of the imported technologies in order to become competitive in the international market. Each country has attempted to provide a relatively adequate number of technicians and engineers necessary for adapting and developing foreign technologies. Several institutes and polytechnics have been established in each country to train the technicians and engineers needed for national industries. Therefore, improving the quality and quantity of education indicators as well as increasing expenditure in R&D activities have been among the important elements in determining the level of indigenous technological capability in each country. It is also argued that East Asian NICs have been more successful in introducing more efficient techniques of production. For example, one can refer to high value-added per worker in manufacturing which have been considerably ahead of the other developing countries [89].

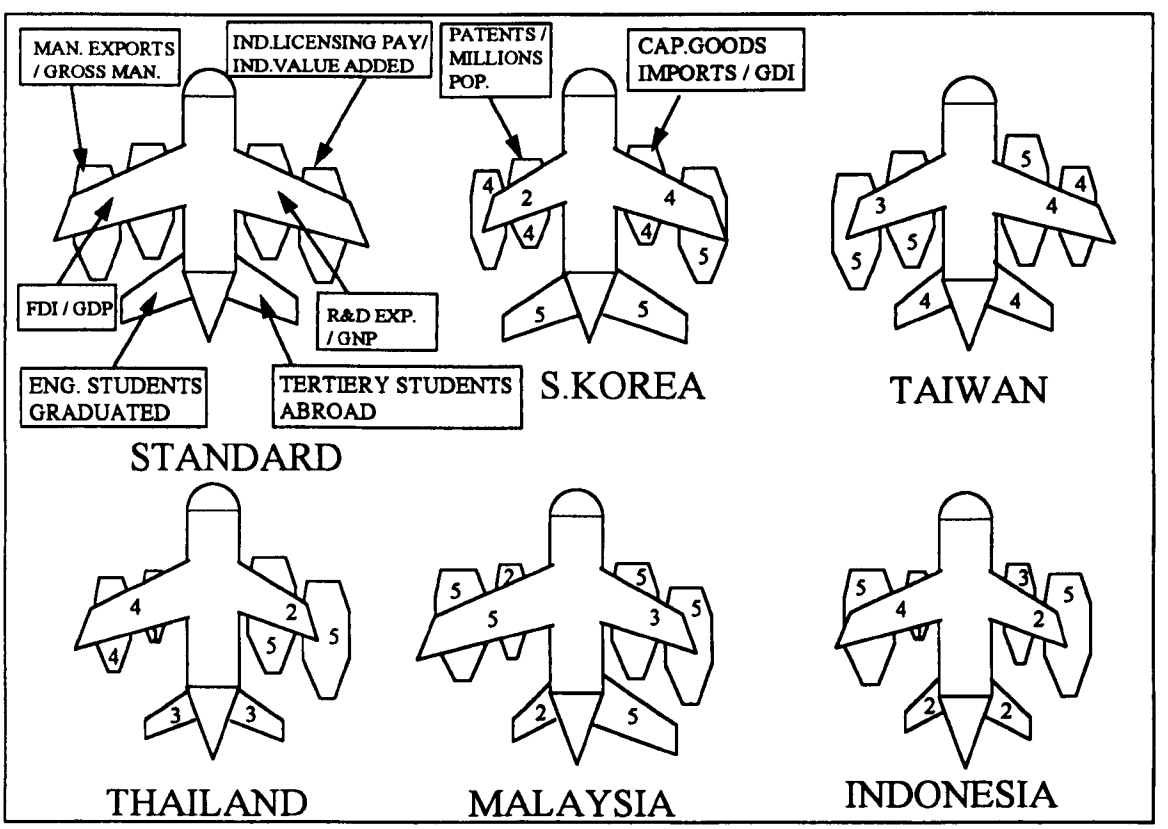


Diagram 5.4 Some of the most important science and technology indicators in East Asian

Diagram 5.4 Some of the most important science and technology indicators in East Asian first and second-tier NICs

As is shown in Diagram 5.4, some of the most important science & technology variables and indicators of the East Asian first and second-tier NICs, have been compared. These indicators include: the ratio of manufacturing exports to total exports, the ratio of industrial licensing to industrial value-added, the share of FDI in GDP, the share of R&D expenditure as a percentage of GNP, the number of engineering students graduated and the number of tertiary students abroad. Each indicator or technology variable has been rated from lowest score of 1 to highest score of 5. It can be seen that S. Korea has obtained the highest score in terms of human capital including the number of engineers and graduated students per 100,00 of its population from abroad. However, it can be seen that the second-tier East Asian NICs have attained lower scores in terms of their human resources indicators. Although Malaysia's score in terms of secondary school enrollment has been higher in comparison with those of its counterparts (Thailand and Indonesia), however, nearly all of these countries obtained the lowest score in engineering graduates per 100,000 of their population.

5. 2. 6 The Confucian Culture and Ethic

As indicated earlier, there are some other factors contributing to the East Asian success which can be distinguished from the previous factors in terms of every country's own condition and also the degree of its importance. The Confucian culture and ethic has been a relatively common factor in many of the East Asian countries which affected the quality of their human labour through the particular characteristics of loyalty, hard work, work ethic and self-discipline, hierarchy and obedience, and the respect for education [90]. Confucianism also emphasises the importance of a protective and generous state, honest leadership, and mass defence to authority. The dominance of ethnic Chinese in business and commerce in most parts of South East Asia can also be seen as a result of Confucianism which was originated in China, but eventually spread throughout East Asia. Therefore, the Confucian heritage has also been used to explain the success of Malaysia, Thailand, and Indonesia, where the Chinese influence is significant. All of these countries have also been influenced by the tenets of Confucian culture. Although the confusion ethic in East Asian

necessary condition for development [91].

5.2.7 The Japanese and US aid

It is argued that Japanese and US financial assistance to many East Asian countries in particular S. Korea and Taiwan played a relatively important role in the early stage of development of these countries. Japan also provided the East Asian countries with a certain amount of financing capital goods, technology, and know-how, which helped them to certain extent in upgrading their national technological capacity. For example, from 1962 to 1980, Japan was the source of nearly 59 % of approved technology licenses, while the United States accounted for only 23 percent [92]. Moreover, as indicated earlier, while U.S. has been the major investor in some Latin American countries such as Mexico, Japan has been the largest source of FDI for most of East Asian first and second-tier NICs, in particular, Singapore, S.Korea, Taiwan, and Indonesia.

The East Asian NICs, particularly S.Korea and Taiwan also depended heavily on US aid to finance their imports and improve the balance of payments in the post second World War period. U.S. aid to S.Korea accounted for almost $ 6 billion between 1945 and 1978, almost as much as the total aid provided to all African countries during the same period [93]. There were also about 42 to 47 per cent of Taiwan's commodity imports during 1953-6 and 82 to 85 per cent of Korea's commodity imports during 1956-8 which was financed by US aid. Moreover, U.S. aid financed 95 % of Taiwan's trade deficit in the 1950s. However, the US financial aid began to decrease in early 1960s and in the case of Taiwan came eventually to an end in 1967 [94]. As indicated earlier, most East Asian first and second-tier NICs pursued the Japanese model of industrial and technological development in particular in the early stage of industrialisation which mostly emphasised massive technology transfer, high investment in human capital and industrial infrastructure, and strong outward-looking, export-oriented policies. One can also refer to the Flying Geese Model which shows the importance of Japan in the economic and technological development of most East Asian countries. The Flying Geese Model indicates that as Japanese wages increased and the Yen appreciated, production facilities and technology flowed outwards from Japan, first to the four NICs (S.Korea, Taiwan, Singapore and Hong Kong), then to the second-tier NICs (Thailand, Malaysia and Indonesia) and to China. Later, as wage costs and technological

four NICs (S.Korea, Taiwan, Singapore and Hong Kong), then to the second-tier NICs (Thailand, Malaysia and Indonesia) and to China. Later, as wage costs and technological levels of four NICs increased and their currencies also appreciated, they too increased their outward investment into the second-tier NICs and China [95].

In other words, according to the Flying Geese model, the technological leader countries such as Japan and other developed countries transferred their technology to the other countries with a lower degree of industrial and technological development such as the East Asian first-tier NICs. As these countries close their technological gap with the technological frontier countries through the catching up process, they can also export some of their products which were previously produced by more advanced countries. Therefore, the very close co-operation of the East Asian countries through trade, culture, and history have helped them to take advantage of each other's experience in production, marketing, management, and policy making. Therefore, the Flying Geese Model shows that developing countries can also replicate the models of other successful countries with a relatively similar characteristics.

Country	1986	2000
Indonesia	Early to Middle	Middle to Late
Thailand	Middle	Late to High-Tech
Malaysia	Middle to Late	Late to High-Tech
Taiwan	Late to High-	High-Tech
Korea	Late to High-	High-Tech

Table 5.7 The catching up process of industrial and technological development in the East Asian first and second-tier NICs (1986-2000)

5.3 SUMMARY AND CONCLUSION

As discussed in detail, the successful experience of East Asian first and second-tier NICs in rapid industrial and technology development can have valuable lessons for other LDCs. The most important common success factors of these countries which can be more applicable to other developing countries are: the early transition to outward-looking, export promotion policies, substantial and efficient investment in development of human resources, effective role of government intervention, and an appropriate technology transfer and development

to adapt and absorb high and modern technologies more efficiently. However, some other non-economic factors such as authoritarian governments, Confucian tradition and US and Japanese financial aid in the early stage of their industrialisation were among the relatively less important success factors of these countries; although they have influenced to some extent labour productivity, saving behaviour, financial and macroeconomic stability and other aspects of successful performance in these countries. Therefore, the success of these countries can not only be as a result of a single factor, but because of a series of interrelated factors.

As indicated earlier, although the Flying Geese Model indicates that the East Asian second-tier NICs have been successfull to follow the first-tier East Asian NICs and both pursued the Japanese model; however, it seems that other LDCs may not easily replicate some aspects of past successful experiences of East Asian countries. It is argued that some of the most important circumstances which provided an appropriate environment for their success no longer exist. For example, due to a less favourable environment for a successful export promotion policy in the present very competitive international market, it seems difficult for other developing countries as newcomers to be as successful as East Asian countries in the implementation of an export promotion policy. However, the successful experience of some East Asian second-tier NICs such as Malaysia and Thailand which managed to expand their manufactured exports more rapidly than did some of the first-tier East Asian NICs such as Korea and Taiwan earlier, can be a good reason for opposing this idea. Moreover, it is also argued while today's developed countries were developed in the period when there were no other more advanced economies, today's LDCs can take advantage of being latecomers and therefore their growth might be more rapid than those of their predecessors. In other words, LDCs can be more successful through a catching up process which does not need to reinvent the wheel. Therefore, it can be generally said that other LDCs can also achieve similar and even better results if they pursue the same model and a set of appropriate policies which have previously been experienced by successful countries in particular East Asian first and second-tier NICs.

Another important and valuable lesson which LDCs can learn from the successful experience of East Asian first and second tier NICs is that they need to create an appropriate and stable macroeconomic environment with a high level of investment and the low level of inflation, which are essential for successful industrial and technological development policies.

macroeconomic environment with a high level of investment and the low level of inflation, which are essential for successful industrial and technological development policies. Moreover, the convergence and consistency of the package of policies mainly export promotion, human resource development and technology transfer and development policies in East Asian first and second-tier NICs have also played a significant role in their rapid industrial and technology development. As discussed in detail earlier, the early shift to the outward-looking and export promotion policies in most of East Asian NICs resulted in a significant expansion of exports in these countries which in turn led to an increase in their overall growth performance.

Moreover, these countries adopted an appropriate technology transfer strategy concentrating on the development of their indigenous technological capability as well as acquisition of new and modern technologies in order to promote the level of competitiveness and productivity of their products in the international market. The effective implementation of export-oriented and technological development strategies have also been followed by efficient and large investment in their technical human resources which enabled them to strengthen their absorptive capacity of high and modern technologies. Moreover, the government in these countries played a key role in directing and conducting efficiently these policies by providing adequate infrastructure and facilities. The close cooperation between private enterprise and the government has also been a central element in the success of these countries.

Despite the successful implementation of a set of appropriate policies which led to their success, the policy makers in these countries have also adopted some incorrect policies which to some degree delayed the rapid process of their industrialisation. However, an important point which also contributed to the success of these countries is that policies have been reversed very quickly if the experience showed them to be ineffective. As an example, one can refer to a decrease in S. Korea's Heavy and Chemical Industrialisation drive in early 1980s, the abandonment of selective industrial policies in Malaysia in the early 1980s and Indonesia's strong policy response to macroeconomic instability in mid-1980s. Therefore, the policy makers of the LDCs can also learn that a successful policy to a large degree depends on the ability of society to place efficiency and public interest on effective and flexible policy making, including the ability to reverse failed policies.

of rapid industrial and technological development. Since their overall growth performance has been unique among other countries in other part of the world, and one may not find any other set of policies other than East Asian success factors, it seems that other developing countries would do well to adopt their model.

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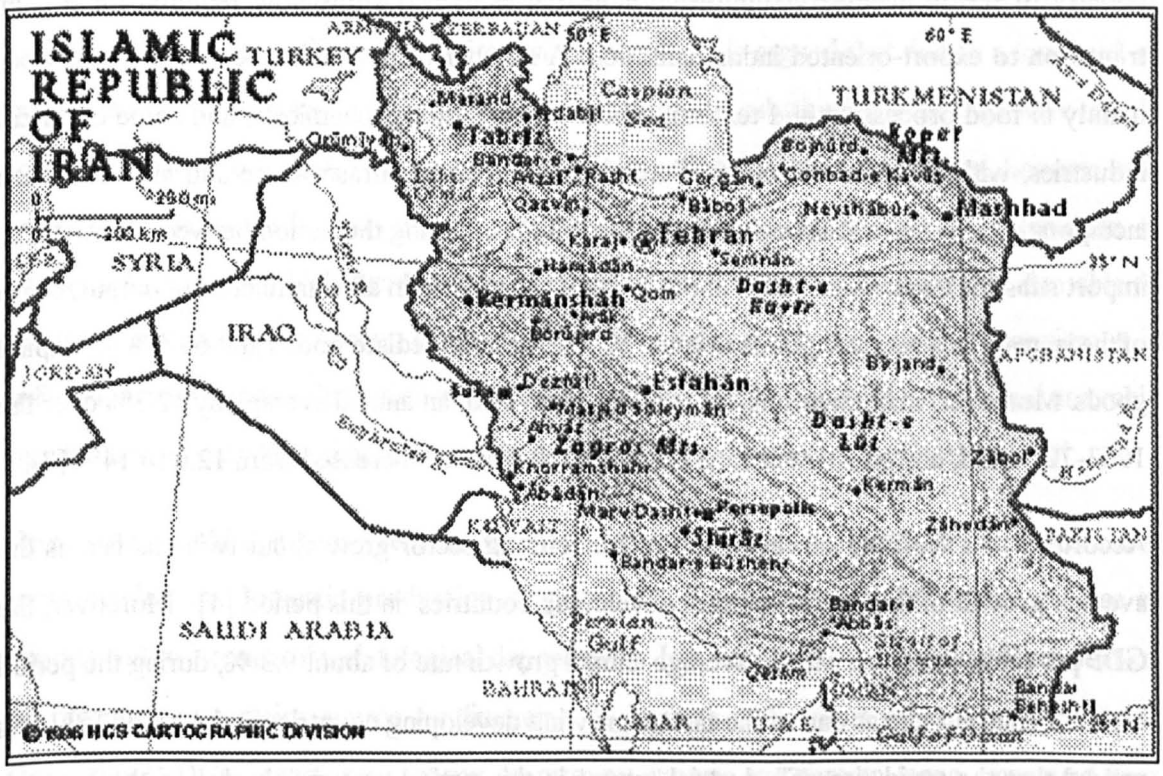
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CHAPTER 6: INDUSTRIALISATION POLICIES IN IRAN

6.1 INTRODUCTION

Iran is a resource-rich country which is located in a strategic area of 1.65 million square kilometres, with the Caspian sea, Turkmanistan, Armenia and Azerbaijan in the north, Turkey and Iraq to the west, the Persian Gulf and the Gulf of Oman in the south and Pakistan and Afghanistan to the East, and with a population of more than 60 million people. It is one of the major oil exporting countries in the world and has also substantial gas and mineral reserves including coal, chromium, copper, iron ore, lead, manganese, zinc, and sulfur. Moreover, Iran has a relatively good transportation network, including about 4,850 km of railroads, 140,200 km of highways, more than 14 main ports, 132 ships, and 261 airports [1]. According to the recent World Bank report (1995), Iran's Gross National Product (GNP) amounted US $ 62 billion at the market price of 1994, which has grown by an average growth rate of 8.1% during the period 1989-1992. During this period the manufacturing sector grew with an average growth rate of 11.5% [2].



6.2 AN OVERVIEW OF INDUSTRIALISATION POLICES BEFORE REVOLUTION

As the experience of the most of the countries studied earlier indicates, the industrialisation process of these countries was started by the adoption of an import-substitution policy which emphasised more the production of consumer goods substituting the imports. In Iran, as with many of these countries, efforts for industrial development of the country commenced in the early 1960s, by adopting the same pattern of import substitution which was aimed at producing previously imported consumer goods with those manufactured domestically. Import substitution has also been implemented by introducing some specific measures such as high tariff protection, import quota systems, fiscal incentives and investment, in order to protect the infant industries. It is argued that the adoption of an import-substitution industrialisation policy may have been inevitable due to the relatively underdeveloped structure of Iranian industry in the early 1960s.

As the experience of the successful East Asian countries shows, the success of an import substitution strategy in the long-term depends on the ability to shift successfully to an export drive. Therefore, in Iran, it was also hoped that the implementation of the ISI would enable the country to set up necessary supportive industrial skills and know-how required for a later transition to export-oriented industrialisation. A number of new industries were established, mainly in food processing and textiles, rubber manufacturing, chemicals, and some electrical industries, with the main objective of creating an adequate infrastructure and industrial base incorporating new and a relatively modern technologies. During the period between 1960-1972, import substitution accounted for about 26% of the growth in all manufacturing output, 6.6% of the increase in consumer goods output, 50.1% for intermediate goods and 63.5% for capital goods. Moreover, manufacturing value added grew with an annual average by 12.3% over the 1963-72 period, and its share in total domestic value added increased from 12.6 to 14% [3].

According to a UNIDO survey, Iran's manufacturing sector grew about twice as fast as the average growth of this sector in other developing countries in this period [4]. Moreover, the GDP per capita increased with an average annual growth rate of about 9.3 %, during the period 1963-78, ranking Iran as one of the fastest growing developing countries in the world [5]. It is argued that the rapid rise of industrial output in this period was mainly due to the capacity expansion in some established import-substituting industries stimulated by domestic demand [6]. However, the agriculture sector did not have a significant growth rate in this period with

average annual growth rate of about 4.4 %, which was less that one-third of the average growth of the industrial and manufacturing sector [7].

Sector	Third plan (1963-68)		Fourth plan (1968-1973)		Fifth plan (1973-78)	
	Target	Actual	Target	Actual	Target	Actual
Agriculture	-	4.6	4.4	3.9	7.0	4.0
Domestic oil	5.0	13.6	15.3	15.2	n.a.	0.7
GDP	6.0	9.7	10.0	11.4	n.a.	6.9
Non-oil GDP	6.3	8.7	8.1	10.5	15.0	13.3
Industrial and mines	-	13.7	12.4	13.0	18.0	15.5
Services	-	8.0	5.7	14.2	16.4	15.3

Table 6.1 Average Annual Growth Targets and Achievements of Iran's Five Year Plans (in percent)

Source: Pesaran, M.H. Int. J. Middle East Stud. 14 (1982), P: 505.

Despite several significant achievements as a result of import substitution such as the expansion of an industrial base capable of producing consumer products for the domestic market, as similar cases in some countries studied earlier such as Indonesia and Mexico show, this policy caused some negative effects on the Iranian economy. It is argued that due to a low level of quality, and lack of efficient productivity levels, most import substituting industries were unable to produce the products for competing in this international market. Moreover, because of a heavy dependency on imports of components and equipment required for the production of consumer products which were mainly financed by oil revenues, they were not also able to compete with similar importing products of cheaper price and better quality. Therefore, it is believed that the import substitution industries in Iran were mainly created for the final assembly of what had already been manufactured in developed countries or by multinationals [8].

One can also add that heavy reliance on oil revenues to import the necessary equipment and parts needed for domestic production of previously imported goods led to an increase in imports and an increase of technological dependency. Iran continued to be highly dependent on oil revenues as a major source for financing its imports while most other Less Developed Countries (LDCs), apart from relying on primary exports and foreign loans, improved their manufactured exports to pay for a proportion of their imports of capital and intermediate goods [9]. Despite several attempts to reduce this high dependency of the country on the oil income,

the total value of non-oil exports constituted only 2 percent of the exports [10].

There has been a shift of industrial development from import substituting consumer goods industries towards intermediate and capital goods during the second phase of the import-substitution policy in the late 1960s and early 1970s. Together, intermediate and capital goods contributed to about 80% of the overall growth of imports in this period [11]. The relative share of intermediate goods imports grew with an annual average of 11% between 1960 and 1973, and by 1979, Iran's large industries relied on 56.7 percent import of the foreign inputs for their production processes [12]. Furthermore, the required materials, components and parts for the industries were characterised not to be produced locally or not in sufficient local supply or not of high enough quality, and finally were higher in cost than those of imported materials and parts. Therefore, one can see that import substitution industrialisation led to an increase of imports and the new industries required additional imports of capital goods. For example, imports of electrical and non-electrical machinery increased from $ 176 million in 1960 (28 % of imports) to $ 964 million in 1972 (35 % of total imports); imports of metal and chemical products more than quadrupled in the same period [13].

As indicated earlier, most consumer goods produced by private firms were unable to create employment opportunities and were characterised by low productivity and therefore could not compete in international markets. This was because they were mostly capital intensive, labour saving and being built through assembly line processes. Moreover, the inflation and a rapid rise in wages of the labour force caused mostly by the oil-boom of 1973, led to the high cost of producing industrial products and therefore further complicated their export. Thus, import substitute industries were unable to reduce the dependency on the import of foreign inputs and to create a self sufficient industry sector. The imports grew from $ 560 million in 1963 to $ 18.4 billion in 1978, and most were for the manufacturing sector [14]. According to another figure, imports increased at an average annual rate of 12.6 percent [15].

One should also note the crucial role of state intervention in the protection of infant industries in this period. The state supplied 60 % of all industrial investment in the period between (1973-78), and also imposed 200-300 % tariffs on many imported goods in order to protect the local industries [16]. Moreover, as is mentioned earlier in the case of Mexico and Indonesia, the government protection of the industrial sector had created an inefficient industrial sector which could not compete in the international market. However, as is shown in the case of some

successful countries such as S. Korea, the protectionist policy may lead to the productivity growth of some of the infant industries. A number of infant industries such as electrical and transport machinery were temporarily protected by the Korean government in the early stage of its industrialisation, which led to some extent to developing their productivity and competitiveness.

Therefore, it can be argued that although the Import Substitution Industrialisation (ISI) policy may cause inefficiencies and low productivity of manufacturing industries, as experience of some successful countries such as S. Korea and Mexico indicated, ISI was essential in the early stages of their industrialisation and provided a supportive base for a transition to an export promotion policy. Nevertheless, it is generally argued that continuous ISI make the local industries inefficient and uncompetitive after a long period of government protective tariffs and subsidies. This is also due to the fact that the high level of protectionist policy provided domestic producers with little incentive to minimise costs or to attempt to promote international standards of quality for competition in international markets. It is also argued that the heavy restrictions on import of intermediate goods can lead to an overvalued exchange rate which is in turn harmful for exports.

As indicated earlier, following the continuous implementation of the import substitution policy, the government in Iran encouraged the private sector to establish and develop the consumer goods industries through the introduction of various measures such as tax credits, grants and loans. Some financial institutions such as the Industrial and Mining Development Bank of Iran (IMDBI), the Industrial credit Bank of Iran (ICBI), and the Development and Investment Bank of Iran (DIBI) were established by government in order to stimulate industrial development by assisting in the creation, expansion and modernisation of private firms and through encouraging and sponsoring participation of private investment. One can say that the IMDB played an important role in mobilising foreign private and domestic industrial development and particularly in the modern industries.

As discussed earlier, while the government emphasised more the development of consumer goods industries in the early stage of import substitution, the industrialisation policy during the later stage of ISI, concentrated more on construction of large-scale and capital intensive industries than the small-scale labour-intensive industries [17]. Large number of capital-intensive and heavy industries have been established such as the machine-building industry in Tabriz and

Arak, the tractor manufacturing company in Tabriz, an integrated iron and steel complex in Isfahan, and several other heavy and capital-intensive industries which will be further explained later in this chapter. A number of auto-manufacturing companies mostly owned by the private sector were also established in the late 1960s and early 1970s through joint ventures with General Motors, Citroen, Chrysler and Leyland for assembly plants of various kind of cars, mini-buses, buses and trucks. For example, the Iran National Industrial Company was the largest auto-manufacturing company, and was established in 1969 as a joint venture with Rootes Motors of England with a capacity of more than 60,000 cars per year [18].

The industries which were created in this period can generally be divided into three categories:

1. The industries which relied on import of foreign technology and machinery, but were not dependent on foreign expertise and raw materials, such as the textile industry, and the food processing industry;
2. Industries which were dependent on foreign technology and expertise but did not need to import raw materials from abroad, such as iron-melting, copper and petrochemical industries;
3. The industries which were dependent on foreign technology, machinery and expertise, mostly operating by assembly-line methods, such as the auto-manufacturing industry.

Selected industries	Level of production (1973-74)	Growth rate (%)	Level of production (1974/75)	Growth rate (%)
Automobiles	51,000	0.1	73,000	43
Buses	1,627	31.5	1,911	31.5
Trucks & Vans	23,223	49	29,365	25.7
Electricity	12,093 million (kwh)	26.0	14,005	15.8
Vegetable oil	189,000 (tonnes)	3.3	239,000 (tonnes)	26.5
Sugar	700,000 (tonnes)	4.6	761,000 (tonnes)	8.7
Cement	3,401,000	0.9	4,628,000	36.1
Refrigerators	257,000	31.1	309,000	20.2
Cigarettes	13,449 (million)	4.1	14,389 (million)	7.0
Paints	25,000 (tonnes)	6.0	33,000 (tonnes)	33.9

Table 6.2 Production level of selected industries between 1973 and 1975.

Source: Bank Markazi (Central Bank of Iran) annual report

The above table gives us a picture of the production level of ten manufacturing industries for the period 1973-1975. It is estimated that small-scale and traditional industries, such as textiles and carpets, constituted about 35% of total industrial output. During the period between 1962-72, the light consumer industries such textiles and food processing grew 10.7%, intermediate goods industries such as steels and petrochemicals 19.3%, and capital goods industries such as cement and electrical goods 21 % [19]. It is argued that the increase in oil revenue in October 1973 led to a substantial increase in government expenditure and massive imports, which in turn resulted an imbalance of payment and budget deficit by mid-1975. Moreover, it is also argued that the adoption of the big push industrialisation policy following a sharp increase in oil revenue in 1973, caused serious damage to rural and agricultural development as well as the absorptive capacity of the economy. This was mostly due to complete neglect of the agricultural sector, which led to the country's heavy dependence on imports of food in the mid-1970s. Furthermore, it is also believed that the country could not utilise effectively the large amount of foreign exchange earned as a result of increasing its oil revenues, due to infrastructural constraints and financial mismanagement. In other words, instead of an investment in the development of the country's industrial infrastructure, and efficient utilisation of natural and human resources, most petro-dollars were spent on imports of consumer and luxury products [20].

It is generally believed that industrialisation in Iran in the 1970s was nothing more than assembly-line production using imported parts [21]. As indicated earlier, there were some factors which mainly contributed to Iran's unsuccessful experience of import substitution industrialisation. The most significant factors were: the low productivity and high cost of manufactured products; lack of effective management in some industrial units; lack of adequate infrastructure required for rapid industrialisation (for example, lack of an adequate transportation network such as sufficient port facilities, caused so many ships to wait for more than six months to unload their cargoes and therefore resulted in wastage of materials); negligence of the agriculture sector that caused large immigration of farmers to the urban areas; the overgrowth of the service sector which widened the gap between rural and urban areas and increased imbalance income distribution.

Therefore, the import substitution policy gradually lost its positive effects in the 1970s and could not provide a favourable environment for domestic industries to compete in the international market and also could not create adequate employment opportunities for a country's large labour force [22]. There were some major obstacles which led to failure of the

creation of self sufficient import-substitute industries. These included the shortage of a skilled labour force and lack of managerial expertise in industrial units, low productivity and lack of standard quality control systems for manufactured products, low level of research and development activity and lack of sufficient facilities for providing investment for the development of the industrial units. Therefore, the consequences of import substitution industrialisation were high costs of production, a decrease in quality of products because of the heavily protected domestic industry, and continuous dependence on world markets, both to build new production capacities and to maintain existing capacities [23].

As indicated earlier, the continuous policy of import substitution in the1960s and 1970s prevented the industrial sector from promoting its quality standards and productivity level needed for competition in the international market. Some government attempts to develop export promotion activities were inadequate and ineffective. For example, the introduction of some export incentives such as the 100% tax exemption for domestic firms which could export 15 % of their production along with other policy measures had no significant effects for expansion of non-oil exports. This was mostly because these measures were not adequate to develop a comparative advantage in the local industries and manufacture products to compete in the international market. As the experience of some East Asian Countries such as S. Korea, Taiwan, Thailand and Malaysia in rapid transition to a successful export promotion policy showed, this needs an appropriate mix of protection, skills development, managerial training, technology transfer, and research and development policies and strategies.

Moreover, the export promotion strategy was further constrained by the very high demand levels of the domestic market relative to the domestic production levels and the willingness of entrepreneurs to satisfy local demand before considering export possibilities [24]. Another reason for neglecting non-oil exports was the increasing rate of oil income since the late 1960s which led to a sharp decline in non-oil exports. Although the non-oil exports increased from $128.2 million in 1963 to $ 634.7 million in 1973, the share of non-oil exports to total exports fell sharply from 23 % of the total exports in 1963 to 15% in 1972, and after the oil boom of the 1973, sharply declined to 2% of total exports [25]. Furthermore, the structure of Iranian non-oil exports mostly consisted of small-scale and tradition industries such as carpets, cotton, leather and skins, and agriculture products, which remained almost unchanged for a long period [26].

One can also refer to an overvalued rial as another obstacle in the promotion of non-oil exports,

in particular rugs as well as some agricultural products (pistachios, caviar, dates) in this period (1970s). As the experiences of some countries in particular East Asian first and second-tier NICs indicated, the real depreciation of their currency was among the most effective policy measures for their successful and rapid transition to an outward-looking, export-oriented policies. However, in the case of Iran, the exchange rate has been kept overvalued artificially to encourage the import of capital and intermediate goods. For instance, one can refer to the damaging impact of an overvalued exchange rate to Iran's most important non-oil exports. It is believed that despite the better quality of Iranian rugs and carpets, the overvalued exchange rate resulted in an increase in cost of local production of rugs and carpets which faced competition from producers in countries such as India, Pakistan and China with lower costs of production. Furthermore, an overvalued exchange rate means that while imports were being subsidised, the export from Iran became much more difficult [27].

It should also be added that, since the oil boom of 1973, manufacturing wages rose by 2.6 times which resulted in an increase in the cost of production of manufacturing products and led to reducing the exports of manufacturing goods [28]. Moreover, as a result of country's oil revenue in October 1973, some resource-based industries in which Iran had a comparative advantage such as textiles, footwear, food processing industries were neglected in favour of other import-based and capital intensive industries such as the auto-manufacturing industries, which affected the country's capacity of the non-oil exports. Therefore, one can see that some of the industrial progress during the period between 1963-1973 came to a halt as a result of post oil boom (1973) economic and industrial policies.

Although the adoption and implementation of an import substitution policy in Iran in the 1960s was at a time that many other developing and newly developed countries also followed the same pattern in the earlier stages of their industrialisation, but there was at least one major difference. While many of the other newly industrialising countries (such as S. Korea and Taiwan), in addition to relying on primary exports and foreign loans, also promoted their manufacturing exports to pay for a proportion of their imports of capital and intermediate goods, Iran, thanks to its large natural resources such as large oil and gas reserves, could not provide such support for export-oriented industries as in the successful East Asian countries. Moreover, as indicated earlier, the experience of the East Asian NICs in particular S. Korea and Taiwan showed that an early transition to an export oriented strategy enable them to promote the level of productivity and efficiency to be more competitive in the international market. Most East Asian first and

second-tier NICs switched to export promotion industrialisation policies, as they found that their manufacturing products were mature enough to compete in the international market. Moreover, as discussed in the case of some oil producing countries such as Indonesia and Mexico, the transition to an export promotion industrialisation policy did not take place until they faced a severe financial crisis as a consequence of the sharp decline in the oil prices which had serious effects on their oil revenues. Therefore, it can be said that the reliance on oil incomes can be considered as a major factor contributing to their failure in an early and successful shift to EPP. However, while the government in Mexico and Indonesia tried to decrease their dependency on oil incomes during the second stage of import substitution policy, no such effort occurred in Iran during the same stage of the import substation policy, and Iran remained heavily dependent on oil exports [29].

Having analysed some of the major problems and obstacles of the industrial development process in the 1960s and 1970s (the pre-revolutionary period), one can refer to the following points as a major obstacles in the development of Iranian industries:

1. There were no appropriate industrial policies and programs for the development of industries in the past, and most Iranian small and large scale industries were established through interests of particular individual or groups.
2. There was little effective co-operation between the various branches of the industry sector and the university research institutes.
3. Most industries established in this period, in particular heavy industries, were extremely dependent on the foreign materials and inputs.
4. Most industries suffered from lack of technicians and engineers, due to the inability of the education system to train the expertise needed for industries.
5. There was an excessive concentration of most industries near Tehran (about 50 percent of all large manufacturing firms) which led to some major problems such as pollution of the environment and unbalanced distribution of facilities for industries located in other areas of the country.
6. Following the high protectionist import-substitution policy and high level of wages, the price of local manufacturing products were much more expensive than similar products which were produced in some foreign countries and therefore could not compete in the international market.
7. The low productivity level of many industrial units resulted in the higher cost of

production of locally produced goods in comparison with the similar products manufactured in abroad.

8. Most industries suffered from inappropriate imported technology which was not adapted to local conditions.
9. The industrial units did not have the appropriate R&D needed for better adaptation and absorption of foreign technology.
10. Lack of adequate infrastructure and facilities such as communication systems (roads, railways, etc..)
11. Most industries relied heavily on importing capital and intermediate goods which required substantial financial resources.
12. Most industries suffered from a low level of production and productivity which was mainly due to the high cost of producing their products and lack of an appropriate distribution system.

Moreover, some major problems emerged from the rush to industrialisation following the oil boom in 1973, such as lack of absorption capacity for adaptation and assimilation of foreign technologies and their values (cultural effects), low productivity and inefficiency of industries, serious bottlenecks in infrastructure, increased dependency on import of components and parts and heavy government expenditure which led to an unbalanced economy. Moreover, as has already been pointed out, the industrialisation policies of the 1960s and 1970s, which mainly focused on producing the consumer goods previously imported from abroad (import-substitution policy), could not utilise the massive financial, human and natural resources of the country, and even led to more dependency on imports, and contributed to the weaknesses of the industrial structure of the country. Therefore, the ISI policy could not create a base for a successful shift to an export-led industrialisation policy due to the existence of inefficient industries unable to compete in the world market, and unwillingness of the government to promote the productivity of local industries.

One can generally say that not only the Shah's ambitious aim to make Iran the fifth industrialised country in the world was not achieved, but it also led to national unrest and finally resulted to his overthrow from power in 1979. It is stated that "the Shah once again underestimated the impact that the rapid industrialisation and urbanization and rising dependence on Western technology and culture might have upon Iran's social and political structure" [30]. However, according to a report published in Fortune magazine, "even if oil

price remains high, the Shah has a chance of transforming Iran into a middle-rank power with a fairly substantial economy, which at least needs a couple of generations in terms of technology and education." [31]. It is also argued that if a substantial amount of the foreign exchange gained from the oil boom of 1973 was invested more efficiently in the development and utilisation of the country's large human and natural resources, and in promotion of indigenous science & technology, the result would have been much better than it was in the late 1970s. Although the pre-revolutionary industrial and technology transfer policies may have made some contribution to the development of some industries, this period is believed to offer little guidance in terms of future trends in technology transfer, and can not serve as a base period from which to plan for future trends. However, it can provide us with some useful evidence regarding the integration of industrialisation and the country's overall national development policy.

6.3 THE POST- REVOLUTIONARY INDUSTRIALISATION POLICIES

During the first years of the post-revolutionary period, Iranian industry faced a serious crisis including the flight of some factory owners abroad, and the sharp decline of production during a period of mass demonstration and strikes against the Shah's regime which eventually led to the end of the monarchy and the establishment of the Islamic republic in 1979. Since the victory of the Islamic revolution in Iran, the creation of an independent industrial structure based on society's needs and demands was among the top priorities of the government. Therefore, in order to achieve this goal, the government attempted to formulate a long term plan for reconstructing the industries, through the nationalisation of basic industries, the appointment of new managers, the provision of facilities such as financial credits for changing the production line of some industries and establishing some new institutions for controlling the production activities of the industry sector. Due to the dependency of the industries on importing intermediate parts and components, the Central Bank allocated Rls 85 billion (each dollar equal to about 74 Rls at that time) for the industries to import their necessary requirements and clearing their delayed loans in 1980. But due to some problems such as lack of adequate supervision and planning for the spending of these credits, only Rls 25 billion had been used by the end of 1980 [32].

According to a survey in 1980, the total manufacturing products decreased by 28% from the previous year [33]. As indicated earlier, the reduction in the manufacturing products can be

mostly attributed to the problems regarding the provision of the intermediate and raw materials, which constituted about two-thirds of the required inputs for the local industries, was imported from abroad. The heavy industries were faced with a lack of skilled personnel acquainted with the advanced technology required for operating these establishments. During 1979, 708 permits for establishing new industrial units were issued, showing an increase of 63 percent. The proposed capital cost of these units was Rls. 17.6 billion, showing a 10 percent increase over the corresponding figure of a year ago [34]. Following the nationalisation of the basic industries in July 1979 and approving the law for the expansion and protection of Iranian industries, the government nationalised about 483 stated-owned enterprises and established a new institution called "The National Iranian Industries Organisation" (NIIO) in order to direct and control these industries. According to the constitutional law, the country's industries were divided into four categories as follows:

1. The basic, strategic and heavy industries including oil, gas, iron melting, copper, ... which were also nationalised before; and also the other important industries which are used in ship-building, aviation, and auto-manufacturing such as the aluminum and steel industries.
2. Those industrial firms or factories which were owned by individuals closely linked with the previous regime and who had left the country.
3. Those fully-assembled, bankrupt and debtor firms which had a huge debt on the banks and could not repay their loans.
4. Those firms which belonged to legitimate owners.

The National Industries Organisation of Iran sustained a loss of about Rls 60 billion for about 290 of the nationalised industrial firms which were debtors of the local banks and could not meet their loan repayments, both interest and capital [35]. The constitution of the Islamic Republic of Iran, which was approved in November 1979, emphasised the increase of those agricultural and industrial products which could meet the general needs and lead the country towards self-sufficiency. According to the constitutional law, all the large and basic industries, the large mines, banking, insurance, foreign trade, power generation, dams and the large-scale irrigation networks, radio and television, post and telegraph, shipping and aviation, roads and railways were declared as public sector and administered by the government. The industrial development policy in the constitutional law also placed its main emphasis on such short-term and long-term objectives as encouraging industrial activities which could provide the basic and

general welfare for all of the people in the country, directing the industrial sector towards self-sufficiency and reducing their dependency through an increase in local manufacturing products. It also emphasised the creation of more employment opportunities through increasing the skill and training of the labour force of the country.

Another important aspect of the constitutional law included encouraging the expansion of technical and scientific researches and efforts for promoting research and development activities in order to achieve the economic and industrial development of the country [36]. It appears from the contents of the constitutional law that it is essential to adopt an appropriate strategy in order to achieve the overall objectives of the economic, social and industrial development of the country. This strategy should be formulated based on analysing the conditions, importance and the background of the industrial sector of the country.

The share of the industrial sector in GDP increased from 14.2 % in 1979 to 15.1% in 1980. The recession in industrial sector activities resulted in a decrease in the production of manufactured products. By 1982, 87% of manufacturing firms employing over five hundred workers were government owned or controlled. Nearly one thousand public enterprises accounted for 70 % of the labour force and 75 % of the value added in industrial establishments with 10 or more employees [37]. The total value of manufacturing products of the large industrial units in constant prices increased from Rls 475 billion in 1980 to Rls 694 billion and Rls 821 billion in 1981 and 1982 respectively. The value of the per capita production at constant prices increased from Rls 1.2 million in 1980 to Rls 1.4 million in 1983, which grew about 12% during this period [38].

Following the decentralisation policy, in 1981 the Ministry of Industry and Mines which was responsible for planning and directing the industry and mineral sector of the country was divided in three new ministries; the Ministry of Heavy Industries, responsible for the basic, strategic, heavy and capital intensive industries, the Ministry of Industry, responsible for light durable and non-durable consumer and intermediate industries and also broadly in charge of industrial development and policy co-ordination; and the Ministry of Mines and Metals, which was responsible for the geological exploration of minerals and some heavy industries such as steel and copper melting. In addition there were several industrial organisations operated under the control of each of these ministry. For example, one can refer to the Organisation for Promotion and Renovation of Iranian Industries (OPRII) which is considered as a major institution for the

Ministry of Heavy Industry; the Organisation for National Iranian Industries (ONII), which controlled a number of nationalised industries under the supervisionary of Ministry of Industry; and the National Iranian Steel Company (NISI), directed by Ministry of Mines and Metals.

Since the beginning of the Iraqi attack on October 1980, most industries which were operating in places near the war zones were not able to continue their production. Due to some problems in unloading the necessary components and parts for factories from the major ports located near war fronts, most industries operated beyond their production capacity. Although the war made serious and destructive impacts and problems on the overall economic and industrial development of the country, such as massive immigration of civilians living near the borders with Iraq, the shortage of exchange for industries to import their required parts and components, destroying some of the infrastructure and factories in particular those located near the war areas, it is argued that some war related industries were significantly improved. Despite the various problems imposed by the war on the Iranian economy, in 1981 the total value added of the industrial sector increased by 5.4 % in comparison with the year before, which could indicate that the industrial sector accommodated the war conditions [39].

In 1982, the government introduced the first Five-Year Plan (1983-1987), aimed at increasing the industrial value-added of the industrial sector by 14.1% per year. In order to achieve this goal, the plan necessitated the completion and implementation of current and new industrial plants and improvements in the country's industrial infrastructure as well as adoption of some policy measures to increase productivity through maximised use of the capacities and promoting local technological capability. Despite the important objectives which were specified for the industry sector, however, the agriculture sector was determined as a major focus of the plan. The industrialisation policy which was introduced in the plan was the same pattern as the previous import-substitution policy with more emphasis on the heavy industries. The long-term objective of the plan was self-sufficiency and economic independence. It was also aimed at concentrating on importing technology and reducing technological dependency. In order to achieve this aim, self-sufficiency study groups have been formed to study and research in the methods of manufacturing the parts and basic materials required by the Iranian industries. Moreover, manufacturing technology has been imported along with importing the required machinery. The industrial policy making bodies have been adding conditions to the contracts with foreign companies to include the importation of the relevant technology as much as possible [40].

The other policy measures of the plan especially in the industrial sector emphasised adopting a decentralised system; increasing the productivity level of the labour force through training; improving the maintenance system and the ability to repair the units; increasing the local content of industrial enterprises; expanding the designing and the production of industrial parts and machines; expanding the industries which produce the essential goods required by the country; decreasing the dependency on oil revenues by an increase in non-oil exports; and developing and expanding suitable industrial culture in various parts of the country, in particular the rural areas. The plan also emphasised the creation of inter-sectoral linkage, and the growth of intermediate and capital goods industries. The plan envisaged an average growth rate of 9 % for the economy which was to be achieved by an annual average growth rate of 7% in agriculture sector, 14.1% of industry sector, and 9.8% in construction [41].

Total investment in the plan projected a figure of about Rls 12,985 billion ($ 166 billion). The plan also aimed at promoting greater industrial investment through closer public co-operation with the private and cooperative sectors. Therefore, special emphasis was placed on encouraging investment in small and medium scale enterprises. Moreover, it also emphasised the government policy of protecting and promoting industrial units in order to enhance the local productive capacity. Due to an increase in the country's oil revenue which caused an increase in the imports of industrial raw materials and components, as well as promoting the managerial expertise of many nationalised industrial units, the industrial activities were expanded in 1982. For example, the production level of many basic industries such as Isfahan Steel Mill and Arak Aluminum Factory showed favourable increase.

The industrial value added	1983	1984	1985	1986	1987
Industry and mine	995.1	1135.	1294.5	1476.5	1684
Industry sector	895.5	1021.5	1165.	1328.8	1515.5
Mine sector	99.6	113.5	129.5	14.7	168.5

Table 6.3 The projected industrial value-added in the first plan (83-87) in billion Rls, (constant prices of 1982)

Source: The Plan and Budget Organisation, P:33.

Approval of the plan was delayed by the parliament (Majles), because of some unrealistic and ambitious financial assumptions and objectives, and the argument about different aspects of the plan between some official and non-official authorities. With several problems caused by the

intensifying war with Iraq, and the sharp decline in oil prices during the mid-1980s, it was never put into effect. The number of new industrial units that started operation or were expanded in 1983 reached 743 with a total capital of Rls. 21.1 billion. There was also an increase in the amount of loans and credits given by the Industrial and Mining Bank to the private and state-owned industrial firms by 28.9 % in 1983, amounted to Rls. 25.4 billion [42]. The export of industrial products in 1983 was about $ 24.2 million, accounted for 6.8 % of total non-oil export with about $ of 354.8 million. The manufacturing products of machinery and metal equipment, basic metals and chemicals were also increased in this year by 37.6%, 31.7% and 24.1 % respectively [43]. Despite some improvement in the relevant figures of manufacturing production, the consistent dependency of the industrial sector on foreign exchange earned from oil incomes for its machinery, technical know-how and raw materials, made local industrial activity conditional upon the continuous availability of foreign exchange.

In 1983, the large industrial units which were directed by the government produced more than 70% of the total manufactured products and about 71% of industrial value-added in that year. This indicated that the government and public sector controlled and administered most of the industrial activity in this year which was mostly concentrated in the production of capital and consumer durable industries. However, in 1984, of the 6,595 large industrial plants, 5,649 were operating on private basis and 947 by the public sector. Furthermore, 2,060 plants (31%) were administered by individuals, 2,543 (39%) by officially registered companies other than the co-operatives, 197 (3%) on a co-operative basis and 1,796 (27%) as unofficial companies [44].

The sharp decline in oil prices in the mid-1980s due to over-supply by some oil exporting countries, caused the decline of the country's oil revenues and therefore led to a sharp decline in importing the required inputs for the industrial units. Moreover, the government's investment in industry and mines fell considerably, by 18.5%, reaching around 104,000 million Rls in 1985 [45]. A review of the composition of government investment in the industrial sector in 1985 shows that a great portion of this investment (66%) was allocated to the establishment and expansion of metal and smelting industries. From the amount invested in this industry, Rls 30.1 billion were allocated to the Ministry of Mines and Metals for starting and operating the Mobarakeh Steel Complex in Isfahan; Rls 11 billion and another Rls 8.6 billion to the National Steel company of Iran to be utilised for the Ahvaz Steel Complex and Steel Mill of Isfahan respectively; Rls 3.4 billion to the National Copper Industries of Iran for the establishment of a copper smelting plant; and Rls 2.8 billion to the Industrial Development and Renovation

Organisation (IDRO) for the establishment of the copper-related industries [46].

The total industrial value-added decreased in 1986 and amounted to Rls 371 billion a reduction of 7% compared with 1985. The share of industrial value-added in GDP accounted for 12.1 % which the share of intermediate and consumer industries were 50.7 %, and 39.8 % respectively. The dependency of the manufactured products on the local resources was 31.5% and the capital goods industries with 70% and consumer durable industries with about 64% were among the most dependent industries on importing their components and materials from abroad. As indicated earlier, the sharp decline of oil prices in 1985 made the Iranian government place more emphasis on increasing the country's non-oil exports and decrease the heavy reliance on the oil income. As a result of the policies adopted by the government, the non-oil exports enjoyed a significant rise during 1986, reaching $ 916 million which mainly consisted of traditional and agricultural products. However, a comparison of data for the first four months of 1985 and 1986 indicated that the share of industrial goods in non-oil exports fell by 78% while the share of agricultural and traditional goods increased by 100 %. Thus, the share of industrial goods, agricultural and traditional goods, and mineral ores in 1986 were 2.2, 94.8, and 3 percent, respectively [47].

In 1987, the total industrial value-added reached to Rls. 1414 billion, of which consumer goods industries had Rls. 636.5 billion, intermediate goods industries with Rls. 697.7 billion, and capital good industries Rls. 80 billion. The export of manufactured products reached $ 70 million and the share of manufactured exports in the industrial value-added and non-oil exports were 0.7% and 9.8 % respectively in the same year. Moreover, a total of Rls. 221 billion were invested in the industry sector, of which about 30% (about Rls 95 billion) of this investment was allocated to metals and metal-smelting industries (such as Mobarakeh Steel Company, Ahvaz Steel Complex, and Steel Mill of Isfahan), 47% in the new industrial units with 1 to 9 employees, and 21% to the new industrial units which had employed 10 to 49 workers and about 2% was allocated to the industrial units with more than 50 workers [48]. In 1988, the industrial value-added reached to Rls. 1414 billion, (consumer industries with Rls. 636.3 billion; intermediate good industries with Rls. 697.7 billion; and capital goods industries with Rls. 80 billion). However, compared to the relevant figures of 1984, which gained the highest industrial value added, it appears that the industrial activity in 1988 was about 72% of 1984. This is mostly due to a sharp decline in oil prices during mid-1980s and a consequence reduction of foreign exchange needed for importing the materials for industry sector. In 1988, the industry

sector was 30.9% dependent on the local materials and equipment [49]. Following the announcement of a cease-fire and the end of the war with Iraq, the government adopted new policy measures including reconstructing war-damaged production lines, completing semi-finished projects and utilisation of unused production capacities. The overall activity of industrial sector between 1983-1988 can be shown in the following table.

	1983	1984	1985	1986	1987	1988
The industrial value added (billion Rls)	463.	491.	480.	371.	350.	318.
The share of industrial value added in GNP (%)	13.6	14.4	14.2	12.0	11.7	10.7
The share of capital good industries in industrial value-added (%)	13.4	15.2	13.1	9.5	8.4	7.4
The share of intermediate goods industries in industrial value-added (%)	48.5	49.1	49.8	50.7	51.3	51.1
The share of consumer goods industries in industrial value-added	38.1	35.7	37.1	39.8	40.3	41.5
The productivity of industrial products (1000 Rls)	1567	1608	1583	1413	1419	1424
The dependence of industrial products on the local materials (%)	24.1	24.	26.3	31.5	31.0	30.9
The share of industrial exports in industrial value added (%)	0.2	0.2	0.5	1.1	0.7	-
The share of industrial exports in non-oil exports (%)	7.3	7.6	13.7	6.5	9.8	-

Table 6.4 The Industry Sector between years (1983-1988)

As can be seen from the table 6.4, the relatively low level of industrial value added per GNP, the low level of capital good industries in industrial products, and the limited share of intermediate goods industries were among the major weaknesses of the industrial sector during the period 1983-1988. As one can also see, the share of industrial value added decreased at an average annual rate of 7.2 % (in 1973 constant prices). The total industrial value added of capital goods industries during the period 1983-1988, also reduced by an average annual rate of 15.2%. The share of intermediate goods industries in total industrial value-added increased from 48.5% in 1983 to 50.7% in 1986, and reached in the following years to 51.3%. The dependence of industrial products on local materials which was about 24% in 1983, increased to 31.5% in 1986. The productivity of industrial production decreased during the period 1983-1988, with an annual average rate of 1.9 %, of which the capital goods industries contributed most of reduction, with an annual average of 9.1 % [50].

As one can see, the share of industrial exports in non-oil exports increased from 7.3 % in 1983 to 9.8% in 1988, however, this figure had a sharp decline in comparison with that of 1979 which was 30%. This can be attributed to some factors such as the restricted capacity of

industrial products to compete in the international market and the low level of quality standard in some manufacturing products. One can also see that, during this period, whenever the country benefited from an increase in oil revenue, the industrial products also increased because of allocation of more foreign exchange to the industrial sector for importing their required materials and components. It can be said that the protectionist policies of the pre-revolutionary period were also continued in the early 1980s and during the 8 years Iraq-Iran war, and the industrial sector was heavily protected through imposing tariffs, preventing imports of certain products, the restricted allocation of foreign exchange rate for specific industries, and price regulation of local and imported industrial products. It is also argued that the overall policies undertaken during the 1982-88 period emphasised more the strong involvement of government and the public sector in managing the economy, the import substitution and inward-looking policy, price control, industrial regulation, and direction towards a self-sufficiency. By 1987, it was estimated that about 60-70% of the entire domestic economy and 90 % of foreign trade were directly or indirectly run by the government [51].

Following the cease-fire and election of the new president (Hashemi Rafsanjani), attempts were made to design a comprehensive reconstruction and economic development plan for the country. Therefore, the new first five year development plan was sent to the parliament (majles) in August 1989 for approval and was finally approved in January 1990 with a total expenditure of Rls 29,316 billion ($ 120.7 billion). The general objective of the Five Year Plan (1989-1993) was as follows:

1. The reconstruction and renovation of infrastructure and production capacity, and civilian centres which were damaged in the war.
2. The increase in growth rate of per capita income, employment, and reducing dependency with emphasis on self-sufficiency in the strategic and agriculture products.
3. The promotion of quality and quantity of educational system with more concern on the development of science and technology in particular for the young generation.

The Five-Year Development Plan (1989-1993) also aimed at developing the industrial sector by renovation of the existing industries; giving priority to the capital and intermediate goods industries; emphasising industries that use domestic resources; encouraging private and foreign investment; reducing the dependency on foreign inputs and technology and improving the management and industrial technology. Some of the quantitative objectives of the industry

sector in the plan were considered as following:

1. An average annual growth rate of 14.2% for the overall value-added of the industry sector, from Rls 1414 billion in 1989 to Rls 2750 in 1993 (in 1989 constant prices).
2. An annual average growth rate of 24 % the for value-added of industrial capital goods industrial, from Rls 80 billion in 1989 to Rls 235 billion (at 1989 constant prices).
3. An annual average growth rate of 20% and 4.2 % for the value-added of intermediate and consumer goods industries respectively.
4. An estimate of an increase in exports of manufactured products from $ 70 million in 1988 to $155 million in 1989, and to $ 1,027 million in 1993. This amount was assumed to be accomplished mostly by the export of consumer goods, basic metals and petrochemical products.
5. An estimation of an annual growth rate of 8.6 % for productivity level of labour forces in industry sector from Rls. 2,472,000 in 1989 to Rls 2,739,000 in 1993.(in 1988 constant prices), which was supposed to be achieved mainly through increasing the utilisation of existing industrial capacity.
6. An average annual growth rate of 11.6% for investment in the industrial sector which was estimated to reach a total figure of Rls 1,932.2 billion, included Rls 914.3 billion in the public sector and Rls 624.8 billion in private sector during the period (1989-1993). This investment was planned to be spent mostly in the intermediate industries such as petrochemicals and metal smelting, and the capital intensive industries.
7. A predicted average growth rate of 8% and 4.8% for GNP and per capita production respectively. It was also forecast that the unemployment rate would decrease to 14% with the creation of 394,000 new jobs per year, and with an average annual growth rate of 5.2% in the productivity level of the labour force.

	Value-added (1989) in billion Rls.	Value added (%)	Value-added 1993 in Rls billion	value-added (%)	The average growth per annum (%)
Industry sector	1414	100	2750	100	14.2
Consumer industry	638.3	45	780	28.4	4.2
Intermediate industry	697.7	49.3	1735	263.1	20
Manufacturing industry	432.5	62.0	1285	74.0	24.3
Capital industry	80.0	5.7	235	8.5	24.

Table 6.5 The growth rate and value added in different sectors of industry during the Five Year Plan (1989-1993):

Source: The First Five year Plan (1989-1993)

Some of the other most important objectives of the first Five Year Plan (1989-1993) were as follows:

1. Development of industrial plants capable of producing primary materials and semi-manufactures including foundries, steel, copper, zinc, lead and aluminium plants.
2. Development of the power industry.
3. Establishment of new petrochemical complexes.
4. Maintaining the existing industries, renovating their production lines and raising the quality of production.
5. Absorbing private capital from trading in the industrial sector, by transferring the small and medium scale plants to the private sector.
6. Removing obstacles which have disrupted the profitability of industrial plants, relaxing some of the price controls and export and import regulations, and tax exemptions, are among the measures contemplated.
7. Efforts to increase the export of industrial products to meet the foreign exchange requirement.
8. The creation of a stable economic environment which is a prerequisite for private investment in productive activities.
9. Establishing and expanding engineering design units in order to absorb data, know-how and technology.
10. The optimum use of hardware (as defined in earlier chapters, i.e. industrial installations) capabilities and being economical in project investment.

11. Collaboration with important foreign companies (MNCs) through joint ventures.
12. Allocating 0.5% of government owned manufacturing sales to the Research and Development in the industrial sector.
13. Revising and reconsidering the labour law in order to increase productivity.
14. Selecting an appropriate industrial strategy, (inward and outward orientated).
15 Determining a new pattern of consumption in the direction of society's needs.
16. Promotion of domestic technology levels by strengthening the design and technological capabilities within the country.
17. Emphasising the development and expansion of those industries which rely on local natural resources.
18. Moving towards self-sufficiency and independence from importing semi-manufactured components by strengthening the manufacturing of them within the country.
19. Identifying, attracting and adapting imported industrial technologies and research and development activities in modern technologies
20. Creating all facilities for promotion of industrial exports, including establishment of free industrial zones.

Moreover, the most important industrial policies in the five year plan also emphasised some aspects such as the reconstruction of infrastructure and factories which were damaged during the eight-year war with Iraq, completioin of unfinished projects and plants, increasing the production of capital goods industries, the maximum usage of intermediate goods industries' production capacity, more efforts towards the better adaptation and the absorption of industrial technology and increasing R&D activities for the expansion of manufacturing products, in particular handicrafts. Therefore, the government's main focus during the implementation of the first five-year development plan was the reconstruction of the country through the adoption of some specific policy measures including privatisation of state-owned industrial enterprises mainly through expansion of Tehran Stock Exchange; deregulation of financial services; and promoting the non-oil exports by introducing various export incentives to exporters including devaluation of local currencies and establishing FTZs; encouraging private and foreign investment; and trade liberalisation policies [52].

It can be said that since the beginning of the First Five Year plan the country's industrialisation policy switched from inward-looking and protectionist policies to outward-looking, export

oriented policies. However, despite the plan's emphasis on expansion of non-oil exports, the implementation of import substitution policy has also been continued. Therefore, the industrial strategy for the First Five Year Plan (1989-1993) was announced as a simultaneous pattern of import-substitution and export promotion policies. The parallel implementation of both strategies suggested by the plan means that while the reliance on imports of foreign consumer goods can primarily be reduced through their substitution with locally-produced consumer products, efforts should also be made for the exports of those products with which the country has a comparative advantage and can compete in the international market. Therefore, with simultaneous implementation of import substitution and export promotion policies, it was hoped that the plan could achieve its short and long term objectives which mainly emphasised country's economic and industrial progress. In other words, one can see that the export promotion policy was not considered as an alternative to import substitution, but as complementary.

As a result of implementing a set of effective policies which has been previously discussed such as structural adjustment, stabilisation, trade liberalisation, privatisation and export-oriented industrialisation policies, the country's overall economic and industrial performance was significantly improved. For example, the industrial production witnessed a noticeable growth rate of 8 % in 1989 and the GDP grew with an annual average growth rate of 8.9 % during the period of first plan (1989-1993) [53]. The value of the non-oil exports increased very rapidly and registered a remarkable growth after 1990. This was mostly due to the introduction of some export incentive measures such as allowing exporters to sell their foreign exchange earnings from export of their products at the free market rate, facilitating the imports of materials and parts required for producing for exports, and tax and custom duties exemptions.

Following an increase in the oil prices in 1990 which resulted in the doubling of the foreign exchange revenues from the oil sector between 1988 and 1990, the government expanded its extensive reconstruction and development projects. Due to adoption of trade liberalisation and the increase in the country's oil revenues, the amount of imports rose dramatically to over $ 25 billion in 1991 from about $ 13 billion in 1989. Moreover, many large projects were completed during the period between 1989-1992. According to data and information presented by the President of Iran when submitting the second Five-Year Plan in 1993, during this period (1989-1992), production of cement has grown by 6%, steel 25%, copper 16.6%, aluminium 26.3%, the heavy auto-industries 30%, the light auto-industries 28%, and road construction machinery

49%. Various policy measures were undertaken for promoting and facilitating industrial production and development. Some of these measures which were adopted to liberalise industries, such as the facilitation of the import of raw materials, machinery and spare parts, and the gradual elimination of pricing and distribution controls, had a major impact on the expansion of manufacturing activities. Also a total of $ 9.2 billion was allocated to the industrial sector in order to expand further industrial production. With the utilisation of additional productive capacities of the existing establishments and the newly established industrial units, the production of the large manufacturing facilities grew by 29 percent, mostly in basic metals such as iron and steel, fabricated and non-ferrous metal products, machinery and equipment and chemicals [54].

As indicated earlier, the government adopted a series of policies (such as liberalisation, stabilisation and privatisation policies) along with the simultaneous implementation of the plan. As a result of these policy measures, many agreements were completed with major foreign firms to reconstruct and develop some of the industrial factories and bases, mainly in the steel, aluminium and auto-manufacturing industries. As an example, one can refer to some of the short and long-term goals for the expansion of these industries, such as an increase in the output of steel industry to more than 10 millions tonnes a year by the mid-1990s which could place Iran among the top 25 steel producers [55]. Increase in industrial products was attained through further utilisation of the existing labour force. According to a survey about the production process in heavy industries in 1990, total value of production of these industries grew by 64% (at constant prices). This growth has been more than 63 % in capital goods industries, 65% in intermediate goods industries and around 57 % in durable-consumer-goods industries [56].

As mentioned earlier, during the first three years of the plan, some effective policy measures have been implemented in order to increase the country's industrial output, such as providing foreign exchange needs of local industries at a competitive rate for importing required raw materials and machinery, removing price controls on manufactured goods and further utilisation of production capacities of industries. As a result of these measures, the industrial value-added grew by 20.6% in 1991 and the share of industry sector in GDP increased from 22.4 % in 1990 to 23.7% in 1991. Moreover, the large domestic demand along with the available raw materials led to more growth in manufacturing capacity utilisation in 1991. The production of some heavy and large manufacturing such as auto-manufacturing industries (automobiles, vans, minibuses and motorcycles) generated considerable growth, in some cases more than 200 percent in 1991

[57].

The privatisation process of many state-owned enterprises which was started by selling their shares on the Tehran Stock Exchange in 1990 was continued in 1991. The shares of 30 companies affiliated to the National Iranian Industries Organisation (NIIO) with a total value of over Rls. 201 billion and also the shares of 32 companies affiliated to the Bank of Industry and Mine (BIM) with total value of Rls. 85 billion were transferred to the private sector at the Tehran Stock Exchange. By mid-1991, a total of about 250 firms had the approval of the council of Ministers, and the process of privatisation has been accelerated with selling a share of 77 factories to the private sectors valued about Rls. 37 billion. There was also a remarkable growth in the number of permits for establishing industrial units which grew by 45.7% and 86.8 % for heavy and light industries respectively. Moreover, as a result of the government policy measures to encourage private and foreign investment, the private sector invested about $ 66 million during 1989-1990 [58]. It should be noted that despite a relatively significant privatisation of state-owned industrial enterprises in the early stage of the implementation of First Five-Year Plan, the process of privatisation has slowed down due to some reasons mainly financial crisis in the later stage.

In addition to the creation of a favourable environment for the expansion of exports, some further export incentives were also introduced to accelerate the growth of non-oil exports. The Export Development Bank has been established in 1991 with initial capital of Rls.50 billion aiming at determining appropriate policy guidelines for better recognition of the country's comparative advantages and further expansion of non-oil exports through provision of required financial support. Other export incentives included the return of up to 11 % of foreign exchange designated for exports to exporters, and provision of credits and foreign exchange for those industries which exports their products and led to a substantial increase in the value industrial exports by 173.3%, reaching $ 660 million in 1991 in comparison with the $ 241.5 million in the year before. The total amount of non-oil exports was also increased in 1991 and reached $ 2,514 million, which showed a growth rate of 90 % compared with 1990. The share of industrial products in total value of non-oil exports increased from 18.4 % in 1990 to 25 % in the 1991. Exports of home appliances with 199.5 %, chemicals with 153.5% and vehicles with 210.6 % had the highest share in the growth of industrial products. Among the major receivers of Iran's non-oil exports, Germany with $ 792.5 million, UAE with $390 and Turkey with $320 million were ranked the top importers of the Iranian non-oil exports in 1991 [59]. As is shown

in the following table, total industrial exports increased from Rls. 4291.1 million in 1990 to Rls 21939 million in 1991.

The industry sector	1990		1991		The growth	
	Value million Rls.	Weight tonnes	Value million (Rls)	Weight tonnes	Value million Rls	Weight tonnes
Chemical	16	3922	1191	211295	7147	5288
Electrical	27	131	312	601	1055	358
Metal industries	6.1	91	11854	24482	-	-
Food industries	1002	18265	1651	26125	65	43
Textiles industries	2395	2410	6162	6948	157	188
Mineral industries	845	680223	769	105019	-9	-85
Total exports	4291.1	75042	21939	374470	411	-47

Table 6.6 A comparison of industrial exports in 1990 and 1991.
Source: The Ministry of Industry (1992).

According to the statistics produced by the Central Bank of Iran, the total value added of large industrial units grew by 20.6 % in 1991 which was more than the projected rate of 12.9 in the plan. The production of metals had a substantial growth rate with steel 45%, and aluminum 10%. In 1992, the fourth year of the implementation of the plan, new measures were taken toward trade liberalisation and privatisation of the further public enterprises, removing the obstacles and distortions to industrialisation, and promoting new investment in the industrial sector. Following the adoption of further policy measures including decentralisation, elimination of red tape in issuing industrial permits, reduction of economic involvement of governmental organisations and placing more emphasis on the policy making role of industrial ministries, and provision of some customs facilities, resulted to the growth of the industrial value-added by 3.2 % in 1992. (a 1989 constant prices). In heavy industries, the production of steel with a growth rate of 27% reached a record high at 3.5 million tons in 1992 and exceeded by 19 % the targeted goal for production. In the light industries, there was an increase in the production of float glass, automatic washing machines and colour TV by 29 %, 35%, and 24% respectively [60].

The National Iran Productivity Organisation (NIPO) was established in September 1992 to increase productivity in particular in the industrial sector. The NIPO's main objectives included creating a national impetus for productivity improvement, developing human resource management through the implementation of training courses, seminars, etc, thereby transferring the productivity concepts and tools to managers and workers, and publishing books, and articles

on different aspects of productivity for various social categories [61]. As stated by the Minister of Industry, the productivity level in the industrial sector has increased by about 34% during the First Five Year plan [62]. Another figure indicates that output per worker has increased by about 20% during the plan, which has mainly been as a result of capacity utilisation. However, per capita productivity of the labour force in the country's industrial sector showed an average annual decrease of 0.7% during the period between 1977-1988, which was mostly attributed to the stagnation of industrial output in this period [63].

Following the policy measures for the expansion of non-oil exports and in particular industrial exports, such as removing administrative red tape, and the provision of foreign exchange and customs facilities, the export of manufacturing products grew by 37.3 % in 1992 comparing to the previous year and amounted to $ 651 million, which also indicated the upward trend of the industrial exports during the period 1989-1992. The total non-oil exports rose to $ 2.93 billion in 1992, showing 12.3 % growth, which mostly exported to countries such as Germany with 25.1%, Turkey with 12.0 %, UAE with 11.3%, Italy with 7.4% and Switzerland with 5.4% [64]. Among industrial products exported in 1992, the exports of transportation vehicles increased by 253.9%, copper bar by 150.2%, detergents and soaps by 70%, and chemical products by 46.4% in comparison to the previous year.

In 1993, which was the last year of the First Five Year Plan, the implementation of structural adjustment policies entered into its most critical and sensitive stage, with the efforts for reunification of the exchange rate. However, due to a decline in oil prices and consequent decrease in the country's revenues which in turn led to some imbalance of payments, the government imposed import restrictions in 1993 in an effort to reduce foreign exchange expenditure which had negative impacts on the process of economic and industrial development. As indicated earlier, because of the high dependency of industry sector on imported inputs, the production of manufactured goods fell sharply and growth of value-added in this sector declined to 1%. However, despite the foreign exchange shortage, most of the planned infrastructural and industrial projects for this year were completed. According to a report, the National Iranian Industries Organisation (NIIO) exported $ 37.5 million worth of products in 1993, an increase of 54% in comparison with the previous year [65].

Moreover, due to the high cost of foreign materials required by the industrial sector, this sector increased the use of domestic raw and intermediate materials and this led to an increase in the

share of domestic goods in production and also decrease in the dependency on importing foreign inputs, which in turn contributed to the increase in the volume of non-oil exports in this year. In 1993, about 18% of the import of inputs required for industrial exports was financed by non-oil exports, thus indicating the movement towards decreasing the dependency on oil revenues [66]. According to some statistical figures, non-oil exports with domestic content grew by 47% in 1993 comparing the previous year, and its share in total non-oil exports reached 19 %. The total amount of non-oil exports increased to $ 3.7 billion in 1993 and the trend of industrial exports was still upward and its value, with a growth of 23 %, amounted to $ 1.2 billion, which had a share of 33% in the non-oil exports [67]. Moreover, since 1993, in the context of considerable depreciation of the rial, substantial import substitution has taken place in such areas as construction materials and intermediate goods for the petroleum industry. In 1993, intermediate goods and raw materials comprised 63 % of imports, followed by capital goods (25%) and consumer goods (11%). Germany, Japan, and Italy were Iran's major suppliers of these goods [68].

	Exports to Iran ($ million)				Imports from Iran ($million)			
	1994	1993	1992	1991	1994	1993	1992	1991
Germany	1,600	2,430	3,500	4,000	825	778	750	900
Dubai	1,180	871	740	565	240	213	200	196
Japan	933	1,500	2,650	2,525	2,760	2,500	2,600	5,870
France	816	725	770	915	1,030	1,430	1,090	1,370
Italy	720	1,250	2,200	1,800	1,000	1,330	1,800	1,688
U.K.	443	742	1000	920	203	365	290	285
U.S.	326	616	748	520	0	1	1	260
S.Korea	n.a.	500	560	557	na	1000	1000	1000
Austria	270	280	383	375	100	80	120	na
Netherland	na	260	483	514	na	1,050	1,000	1,170
Argentina	27	248	324	323	na	0	0	0
Turkey	250	240	395	430	690	650	237	80
Brazil	na	260	350	427	166	289	954	na
Belgium	180	334	390	400	41	40	1,000	1,000
Spain	na	na	270	387	na	na	na	728
Australia	na	260	260	274	na	na	10	10
Canada	na	200	294	265	na	185	103	60
Others	3,255	1284	7683	9,803	9,945	8,089	6,845	1383
Total	10,000	12,000	23,000	25,000	17,000	18,000	18,000	16,000

Table 6.7 Iran Selected Trade Partners, 1991- 1994 ($ million)

Source: Iran Quarterly Report, Economic outlook, 1995, P: 25.

In 1994, the privatisation of state-owned industrial firms continued through selling their shares with the total value of Rls. 793.4 billion in Tehran Stock Exchange, which had a 53.9 % increase over the previous year. With the end of the First Five Year Plan in 1994, several industrial projects in particular in the petrochemical, steel and metal smelting industries were completed. It is argued that the completion of these industrial plants and supply of their products enabled the country not only meet the domestic needs and substitute for the import of similar products, but some of their products have also been exported. For example, one can refer to the steel industry whose output increased three-fold during the period 1989-1994 and amounted to an estimated 4.8 million metric tons in 1994, with almost a third of this amount exported [69].

Moreover, as a result of introducing various export promotion policy measures during the First Five Year Plan, mainly custom duties exemption for exporters, facilitating the importation of required materials for producing the outputs, and allowing the exporters the exchange earned from exports of their products on the free market rate, non-oil exports grew from less than one billion dollars in 1989 to $ 4.5 billion in 1994. Moreover, since the implementation of the Five Year Plan, there has been a considerable growth of the industrial output in particular in some heavy industries, and metal production industries. For example, the supply of steel products amounted to 4.7 million tons, showing 20.5 % growth in 1994 and production of various aluminium products also enjoyed a growth of 17 to 29 %, and the production of zinc sheet tripled, compared to the previous year [70]. As indicated earlier, during the Plan a number of new plants started their operation and some of the unfinished projects were completed and reconstructed. It seems necessary to study briefly the most important manufacturing sectors and plants in Iran in order to have an overall view of the country's industrial infrastructure. The following is some of the most important production projects in some selected industries which were mostly implemented during the period 1989-1993.

6.4 PETROCHEMICAL INDUSTRY

The petrochemical industry is one of the most important sector of Iran's industries, considering the country's vast potential oil and gas reserves which can be used as an input for producing petrochemicals. Many petrochemical complexes have been established since the mid-1960s. However, National Iran's Petrochemical Industry (NIPC), which has been established since early 1965 to assist the development of this industry, continued its important role in the expansion of several petrochemical plants during the implementation of the First Five-Year Plan (1989-1993).

During this period, NIPC invested about $ 7 billion in the industry to add nearly 5.5 million tonnes to the annual capacity. Furthermore, the NIPC is expected to spend a further $ 4 billion between 1994 and the end of the century to raise the output level to 12.6 million tonnes a year by the year 2000 [71]. According to the new strategic program for the petrochemical industry in the next 20 years, it is predicted that the total output of petrochemicals would reach 18.5 million tones by the last year of the program (about 2015). It is also projected that the export of petrochemicals will reach to the 11.5 million tonnes by the end of the program, from about 1.9 million tonnes in 1994 [72]. Therefore, one can see that Iran has a substantial potential capacity for petrochemical exports, due to its comparatively broad and diverse production base, and the availability of appropriate human resources, technical know-how and expertise in manufacturing of petrochemicals.

Some of the important petrochemical plants include:

- Shiraz Petrochemical Complex was one of the first petrochemical complexes, established in 1963 with the cooperation of a group of a French companies. It was originally called the Chemical Fertilizer Plant in Marvdasht, and is currently operating with a capacity of 200,000 tonnes/year ammonia phosphates, 84,000 tonnes/year of methanol, 1500 tonnes/year urea, 600 tonnes/year nitric acid, 750 tonnes/year ammonium nitrate, 7000 tonnes/year bicarbonate, 3000 tonnes/year hydrochloric acid, 23,000 tonnes/year caustic soda, 22,000 tonnes/year sodium hypochlorite and 10,000 tonnes/year liquid chlorine [73];
- Kharg Chemical Complex was established in 1966 with a daily capacity of 600 tons of sulphur and 6000 tons of liquid gas. However, it was damaged through Iraqi air attacks during the war (1980-88), and has been reconstructed and resumed production since 1989, with a full production capacity of 5000 tonnes per year PVC, sulphur and Liquid Petroleum Gas (LPG) mostly for export;
- Razi Chemical Complex became operational in 1970, and its activity was interrupted during the war with Iraq. The reconstruction of the complex began since 1989, and has been operating with a capacity of 495000 tonnes per year sulphur, 720,000 tonnes per year ammonia and 700 tonnes per day (tonnes per year) di-ammonium phosphate;
- Abadan Petrochemical Complex was established in 1970, to produce PVC, primary materials of plastics, primary material of detergents, and potash. Its operation came to a halt after the Iraqi attack in 1980. However, the reconstruction of the complex started in October 1989, and since then, it has been operating with a capacity of 40,000 tonnes per annum PVC, and

30,000 ta caustic soda;

- Iran Carbon Company was established as a joint venture with 20% share of NIPC, 30% to Industrial and Mining Development Bank, and 50 % to American Kabout Company and is currently operating with a capacity of 15,000 tpa carbon black [74];
- Farabi Petrochemical Plant, was established in 1972 as a joint venture with Japanese companies and is located in Mahshahr producing mainly softener materials for plastics, anidric fetalic, and phthalic anhydrides;
- Razi Petrochemical Complex, is located in Mahshahr near Bandar Khomeini producing urea and diammonium phosphate and azote fertilizers;
- Isfahan Petrochemical Complex, came on stream late in 1991 with a $ 250 million aromatics plant with a capacity to produce 75,000 tonnes per year benzine, 44,000 paraxylenes, 22,000 orthoxylene and 20,000 toluene;
- Arak Petrochemical Plant: an NPC and Bank Melli (National Bank) joint venture (NPC 51% and Bank Melli 49%), located in a 750-hectare site west of Arak (central province). There has been a licensing contract with Italy's T.P.L, in cooperation with the Dutch company K.T.I. for the Elfin unit. It comprises 15 units with a designed annual production capacity of 60,000 tonnes of high density polyethylene, 60,000 tonnes of low density polyethylene, 50,000 tonnes of polypropylene, 25,000 tonnes of polybutadiene, 30,000 tonnes of vinyl acetate, and 105,000 tonnes of ethylene glycol [74]. It can also produce 14 kinds of other basic petrochemicals, rubber and chemical products including a capacity of 500,000 tonnes / year urea and 330,000 tonnes/ year ammonia;
- Tabriz Petrochemical Plant: which is considered as a third giant petrochemical complex, with construction supervision by Engineers India and in cooperation with an Italian subsidiary of Technipetrol, providing feedstock for the newly finalised downstream units, and Daelim of South Korea, producing 100,000 tonnes/year polyethylene, 65,000 tonnes/year polystyrene, 14,000 tonnes/year rubber, 12,000 tonnes/year latex, 50,000 tonnes/year propylene, and a 55,000 tonnes per year benzene extraction unit worth $80 million, and Technic of France and TEL of Italy designed the equipment and the installation of a high density polythene and butane plant with a capacity of 107,000 tonnes per year;
- Bandar (Imam) Khomeini Petrochemical Complex: is the country's biggest petrochemical complex, with a total cost of about $ 5,540 million. It was firstly established in the 1970s, called the Iran-Japan Petrochemical Complex, but the project remained incomplete due to some difficulties, mainly the severe damage caused by war. Since the end of the war in 1988,

several contracts have been signed with France, Italy, Germany and S. Korea in order to reconstruct and complete the plant. In 1991, the Liquefied Petroleum Gas (LPG) unit of the complex was put into operation with the potential export capacity of 500,000 tonnes/ year. The exports, under an agreement with the South Korean firm Daewoo, are worth $ 65m a year and could be doubled if the two sides agree. The agreement is part of advanced sales of the products at Bandar Khomeini whose second phase opened in August 1994 [76]. The complex has sold $ 900m of its production in advance to finance its construction;

- Khorasan Chemical Fertilizer Plant: producing 420,000 tons per year sulphur coated urea and 65,000 tons per year agricultural sulphur;
- Khorasan Petrochemical Complex: built with an investment of over Rls.1.2 billion and as a fertilizer complex with a capacity of 330,000 tons per year of ammonia and 495,000 tons per year of urea. The complex used technology licensed by Kellogg of the UK for the ammonia unit and by Stamicarbon of Netherlands for the urea unit. There is also a $ 450 million investment to build a fertiliser complex during the first plan period;
- Orumiyeh Herbicide Plant: the construction has started on this plant with a capacity of 1,500 alchlor, 1500 butaclor, 10,000 mono-chloro-acetic acid, 1500 chloroacetyl chloride and 2,500 dimethyl aniline tonnes per year.

Moreover, there are some current projects undertaking in the petrochemical industry including, the paraxylene extraction with a total capacity of 160,000 t/yr, a methanol project with the capacity of about 660,000 t/yr, the sixth olefins project to produce ethylene, high density polyethelene, stryrene, high impact and general purpose polystyrenes with a capacity of 307,000 t/yr, and the engineering plastics projects to produce polycarbonate.

The NIPC has also listed five big plants as priority projects during the Second Five-Year Plan started in March 1995. The five projects are: a methyl tertiary butyl ether (MTBE) plant in the south to manufacture the additive to help produce 500,000 tonnes of unleaded gasoline a year; the doubling of the annual capacity of the olefin unit of the Bandar Khomeini petrochemical complex to 530,000 tonnes; a methanol unit on Kharg Island, with an annual capacity of 600,000 tonnes; and two plastics projects. The new facilities will require a government investment of $ 1,800 million. Based on statistics reported by the Plan and Budget Organisation, the volume of petrochemical output rose to 4,369,000 tons by the end of 1993, bringing 500 million dollars in foreign currency for the country. The petrochemical reached to 11.8 million tonnes in 1996 compared to 2 million tonnes in 1979 [77]. Despite the significant expansion of

the petrochemical industry during the recent years, however, it is argued that some major constraints such as lack of skilled labour force, and shortage of foreign exchange to import necessary machinery and equipment, are preventing this industry from further improvement. The following table shows the production capacity and consumption of petrochemicals in 1990 and their predicted figures for 2000. In the Second Five-Year Development Plan (1995-1999) an investment of 11,000 billion rials is to be made in the petrochemical industry which will increase its capacity from 9 million tonnes in the First Development Plan to 12 million tonnes. According to the estimates of the second plan, 60% of the petrochemical production of Iran will be exported. The expected export items will be plastics and chemical products such as MTBE (methyl-t- butyl ether) which is used for making lead-free petrol and has a very high added value [78].

Petrochemical product	Capacity (tons)		Consumption (tons)		% share of Iran in Middle East	
	1990	2000	1990	2000	1990	2000
Ammonia	1093	1650	381	1,316	14	16
Aromatics	7	900	28	225	9	18
Olefines	43	1,600	8	958	0.3	14
Methanol	90	850	14	98	6	23
Plastics	60	1000	324	1,043	38	51
Rubbers	-	135	27	119	77	73
Synthetic fibres	117	163	160	294	90	92
Total	1410	6,298	942	4,053	14	21

Table 6.8 The production capacity and consumption of petrochemicals in 1990 and their predicted figures for 2000.

Source: MEED (Middle East Economic Digest), 22 May 1992, P: 10.

6.5 IRON AND STEEL INDUSTRY

Because of country's large mineral resources in particular an estimated amount of 1,070 million tonnes of iron ore, much emphasis in this sector has been given to steel production plants and development of iron-ore mining [79]. The Iran's National Steel Company (NISC), which was established in early 1980s to monitor the country's large still plants, mainly Isfahan steel mill, Mobarakeh steel complex and Ahvaz steel complex. The Isfahan Steel Mill has been established in 1965 near Isfahan in central part of the country with technical assistance of the former Soviet

Union, and with initial capacity of producing 750,000 tons per year. In 1992/1993, the mill was expected to produce a record 2.4 million tons of steel (mostly low-grade construction beams). Contracts have been signed with Japan's Nippon Steel and Italy's Danieli in order to transfer the know-how and technical expertise. The production capacity of Isfahan steel mill was expected to increase to an annual average of 4-5 million tonnes by 1996. The Mobarakeh steel complex is one of the country's largest steel complexes. The construction of the plant started in 1979, but was put into operation in 1991 with a total capacity of 2.4 million tonnes of steel sheet a year. Several contracts have been signed with some major foreign steel companies such as Italy's Italimpianti and Japan's Kobe steel in order to increase the complex's output. A turn-key contract was signed in January 1989 to build another plant on the site to produce laminated steel products, with an initial investment of nearly $2 billion. Contracts have been signed with Marubeni and Kobe Steel of Japan, to develop Chador Malek iron ore mines to supply the Mobarakeh steel complex [80].

The Ahwaz Steel Complex, a three-unit direct reduction plant using natural gas, was established in 1975 through the initial contract with a European-American consortium and with a sponge iron capacity of 330,000 tons and intended total capacity of 2.53 million tons per year [81]. Despite severe damage caused during the war, three of its phases started operation with a capacity of 550,000 tonnes a year in 1989. The overall design capacity of steel production by the Ahwaz complex has recently reached 1.65 million tons of steel ingots, using the direct reduction method, and 1.55 million tonnes of billet and steel slabs. There has been a contract between Iran's National Steel Company (NISC) and Japan's Kobe steel Company, for increasing the production capacity and transferring the technological know-how and training of the labour force. After combination of the three main steel complexes, (Ahwaz steel complex, Kavian steel complex and the Iran national steel industry group),the country's total steel production capacity has increased by 2.5 million tons.

The Isfahan Steel Company has its own research and development organisation which in 1994 designed and built a pilot direct-reduction module using a new technology which is claimed to be better than US's Midrex process installed by Japan's Kobe Steel at the new Mobarakeh mill. It has also applied for a patent in Germany and planned to convert the old Isfahan mill to direct reduction and press for its use in all new steel mills in the country. Contacted in the US, Midrex, which has 67 % of the world's direct reduction market, initially said it was not aware of the Iranian plans. After checking, Midrex said there was indeed a plant at Isfahan using a different

technology, but that it may not be new and only a refinement of an unused existing technology [82].

The country's Steel production increased from about 1.1 million tonnes in 1989 to 3.8 million tonnes in 1992. The average annual growth rate of iron-ore output during the first five development plan was 24.2 %. Iron-ore output reached 6,290,000 tons in 1994 from 1,850,000 tonnes in 1988. Moreover, according to a latest report by "The Metal Bulletin", Iran stood in the 28th place in the list of the world steel producers in 1995 for the production of 4.7 million tons of steel [83]. Iran has also emerged as a steel exporter, with about 1.5 million tonnes, mostly to East Asian countries [84].

6. 6 COPPER PRODUCTS INDUSTRIAL COMPLEX

Copper is one of the country's most important mineral reserves, which is mostly located in Sarcheshmeh copper mine in Kerman province, with total estimated reserves of 1,223 million tonnes [85]. The Iran National Copper Industries Company (NCIC), as a part of Ministry of Mines and Metals, is mainly involved in the exploring, and expanding the new and existing copper mines in order to increase the country's copper products. The Shahid Bahonar (Sarcheshmeh) Copper Complex is the country's biggest manufacturer of copper products, producing various copper and copper-alloyed products, copper pipes, wire, copper and brass sheets and straps, copper and nickel alloys, and coins and tinsel. The complex has a design capacity of 144,000 tonnes a year, consists of copper mines, mills, and enrichment, melting and purifying units. It has also design capacities for production of gold and silver of 400 kilograms and 12 tonnes a year [86]. Several agreements have been signed with some large foreign companies including Autokumpu of Finland, Krupp of Germany for building smelting and casting units, and the Marubeni corporation and Kobe Steel company, both of Japan, for constructing rolling unit.

Moreover, new copper deposits, at Sungun in Northwestern part of country and Meiduk near Sarcheshmeh, are being developed to provide inputs, in order to raise the capacity of the complex from 144,000 to 200,000 tonnes a year. The plan is to increase copper output from Sarcheshmeh copper mine and smelter, near Kerman, from 92,000 tonnes in 1990 to 200,000 tonnes a year. As recent data indicates, the production of anode copper increased from 58,000 tons in 1989, to 102,000 tons in 1994, showing 22% of annual growth [87]. The electric cable industry is seen as a prominent area for exports but it needs modern technology and expertise to

be able to compete in the international market. The total copper production rose to 416,000 tonnes during the first Plan (1989- 1993) from 165,000 tons, indicating an average annual growth of 20.2 % [88].

6. 7 ALUMINIUM MANUFACTURING PRODUCTS

Arak Aluminum Company was constructed in 1967 as a joint venture between Iran with 70 % of the share, and Pakistan, US Reynolds Metals Company, holding 25% of the share. The Arak aluminium factory is capable of producing 45,000 tons of aluminum bars in its reduction unit, and 120,000 tons of alloys in its casting unit. Since the implementation of the first plan, efforts have been made to raise the production and to increase the design capacity to 120,000 tonnes a year [89]. The aluminium powder used by the industry is imported at 100,000 tonnes a year mostly from Australia. The other Aluminium plant, Alum Pars which was set up in 1977 in Saveh in Central Province, has a cold rolling plant with an annual capacity of 12,000 tonnes. The Almahdi Aluminium complex, claimed to be the largest in the Middle East, has recently been built in Bandar Abbas (a major southern port), by a joint venture with the Dubai based International Development Corporation Company (I. D. C.) holding 40% of shares. The smelter is to have an initial output of 220,000 tonnes of a, increasing gradually to 330,000 tonnes per year. The complex will include a 300-400 MW power station and a desalination plant.

According to a report by the Ministry of Mines and Metals, the output of aluminium stood at 90,100 tonnes in 1994 from over 28,000 tonnes in 1989, indicating 26.3% annual growth rate, while the target for the first development plan was 18.5% [90].

6. 8 CAR MANUFACTURING INDUSTRY

During the First Five Year Plan (1989-1993), in the automobile manufacturing industry, there were two new types of buses, one new type of minibus, two types of car and for the first time the production of cars has been achieved with manufacturing of more than 50% of their components by local manufacturers. Following an attempt for privatisation of most state-owned enterprises, major car manufacturing plants including Iran Khodro, SAIPA, Pars Khodro, Iran Vanet, Khavar, Khodrowsazan, Zamyad, Moratab, Iran Kaveh and Shahab Khodrow which mostly were under the control of the Ministry of Heavy Industry, were put on sale by the Stock Exchange in 1992. Assembly and manufacturing plants have also been completed by the large state-owned car companies that are being privatised. However, as a recent report by UNIDO

(1995) indicated, several attempts to introduce a locally-designed "national car" to replace the existing type (Peykan) has been unsuccessful so far [91]. Therefore, due to heavy dependency on imports of parts and kits, the Iran's auto-manufacturing industry still lacks a self sufficient capacity to manufacture a complete domestically-produced car.

Iran Khodrow is a pioneer producer of passenger cars, vans, minibuses, ambulances, buses, and bus engines. In 1989, it signed a $ 1,500 million contract with Peugeot of France to set up local manufacturing facilities to assemble 60,000 Peugeot 405 engines to be used in Paykan passenger cars. Another project of Iran Khodro includes the expansion of its bus producing unit, to turn out 4,000 Mercedes Benz, 302 buses a year. Iran Khodro, has also exported 1,070 various kinds of vehicles including 500 Peugeot cars, 501 minibuses, 119 buses and 33 ambulances to Russia in 1993 [92].

SAIPA is another country's major manufacturer of various types of vehicles mainly through assembly and CKD (Complete Knocked Down) kits. It has mainly assembled passenger cars including Renault 5 and Renault 21 under licence from Renault of France, Diane (Citroen) as well as Pride (Kya motors of S. Korea) and Nissan of Japan. In addition, several contracts have also been signed with Mercedes of Germany, Fiat of Italy and Daewoo of South Korea to set up facilities for the assembly of passenger cars. Moreover, a joint-venture agreement has also been signed with AWD-Bedford of UK to assemble 2,000 trucks a year. SIPA produced 21,300 Renault-5 cars and Nissan pick-up trucks during the first eight months of the 1992. The Sazeh Gostar company, a design and engineering affiliate of the Industrial Development & Renovation Organisation (IDRO), with the latest computer technology and working under a systems approach requiring a high degree of specialisation, has been drawing complete designs of the Renault-5. While copying the Renault-5, the company is designing new parts for other cars such as Nissan Patrol, Jeep, Land Rover, and Mercedes and Volvo heavy vehicles.

According to a report by the Minister of Heavy Industries, during the period 1988-92, the average growth in vehicle production was as follows: Vans, 3.9%; lorries, 2.9%; buses, 2.5%; minibuses, 2.2%; station wagons, 2.1%; cars, 1.6% [93].

6. 9 HEAVY MACHINERY AND EQUIPMENT INDUSTRY

The most important heavy machinery and equipment manufacturing facilities in the country are located mainly in Arak in the central part and Tabriz in the northwest of the country. As

indicated earlier, the Arak Machine Manufacturing Company (Machine Sazi Arak), was established in 1969 with technical and financial assistance from the former Soviet Union, and with a capacity of 20,000 tons, for the production of machinery, boilers, cranes, conveyer belts, and agricultural equipment. There was an agreement with the German Krupp company in early 1989, to produce 1,500- cubic-metre-a-day desalination plants with 70 % local content, to be increased to 85% [94]. The Tabriz machine Manufacturing Company (Machine Sazi Tabriz), was put in operation in 1972 with technical assistance from former Czechoslovakia, with a capacity of 10,000 tonnes of lathing and milling machines, lathing plates, drilling and grinding machines per year. It was also designed to produce 50,000 electro-motors, 10,000 compressors and spare parts and 3,300 small diesel engines. Iran Tractor Manufacturing Company (Tractor Sazi Iran) was formed in 1968 with technical assistance of Romania and with an annual design capacity to produce 18,000 Massey-Ferguson tractors through assembly operation, 10,000 tractors and industrial engines, 7,450 trolleys, casting parts and ironworks. In 1987, its production capacity was planned to expand to about 30,000 Massey Ferguson tractors, 36,000 perkins engines, 54,000 tonnes of casting and 36,000 tonnes of ironworks. With a combination of the Romanian and British Massey Ferguson techniques, the company could produce a new type tractor which is stronger than other types by 10 horsepower [95]. Azar abb Company was established in Arak in 1984, with an investment of about Rls 30,000 million and design capacity of 25,562 tonnes to manufacture steam boilers for power plants, and equipment for the oil refineries and other plants in the country. Several contracts have been signed with Japanese companies, including a joint venture with Japan Steel Works company to build steam boilers for the country's major power stations.

6.10 FOOD, AND FOOD PROCESSING INDUSTRIES

This industry covers a total of about 928 large and about 8000 small production plants. The availability of the raw materials required and the relatively expanding export markets, has helped the industry to achieve an average growth rate of 7.8% in the last few years [96]. One of the most recent examples from the food processing industry is a 50-50 % joint venture between Swiss food manufacturer company, Nestle, with Iranian family firm, Nowzad, to build a $ 44 million baby food factory near Tehran with a primary capacity to produce 20,000 tonnes per year of infant formula and cereal in September 1994.

6.11 CARPET MANUFACTURING

Carpet weaving, which involves 4-5 million people, is still the most important branch of the handicrafts industry. There are about 18 factories involved in machine-made carpets with an annual production valued at $ 1.5 billion. The exports of hand-made carpets and rugs which is the largest figure among non-oil exports, constituting about 50% of non-oil exports, has recently faced a crisis and amounted to only $ 968 million in 1995 which showed a 40 % decline from the previous year ($1.4 billion). This is mostly due to fluctuation in exchange rate and competition from machine-made carpets of other countries such as China, India, Nepal, Pakistan and Bangladesh with very low prices. Furthermore, the government decision in requiring the rug exporters to sell to the banking system their foreign exchange earnings at the official rate has also slowed down the export of rugs. Moreover, shortage of raw materials and the US trade ban with Iran (announced on May 1995) which was one considerable market of Iranian carpet and rugs is also viewed by the UN report as other factors contributing to reducing its exports [97]. However, due to relatively reduced dependency of the carpet and rug industries on importing foreign inputs and materials, most of the revenues from the export of rugs and carpets can be used as a source to assist for the further expansion and development of this traditional industry.

6. 12 TEXTILES, KNITTING AND LEATHER INDUSTRY

This industry is one of the oldest in Iran, and probably the first to start using modern techniques. The textile industry includes a number of spinning, weaving, and knitting plants producing a variety of woven and knitted fabrics with yarn spun from different natural and synthetic fibres. The number of large plants in this industry fell from 1,221 in 1982 to 1,112 in 1987. Domestic demand for cloth amounts to 900 million square metres per year. One of the important knitting and weaving manufacturers in Iran, Chite-Ray, started in early 1989 installing 150 sets of very modern weaving machinery, mostly imported from (former) Czechoslovakia. This company is exporting nearly 50,000 metres of cloth per month. However, this industry, like other industries, needs to import some of its basic materials such as polyester and acrylic fibres from abroad. According to the available data, the total number of operating spindles amounted to about 1.5 million in 1993 while the number of weaving and knitting machines amounted to approximately 4000 [98].

Moreocer, some important industrial plants and projects undertaken during the First Five-Year

Plan (1989-1993) include: a $52 million paper manufacturing plant; 27 new cement plants with a total capacity of 13.7 million tonnes a year which could raise annual output by the mid-1990s to 33 million tonnes a year; a joint venture with a Swiss firm for repairing war damage to the Neka Power Station on the Caspian Sea along with building another power station, powered by two 137 megawatt gas turbines near Neka; building a $ 260 million power plant with the help of a German company in Gillan northern Iran; the plumbago smelting unit in Zanjan; the gold smelting unit of Moteh (near Moteh Gold Mines); the DMT manufacturing plant, producers of synthetic fibres, PVC and rubber manufacturing plants in some cities in Iran; the serum manufacturing plants in Mashhad and Tabriz; the LAB unit, manufacturers of detergents, the textile industries and textile machinery; the ship building yard at Neca in northern Iran; and the pharmaceutics units. During this period, a total of about 1000 industrial plants became operational each year. About 300 engineering design units and 245 assembly design units have also been established in heavy industries. The expansion and development of these units during the next Five Year Plan can play an important role in increasing the ability and capability of learning and assimilating know-how and foreign technologies. During the period of the first plan (1989-1993), the production of cement grew by an average growth rate of 6%, steel 25.2%, copper 16.6%, aluminum 26.3%, and the auto-manufacturing 29% [99].

	1990	1991	1992	1993	1994
Industry	214,611	216,226	215,416	193,529	170,91
Food and sugar	4,962	4,774	3,791	12,800	348
Textiles, handicrafts and leather	2,724	2,760	7,493	6,810	6,237
Cellulose and printing	-	-	-	9500	-
Chemical and petrochemical	18,893	37,905	35,535	88,118	82,215
Non-metallic minerals	7,401	2,605	1,435	7,050	-
Metal and metal smelting	164,678	154,300	122,846	45,150	47,845
Mechanical	5,165	6,779	28,000	750	15,000
Transportation vehicles	6,564	-	170	-	-
Damaged establishment project	721	1,090	2,682	-	-
Industrial supervision & research	2,193	3,577	7,177	11,122	9,175
Technical assistance	10,309	2,436	6,287	12,229	10,092
Mining	51,859	94,334	100,138	118,759	156,58
Total	266,470	310,560	315,554	312,324	327,50

Table 6.9 Government Development Payments for Manufacturing and Mining Sector (Million Rials)

Source: The Central Bank of I.R. Iran, Annual Review, 1994-95, P: 30

According to a report by the Minister of Industry, of the total amount of Rls 7,500 billion, and $ 14 billion (from oil sales revenues) were invested in the industrial sector during the period of First Five Year Plan, 55% of the sum was invested by the public sector and 45% by the private sector. The investments made by the government went mostly to infrastructure projects and key industries such as petrochemicals, steel and auto-manufacturing industries. Industrial exports grew by 40% and reached a total value of $ 1.2 billion in 1993. Domestic production of petrochemical products rose to 5.5 million tons in 1993 from half a million tons in 1989. The production of various types of steel increased from 1.4 million tons in 1989 to more than 4 million tons in the last year of the plan (1993) [100]. Following the implementation of the privatisation policy during the first plan (1989-1993), a substantial amount of private investment has been attracted. For example, Industrial and Mining Bank of Iran offered 69 million shares of state-owned enterprises, with a total value of Rls 480 billion ($ 160 million) on the Tehran Stock Market. Moreover, about 300 companies with the total value of $ 700 million have been transformed to the private sector since the implementation of privatisation programs in the First Plan [101].

Having compared the achievement of the targeted figures during the First Five Year Plan, as a report by the Plan and Budget Organisation indicated, 1989-1990, the value-added in the industrial sector grew by 8% and 11.2% in 1989 and 1990 respectively compared to the projected figure of 14.2% growth rate of industrial output for the period of the plan. The annual growth rate of value-added in capital goods industries has been 25% in both years, more than the planned target of 24%. Targets for the annual growth rate of intermediate goods industries has been 20% while the actual rates have been 10% and 23.7% in 1989 and 1990 respectively. According to Bank Markazi reports during 1990-1991, labour productivity in the industrial sector had a growth rate of 25% and capacity utilisation reached 40-50% with oil related industries operating at near full-capacity [102].

As indicated earlier, the plan was aimed at the average annual growth rate of 4.2 % for consumer goods industries value-added, however according to some statistics, the real average annual growth rate for value-added of consumer good industries in the four year of the plan was much more than the target figure. The failure in achieving some of the above targeted figure (such as annual growth rate for intermediate industries), can be mainly attributed to some factors such as: giving foreign exchange subsidies to industrial investors for importing machinery and

equipment which led to a decrease in their demand and tendency for producing domestic capital goods; lack of adequate supportive quotas and tax on imports; and the lack of technological capability and decentralisation of decision making due to the existence of three ministries in charge of the industrial sector.

Having analysed the targeted figure for non-oil exports in general and industrial exports in particular, non-oil exports were expected to increase to $ 17.8 billion during the Plan period (1989-1993) half of which was assumed to be the contribution of manufacturing exports. However, the total value of non-oil exports has been $ 11.7 billion over this period. The plan has also failed to achieve the targeted figure for the exports of industrial products. As indicated earlier, targets for exports of industrial products have been , 543.8; 692.9; 950.9; 1310.9 and 3740 million dollars for the period between 1989-1993, however, the actual figures for export of industrial products have been, 154.7, 234.2, 722, 1045.2, and 1243.4 million dollars for this period [103]. It is argued that the unstable and inconsistent exchange rate policy was one of the major factors affecting the performance of non-oil exports and in particular manufactured exports. Although the initial devaluation of currency which was implemented in accordance with the trade liberalisation policy since 1989, resulted in some very favourable effects on increasing exports (increasing non-oil exports from about $ 1 billion in 1989 to about $ 3 billion in 1992), severe fluctuation in the value of the floating exchange rate caused to a sharp increase in the price of domestic products due to their heavy dependency on imports of materials and components which in turn affected the value of exports.

Moreover, following the government decision to unify the exchange rate in April 1993 (the devaluation of the Rial by 95.6%), the government announced a new floating exchange rate substituting the previous multi-rates exchange rates. However, due to some problems caused by the severe shortage of foreign exchange and the trade ban imposed by the U.S government, the exchange rate unification could not be accomplished. Moreover, although the experience of some countries studied before (such as Indonesia, Malaysia., etc ...) indicated the favourable effects of devaluation of their currencies, in Iran, due to heavy dependency of domestic industries on importing their required materials and parts from abroad, the devaluation of Rial led to an increase in the price of these materials and therefore led to high cost of production which in turn resulted in loosing the competitiveness of domestic products in international markets. The widening gap between official and free exchange rates (the free market rate was 260% higher than the official rate by May 1995) had some inflationary pressure on the economy

which made government officials introduce new policy measures in May 1995 to prevent further soaring prices. These new measures included fixing the official rate at Rls.3000 per dollar and requiring exporters to sell their foreign exchange earnings at the official rate within a period of three months (6 months for carpets) have had negative effects on the amount of non-oil exports. Exporters are also allowed to use up to 50% of their export value to import basic materials into the country.

Some of the other most important reasons for the weakness of industrial exports were as follows:

1. Lack of precise recognition of the country's export regarding its comparative advantages,
2. Lack of adequate quality standards for local industrial products,
3. Lack of consistent exchange rate policies during the implementation of the plan (1989-1993),
4. The unrealistic and ambitious targets for industrial exports,
5. Heavy dependency on the import of foreign inputs for producing industrial output, (about 65%)
6. The lack of sufficient export incentives for the domestic industrial producers (private and public)
7. Lack of a competitive environment both from inside and outside the country,
8. The high cost of production due to low levels of productivity ,
9. The lack of adequate absorptive capacity for the adaptation of the imported technology and low technological capability,
10. The lack of strong supportive regulations for encouraging industrial exports and the existence of some administrative barriers and red tape,
11. Lack of efficient managerial and technical expertise,
12. Inadequate industrial infrastructure and relatively low level of private and foreign investment in the industrial sector,
13. The existence of unused industrial capacities in most of the industrial investment ,
14. The lack of adequate marketing expertise and inadequate packaging,

However, some steps were taken to tackle these obstacles in particular the weaknesses of industrial exports. These include more investment in industries which are involved in the

packaging of exporting products, greater emphasis on promoting quality control and standards levels of the products, and active participation in international trade fairs in order to learn more about various ways of penetrating international markets with the right products [104]. Moreover, an overview of the composition of non-oil exports during the period between (1971-1992) indicated that the share of manufacturing exports has never exceeded 22%, and agricultural and traditional goods contributed the majority of most of non-oil exports.

	1975	1980	1985	1988	1989	1990	1991	1992
Agricultural and traditional goods	69.9	93.3	79.8	74.4	85.7	79.1	75.0	69.6
Metal ores	5.5	3.0	6.5	3.2	2.6	2.5	1.5	1.2
Industrial goods	24.6	3.7	13.8	22.5	11.7	18.4	18.2	21.3
Other	-	-	-	-	-	-	5.3	7.8
Total	100.0	100.0	100.	100.	100.	100.	100.	100.0

Table 6.10 The Composition of Non-oil Exports during the period between (1975-1992)

Source: Plan and Budget Organisation Iran, Tehran.

Regarding the targeted figure of 15% for the average annual growth rate of the industrial and mining sector, it is estimated that the real rate was 7.6% over the first three years of the plan, achieving only 53% of its projected growth rate. However, the growth rate of manufacturing sector declined to 3.2% and 1% in 1992 and 1993 (fourth and fifth year of the plan) respectively [105]. As indicated earlier, in addition to the above mentioned points, some factors such as the lack of consistent and coherent strategy for industrialisation; the existence of several decision making centres in the industry sector; lack of adequate managerial and technical expertise; inability to generate adequate employment opportunities; lack of adequate inter-sector linkage within industry sectors; the inappropriate technology and obsolescent processes of most industries; low productivity levels; the slow process of privatisation of industrial enterprises, inadequate and inefficient utilisation of natural raw material; the shortage of allocated foreign exchange and credit; a relatively low capacity utilisation; and unplanned facilitation of imports during the second year of the implementation of the Plan (inadequate protection of domestic industries against foreign imports), were among the most important reasons for the failure of the Plan to achieve its actual target for the growth of the industrial sector. Moreover, as indicated earlier, a continuous heavy dependency of manufacturing sector on imported inputs for its growth, led to its decline when the country faced the shortage of foreign exchange as a consequence of decreasing oil prices.

Having compared the other targeted and actual figures of the plan, one can note that while the plan envisaged an average annual GDP growth rate of 8.1 % for the period between (1989-1993), GDP grew by an average annual rate of 7.2% in this period. However, the average annual GDP growth rate in the first two years was significant (10%) and above the projected rate. The high growth rate achieved during the first half of the plan can be mostly contributed to the initial effects of the trade and foreign exchange liberalisation and the utilisation of unused capacities in the economy, along with increase in the oil prices following the Iraq's invasion of Kuwait. Moreover, the figure for the average annual growth rate for ratio of investments to GDP was projected to be 19.7%, but its actual rate in the first four years of the plan was 10.6%, only 54% of the expected rate. Thus only a small portion of the GDP was invested in the economy.

The different economic sectors	1984 -1988 The av. growth	1979 -1984 The av. growth	1989 - 1993 The av. growth	The targeted figure of plan (%)
Oil	1.4	4.9	5.9	6.1
Industry and mines	2.2	-8.5	8.6	9.5
Water, power and gas	1.5	7.8	9.1	15.0
Construction	4.8	7.1	12.7	9.1
Services	-17.5	3.3	5.3	14.5
Gross Domestic Products (GDP)	-18.1	3.7	6.5	6.7

Table 6.11 The average growth rate of different economic sectors during the period between 1979-1993

One can refer to some obstacles and problems which prevented some of the targets and goals of the plan being completely achieved such as; swift revisions to the plan; shortage of technical and managerial expertise; ineffective bureaucracy; different sources of policy making and lack of co-ordination between them; inconsistent and unstable regulations and fluctuation in exchange rate; high dependency on the oil revenues for financing the reconstruction plant and imports of required inputs for local industries, and lack of adequate utilisation of local productive capacity.

Sectors	1989		1990		1991		1992		1993	
	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
Agriculture	4.2	3.7	4.6	8.1	6.1	5.1	7.1	7.4	8.5	3.5
Oil	21.	7.7	9.6	19.9	3.4	11.12	11.3	2.1	3.0	5.5
Industries and mines	14.	6.6	15.2	13.4	14.6	17.2	16.4	4.7	13.8	2.1
Water, electricity and gas	6.5	11.0	7.0	19.4	11.7	15.5	5.3	8.5	47.8	9.4
Services	5.1	1.8	7.1	9.7	7.2	9.9	7.0	8.0	7.0	2.9
Construction	29.	-1.7	15.7	29	12.4	16.0	10.0	7.9	6.5	2.9
Gross Domestic product	7.9	42	9.2	11.5	6.8	10.12	8.5	6.00	8.4	3.3

Table 6.12 A comparison of planned and actual objectives of the first five year plan (1989-1993)

As the implementation of the First Five Year Plan ended in 1993, the government officials decided to study and evaluate the overall achievement of the first plan in 1994, to analyses the strength and weaknesses needed for designing future plans. The Second Five-Year Plan (1995-1999) which officially started from 21 March 1995 (the beginning of the Iranian new year) aimed at some overall objectives such as an average GDP growth rate of 5.1%, an average growth rate of 4.3% for agriculture, 5.9% for industries and mines, and an average growth rate of 8.4% for non-oil exports with total value of $ 24 billion during the plan, which seems to be lower than similar targets in the first Plan [106]. However, one can see the high priority and great emphasis placed on the expansion of non-oil exports during the second plan. In order to achieve its goals in increasing non-oil exports during the period 1995-1999, the Plan considers some export incentives measures such as, improving export regulations and smoothing the administrative procedures of exports, removing nonessential procedures and bureaucratic customs, centralising the government receipt of custom tariffs, introducing export insurance and guarantees, assisting exporters with their international marketing operations, providing exporters with up-to-date information through establishment of data banks, as well as offering export facilities such as export credits. The plan also projected the total fixed investment to be increased by an average of 24.6 % of GDP during 1995 - 2000 as one of the basic targets for growth in this period. Gross Domestic Investment (GDI) is also projected to increase from Rls 2403 billion in 1995 to Rls 3056 billion in 1999, by a 6.19 % annual compounded growth [107].

In addition to the above quantitative targets, the Second Plan also aimed at continuing the development and completion of plant from the First Plan, reform of the country's administrative system, and improvements in income and wealth distribution, in particular in rural areas. Moreover, economic stability and reduction of foreign debt are considered as two of the principal objectives of this plan. In order to assist the improvement of rural and undeveloped areas, an amount of Rls. 3000 billion has been allocated during the Second Plan. The Second Plan has also provided for introducing some measures in order to increase efficiency in domestic production, promoting local technological capability, increasing manufacturing output and industrial exports. Some of these measures include the reduction of tariff rates, more efficient use of the country's existing industrial potential and comparative advantages, and continuing the improvement of the country's infrastructure such as transportation networks and communication

systems.

Some of the most important objectives of the Second Plan (1995-1999) in the industry sector are: increase in industrial production; the development of the quality of local manufacturing products in order to compete in the international market; the development of local technological capability; the provision of necessary facilities for more and better attraction of foreign investment and technology; the maximum utilisation of the existing industrial capacity; the establishment and development of small-scale industries with high technology which can associate and compete with the local medium and large-scale industries; the development of the handicraft industries in particular in rural areas; and the development of industrial investment in particular in petrochemicals, the agricultural industries and electronics. The industrial policy in Second-Plan has also placed more emphasis on continuing the restructuring and privatisation process of the First Plan, greater intensity towards export promotion industrialisation policy and more utilisation of potential domestic resources and industrial capacity. Moreover, some of the most important quantitative objectives of the industrial sector during the Second Five-Year Development Plan (1995-1999) are:

1. A total investment of about Rls 20,000 billion in addition to $ 6-8 billion in the industries,
2. The average growth rate of 6.2% for industrial value added during the period of the plan,
3. The average growth rate of 10% for engineering and software design activities,
4. The expansion of the industrial applied research activities so that their value will reach 0.3% of total value of industrial production by the end of the plan in 1999.
5. Increasing the share of technicians and skilled labour working in industry sector from 3% to 4% in the end of the plan.
6. Increasing the exports of carpets and handicrafts to an average annual of $ 1.6 billion,
7. Increasing the production of petrochemicals, steel, copper, plumbago, zinc and aluminium to an average annual rate of 13 million tons, 7 million tonnes, 200,000 tonnes, 40,000 tonnes, 60,000 tonnes and 230,000 tonnes respectively by the end of the second plan (1999).
8. The total value of Rls. 20,000 billion investments in industries and mining in terms of fixed prices of the 1993.
9. The total of $ 10 billion of manufacturing exports during (1995-1999).

According to the Plan, before signing agreements with foreign companies, the government is required to oblige them to transfer know-how and technical knowledge along with the training of the local labour. It seems also essential to pay more attention to enhancing local industrial and technological capacity when purchasing foreign machinery and equipment in order to facilitate the transfer of know-how and technical expertise embodied in those machinery and equipment. The second plan is also aiming to improve Iran's international competitiveness, through the adoption of some trade and exchange policy measures such as reunification of the exchange rate, elimination of tariff exceptions for all public enterprises, and providing sufficient protection for domestic production. The government also hopes to increase Iran's industrial competitiveness and exports by encouraging the adoption of good management techniques, acquisition of modern and up-to-date technologies, and pursuing consistent and coherent policies. The privatisation policies implemented in the First Five-Year Development Plan are to be continued with higher speed and with aim of the leaving only 10 % of Iranian industry in the public sector by the year 2000.

Economic indicators	(%)
Real GDP	5.1
Oil	1.6
Agriculture	4.3
Industry and mining	5.9
Services	3.1
Imports	4.3
Oil exports	3.4
Non-oil	8.4

Table 6.13 Quantitative Targets (average growth rate) in Second Five-Year Plan (1995-1999)

Source: Central Bank of I.R. Iran, Economic Trends, Economic Research Department, P: 20

The Second Plan is also aimed at expanding support for small and medium scale industries, in particular in rural areas. As indicated earlier, among the quantitative targets of the Second Plan is the average annual GDP growth rate of 5.1 % for the period between 1995-2000. However, it seems essential for Iran to continue to intensify the stabilisation and outward-looking policies in order to sustain this targeted figure, bearing in mind the experience of first plan which achieved a high growth rate in the first two years of the plan but fell sharply in the latter years. Having considered its large potential natural and human resources, Iran can achieve most of the second plan's targets through implementation of a set of sound policy frameworks and providing

an appropriate environment for overall growth. It is also essential to emphasise more on the efficient utilisation of the country's potential assets in particular those in which the country has a comparative advantage, such as petroleum and vast natural gas reserves, substantial agriculture and other valuable minerals such as copper, zinc, gemstones. Therefore, efforts need to be made to maximise the efficient use of country's national and human resources.

As indicated earlier, despite the government attempts to reduce the dependency on oil revenues, it seems that oil continued to dominate the country's merchandise exports, which averaged about $ 18 billion per year in the period between 1989-93, with about 85 % from oil [108]. The oil revenue is also projected to amount to $ 72 billion during the period between 1995-1999. However, the Second Plan envisaged a slower growth rate for the oil sector (average annual rate of 3.2 %). As indicated earlier, there has also been an especial emphasis on the growth of the non-oil exports which expected to increase to an average annual of $ 5 billion over the second plan and will amount to a total value of $ 27.5 billion by the year 1999. This can be achieved through the adoption of comprehensive export promotion policy measures including giving export incentives to exporters and concentrating on products in which the country has a comparative advantage, such as carpets, fresh and dried vegetables and fruits, spices, handicrafts, canned foods, fresh flowers, electric goods, fabrics, paints and petrochemicals. In 1994, a total value of $ 4.5 billion, non-oil products were exported which had a 15% growth rate in comparison to 1993. The non-oil exports in 1994 consisted of $ 1.69 billion of carpets and other handicrafts, $ 1.17 billion of industrial products, $ 985 of agricultural goods, $ 63 million of minerals and $ 547 million other goods and products [109].

Product	Value ($ billion)
Textiles and clothing	0.25
Chemical and cellulose	1.16
Food and pharmaceutical	0.32
Non-metallic minerals	0.22
Petrochemicals	2.23
Metals	2.24
Carpets and handicrafts	7.00
Trucks	0.14
Buses	0.06
Others	1.91
Total	15.80

Table 6.14 Projected value of manufactured exports by major product group, second development plan of the Islamic Republic of Iran (1995 -2000) ($ billion)

Source: Plan and Budget Organisation, Draft of Second Social Economic and Culture Development Plan of the Islamic Republic of Iran

There is also an especial emphasis on attracting Foreign Direct Investment (FDI) in the Second Plan, as one of the major sources of foreign capital and technology during this period (1995-1999). This can be done through the implementation of the new Foreign Investment Law, expansion of Free Trade Zones and creation of political and macroeconomic stability. The plan also projected using up to $ 10 billion foreign capital and credits in the form of buy back, for investing in the development projects and expansion of the country's infrastructure. The plan also projected a current account surplus in order to repay foreign debts. Debt service payments would average about 16 % of goods and services exports compared to 29% at end-1994 [110]. In order to service the foreign debt, the government adopted a strong import compression policy whereby imports decreased from $ 25,190 billion in 1991 to $ 19,287 billion in 1993, 16.1 billion in 1994 and $12.7 billion in 1995. As a result of this policy measure, trade and current account had a surplus of $ 6.3 billion and $ 3.3 billion, in 1994 and 1995 respectively [111]. Therefore, it seems that even if excluding the flow of foreign capital and investment, the country's current account surplus would be able to cope with foreign debt repayment.

	1995/	1996/	1997/9	1998/9	1999/20	Total
Total revenue	17637	18762	19857	21440	22486	10018
Non-oil	4565	4940	5446	5984	6589	27524
Oil	13072	13822	14411	15456	15897	72658
Oil products	666	578	556	652	668	3120
Crude oil	12406	13244	13855	14804	15229	69538
Exports	2344	2419	2449	2535	2529	12276
Price per barrel	1450	15.00	15.20	16.00	16.50	-

Table 6.15 Foreign Exchange Revenues Projection in Second Development Plan (In $ millions)

Source: Azizi, A. "Iranian Economy", Presented in the conference on Iran in London, 1995.

6. 13 SUMMARY AND CONCLUSIONS

In sum, having surveyed the industrial policies of Iran during the pre-revolutionary and post-revolutionary period, one can find several common features in the industrialization experience of Iran with those of oil-exporting countries such as Mexico, and Indonesia. As

indicated earlier, like many other developing countries, Iran adopted import substitution policies in the early stage of industrialisation in 1960s which mainly emphasised on the creating an industrial sector capable of producing consumer goods for domestic market. Despite some positive effects of ISI on Iranian economy in particular in the first stage of its implementation such as development of an consumer and intermediate goods industries which could meet to some extent the domestic needs, however, due to lack of an appropriate level of productivity, these industries were not mature enough to compete in international market. Moreover, as indicated earlier, heavy reliance of most local industries on importing the raw materials and equipment which financed mainly by oil incomes resulted to technological dependency. Therefore, there has been a close linkage between the oil revenues and the industrial outputs. Whenever, there was a decline in the country's oil income as a result of reducing oil prices, this in turn affected the industrial performance of the country.

As discussed earlier in the case of some East Asian first and second-tier countries as well as countries such as Mexico, and Turkey, the government in these countries played an important role in adoption of some effective policy measures which directed them towards a successful transition to an export oriented industrialization phase. For example, the governments in Mexico and Indonesia, which have been among the major petroleum exporting countries, managed to decrease their dependency on oil revenues in the second stage of the import substitution policies. However, as indicated earlier, there has not been a serious effort and specific policy measures in Iran during the same stage in the 1970s, and the country remained heavily dependent on oil incomes. Moreover, as discussed in detail in the case of the East Asian first and second tier NICs, it is argued that the early shift to an outward-looking and export promotion policies in these countries from the previous import substitution policies has been among major success factors of these countries in rapid industrial and technological development.

The government in these countries adopted effective policy measures including various export incentives such as tariff and custom-duty exemptions for importing required inputs for the exports, low interest rate loans and financial credits for exporters, and providing an appropriate and stable macroeeconomic environment needed for the successful implementation of EPP. Furthermore, they also managed to develop an industrial base in the later stage of import substation policy which have the potential capability to

manufacture products for international market. In Iran instead, no such efforts and policy measures have been undertaken, and as explained earlier in this chapter, the government in Iran continued the implementation of ISI and protectionist policies in the 1970s and early 1980s. As discussed earlier, only a few steps have been taken during this period for shift to an export-oriented industrialization policy which were not adequate enough to create an appropriate environment for successful transition to an EPP. Therefore, the implementation of ISI in Iran could not create an industrial base to be able to compete in international market because they were mostly immature and lacked the appropriate level of productivity and competitiveness.

However, as already indicated, due to a sharp decline in oil prices in mid-1980s and the announcement of a cease-fire in 1988, the government introduced a series of export promotion and liberalisation policies under implementation of the first five-years development plan aiming at promotion of non-oil exports and the consequent reduction in dependency on oil revenues. Despite a significant performance in GDP growth rate and expansion of non-oil exports in the first two years of the plan which were mostly as a result of efficient utilisation of the unused production capacities of the country, this was not sustained due to lack of macroeconomic stability, and effective and consistent policy measures. As is shown earlier in this chapter, although several attempts have been made to reduce the dependency on oil revenues during the past years, Iran still heavily relied on its oil revenues in order to finance the imports of industrial inputs needed for the manufacturing sector. This dependency can be considered as a major obstacle in the expansion of non-oil exports and industrial progress of the country. As surveyed in the case of some oil-rich countries such as Mexico, Indonesia and to some extent Malaysia, these countries managed to reduce significantly their dependency on oil exports through investing in the areas which they have a comparative advantage and capability to compete in the international market. Moreover, these countries develop a supportive intermediate and capital goods industrial base which could partly provide the necessary parts and equipment for the other industries with large export potentials.

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CHAPTER 7: FOREIGN DIRECT INVESTMENT AND TECHNOLOGY TRANSFER IN IRAN

7.1 TECHNOLOGY TRANSFER AND FDI TO IRAN IN THE PRE-REVOLUTIONARY PERIOD

As in the other countries studied before, technology transfer in Iran has played an important role in achieving economic and industrial development during the past years. The history of technology in Iran dates back several centuries when Iran was an exporter of the technology of the time and was a centre of development, exchange of ideas and sciences. As indicated earlier, since the adoption of import substitution policy in the early 1960s, the use of imported technology was widely practised in Iran. As an example, one can refer to the proportion of foreign technology during 1965-70 that was estimated by the United Nations Conference on Trade and Development (UNCTAD) [1].

Year	Payments for patents, licenses and trademarks ($)	Payments for management and other technical services ($)	Total ($)
1965	1,065,000	998,000	2,063,000
1966	815,000	2,282,000	3,087,000
1967	1,238,000	638,000	1,921,000
1968	1,762,000	1,158,000	2,920,000
1969	6,139,000	1,455,000	7,594,000
1970	1,722,000	1,588,000	3,310,000

Table 7.1 Payments by Iran for Technology Transfer in Dollars during the period 1965-70

Source: UNCTAD/TD/106

As is shown in the table 7.1, a total of nearly $3.3 million was spent in 1970, which was 0.03 per cent of GDP on that year, compared to a total of $2.1 million payments for transfer of technology spent by S. Korea for the same year. According to the statistics published by United Nations Industrial Development Centre, UNIDO, the share of foreign technology in Iran was 93.1 per cent in 1965, 92.7 per cent in 1970, and 96.8 per cent in 1976 [2]. In other words, Iran was in a period of absolute technological dependence, because most of its required technology had to be imported from foreign countries. Most of the foreign technology contracts

concentrated in manufacturing and mining sector which accounted 70% of the contracts, out of which "pharmaceutical" and "electrical products", mainly radio and television set assembly plants, have the first and second highest number of technological contracts with foreign firms [3].

During the first phase of import substitution in Iran, much technology was transferred mainly through imports of machinery and capital goods, turn-key plants and acquisition of licenses (know-how and patents agreements). As an example, one can refer to the two largest producers of motor vehicles, Iranian National and Khavar Companies, which operated through a licensing agreement with foreign companies in the UK and Germany. It is argued that technology transfer by licenses had some advantages such as a relatively low cost, greater likelihood of success, and a shorter completion time. However, many licensing agreements were accompanied by a series of restrictions imposed by foreign licensers, and could not contribute to promoting the manufacturing capability of local firms. Furthermore, the licensing of new industrial products has been made mostly regardless of implications for employment. There were also other channels of acquiring foreign technology in Iran including the establishment of a set of joint venture and technical assistance agreements with foreign firms which were used mostly in the chemical and petrochemical industries, steel and electric machinery. For example, of a total of 267 technology transfer contracts in the period between 1963-77, about 103 were in the form technical assistant agreements, 86 in the form of establishment of foreign subsidiary and 58 in the form of joint venture agreements [4].

Many of the country's large-scale industrial plants including petrochemicals, cement, steel, vehicle assemblies, started their operation through turn-key projects which did not promote the know-how and the skills of the labour force. Moreover, there has been a relatively heavy reliance on imported parts and equipment in some industries such as the auto industry which was mainly operated by assembly from imported inputs and CKD (Completed Knocked Down) packs. However, some of the components and equipment required for the local industrial units were built in the country or were copied from imported technologies such as plastic making factories. This method, which is known as reverse engineering, is used by many countries, especially Japan in the early stage of industrialisation. It should be noted that due to relatively sophisticated technology embodied in some parts and components such as motor engines, the local manufacturing of these parts through reverse engineering becomes also difficult and needs high levels of technical expertise. Another obstacle in using this method may be the low quality

of many locally produced components in comparison with similar products imported from abroad, which results in higher costs of production.

The acquisition of foreign technologies was also formulated within the framework of Iran's industrial development plan through some other informal methods such as introducing modern technical subjects in vocational schools and universities; continuous collaboration with the international technical and scientific organisations, and sending students and researchers to universities abroad to obtain high degrees in science and engineering [5]. Some other methods of technology transfer such as buy-back contracts have recently been examined. Because of the shortage of imported materials and parts needed for the industrial sector, some local manufacturing firms tried to enter into buy-back contract with the foreign firms which would agree to provide required materials and components and in return would buy-back the finished products. However, it is argued that this method faced serious difficulty due to the low quality and productivity levels and high production costs of local firms [6].

Like some countries such as S. Korea which adopted restrictive policy measures towards the flow of Foreign Direct Investment (FDI) in the early stage of industrialisation, in Iran, FDI has also played a relatively less important role in comparison with the other channels of the acquisition of foreign technology. For example, FDI ranged between 0.04% and 0.24% of gross investment between 1964-1974 and represented only 38.3 % of total capital movement to Iran and its share in non-oil sector accounted only 4% of total investment [7]. The petrochemical industry ranked first among the industrial sectors in attracting FDI followed by the rubber industries, pharmaceutical and chemicals, and electrical and electronic industries. A survey of about 168 cases of FDI approved by the Centre for the Attraction and Protection of Foreign Investment (CAPFI) during the period between 1956-1974, which make up more than 80% of total FDI into Iran in this period, considered variables including national origin, multinationality (whether the supplier is a MNC or non multinational), industry category classification, investment size, and the share of foreign equity. In the case of the national origin of FDI, US with 36%, followed by W. Germany with 15.19% and Japan with 12.81% were among the major countries which invested in Iran in this period. Moreover, the results showed that 86% of supplier firms involved in FDI in Iran were multinationals and the other 14% consisted of non-multinational. In terms of industrial category classification, pharmaceutical, chemicals and petrochemicals with 37.2% of total FDI, and industrial machinery and equipment with 36% were among industrial sector attracted a relatively larger share of FDI. Moreover, the

size of investment ranged from a low of 2 million to a high of 3,204 million Rls, with the average investment of 340 million Rls. Furthermore, foreign equity ranged from 13% to 100% of registered capital [8].

	1955-63	1964	1965	1966	1967	1968	1969	1970	1971
Rubber industries	197	52	376	256	70	502	118	231	155
Pharmaceutical and chemicals	159	64	126	203	204	223	274	248	351
Electrical Industries	77	63	34	78	20	153	176	244	276
Metallurgical Industries	105	18	28	95	66	128	283	263	118
Construction Industries.	368	40	29	0	47	38	64	77	74
Petrochemical Industries.	0	0	0	67	52	37	2,907	0	64
Auto& transport Industries.	98	5	19	17	35	86	77	245	76
Food industries	30	0	50	2	7	19	32	36	24
Motor oil refining Industries.	0	0	0	97	8	60	10	64	22
Mining	291	27	146	113	159	274	103	297	140
Hotels	0	0	0	0	0	50	30	95	55
Air plane, Helicopter	0	0	0	0	0	0	0	209	0
Glass and china-ware	0	0	0	0	0	0	0	150	22
Agro industry	0	0	0	0	0	0	0	89	83
other	22	11	0	30	0	13	0	179	12
Total	1,347	280	808	958	668	1,583	3,264	2,527	1,472

Table 7.2 Gross Inflow of Foreign Capital and Loans to Iran Through to Centre for Attraction and Protection of Foreign Investments in Different industries during (1955-71) (In Million Rls).

Source: Bank Markazi Iran cited in Saghafi nejad, T. 1976.

Foreign Direct Investment in Iran during the pre-revolutionary period was mostly inward-oriented and was directed towards production for the local market of products previously imported. This was also because of Iran's large domestic market which encouraged foreign investors to implement an inward oriented investment. According to the Law for the Attraction and Protection of Foreign Investments of 1955, foreign investors who obtain the required approval from the government would enjoy such facilities as the same legal protection as granted to local investors, the exemption from foreign exchange regulations, and the government's guarantee of fair compensation in the event of nationalisation or legislation which results in the loss of the foreign investor's share of the investment. This law provided for the establishment of a Centre for the Attraction and the Protection of Foreign Investment (CPAFI) affiliated to the Ministry of Economy, for overall decision-making responsibility regarding the flow of foreign capital and investment. Despite the very limited amount of FDI during the first eight years after enacting this law, due to the rapid growth rate and creation of a

macroeconomic and political stability, the flow of FDI increased over eight times during the period between 1963-1970 and reached to 1,472 million Rls in 1971 [9].

As indicated earlier, due to restrictive policies towards the flow of Foreign Direct Investment, only 38.3% of the total capital movement to Iran in the 1960s was achieved through FDI, and in 1967 the FDI outside the oil sector accounted for only 4% of total capital movement. At this stage, much technology was transferred mainly through imports of machinery and acquisition of licenses. In the period between 1962-67, total non-oil foreign investment amounted to about $ 160 million through the Centre for Attraction and Protection of Foreign Investment. However, according to the report by Central Bank of Iran, in the period between 1963-69, total foreign investment including the oil sector amounted to about $ 1 billion, 90% of which was in the oil sector [10]. In the industrial sector, petrochemical, rubber, pharmaceutical and metallurgical industries were among the major industrial sectors which attracted about $ 43 million during the years between 1968-1970. There were about 193 joint ventures between Iran and its foreign counterparts [11].

Following the oil boom of 1973, the sharp increase in Iran's oil revenues, and the introduction of further incentive measures such as a 50% tax exemption, foreign investment in industries grew at a significant rate. As an example, foreign investment in petrochemical industries alone was $ 2.3 billion mostly from Japan and Germany in 1974. It was estimated that by 1976, a total of 197 investments projects had taken place from 21 industrialised countries to Iran which were mainly concentrated on petrochemicals, steel manufacturing, auto-manufacturing, and electric appliances. It was also estimated that US firms accounted for one third of foreign investment in Iran in the late 1970s [12]. Despite the large amount of foreign investment in the 1970s, the total flow of FDI to Iran in 22 years of foreign investment was less than the amount invested by MNCs in Mexico in 1979 [13].

According to data about multinational companies (MNCs) activities in Iran in 1973, there was investment in 116 companies with different investment rates of below $ 1 million and large MNC-Iranian joint ventures with capital between $ 100 million to $ 5 billion. A total of 34 companies operated with an investment below $ 1 million and providing services such as transportation, movies, hotel management and shipping. The next larger group consisted of 22 firms with capital from $ 1 to $ 5 million which were mostly companies involved in small-scale manufacturing and the assembly of imported parts and equipment, such as

motorcycle assembly; china and glass; lighting equipment; ceramics; electrical equipment; medical instruments; tractor assembly; marketing and insurance.Another bunch of 19 companies possessed capital levels from $ 5 to $ 10 million which were mostly in textiles, clothing, and small appliances. There were about 24 MNCs operating with capital between $ 20 to $ 72 million which involved mainly in intermediate level industrial manufacturing, e.g. pipes and tubing, metal products, cast iron, tires, detergents, car engine assembly, and petrochemicals. The last group of multinationals with a capital investment of between $ 100 million to $ 5 billion, engaged more in petrochemicals, paper, pulp and lumber. However, there were a few of the largest multinationals with the a capital of more than $ 1 billion, such as Iran Helicopter industries specialised in assembling Bell helicopters, and the Iran-Japan petrochemical complex with a capital of $ 5 billion, owned jointly by the Iranian National Petroleum Company and two major Japanese firms, Mitsubishi and Nishuwai [14].

Country	1968	1972	1973	1974	1975	1976	Total
U.S.A	855	349	1090	797	589	1324	5004
U.K.	242	29	25	52	135	148	631
Germany	178	131	662	130	238	1730	3069
France	67	102	23	61	629	214	1096
Italy	6	5	-	-	-	-	11
Japan	-	221	1659	2867	1707	2728	9182
Holland	33	5	-	-	-	-	38
Sweden	25	32	-	-	-	-	57
Switzerland	50	-	-	-	-	-	50
Luxembourg	-	-	-	-	-	-	-
Other	9	462	585	593	678	393	2720
Total	1465	1336	4044	4500	3976	6527	21858

Table 7.3 Private foreign investment inflows to Iran through the Centre for Attraction and Protection of Foreign Investment (in Million Rls)

Source: Ministry of Economy and Finance, Iran

However, as indicated earlier, MNCs, in many cases, did not transfer the real technical know-how and managerial expertise required for promoting the country's indigenous technological capability. It is argued that MNCs mostly entered into a series of simple assembly operation and turn-key contracts with Iranian domestic industrial firms which led to heavy dependency on the imports of components and parts. Moreover, many MNCs

which were involved in technology transfer activities in Iran did not help themselves by training local workers to facilitate the effective adaptation, and assimilation of technologies.

Furthermore, some MNCs imposed several restrictions to prevent local firms from being their technological competitor in the future. MNCs' investments were also focused more on domestic-oriented production activity and therefore did not contribute to promoting the productivity and efficiency level of local industries. It can be added that MNCs investment had also some negative impacts on Iranian industries including over pricing the components and parts needed for manufacturing the products which in turn resulted in high costs of local production. The MNCs investment activity did not increase the amount of industry value-added in many local industries. One can also refer to the insignificant contribution of FDI to gross capital formation is the local manufacturing industries. During the period between 1965-1976, foreign investment in the manufacturing sector accounted, on average, for only 5.1% of the total capital formation in that sector [15]. The following table shows the comparison between the percentage of local value added in production in those industries which obtained 60 % of total FDI in 1962 and 1973.

The type of industry	The percentage of local value-added to production in 1962 (%)	The percentage of local value-added to production in 1973 (%)
Electrical equipment	54	41
Basic metals	29	22
Non-electrical equipment	79	31
Chemicals, pharmaceutical	41	35
Rubber	41	33
Paper	57	29
Transportation vehicles instruments	38	24

Table 7.4 A comparison of the industrial value-added in some Iran's local industries in 1962-1973

Source: Bank Markazi of Iran (Central Bank of Iran).

The law concerning attraction and protection of foreign investment in Iran, which was initially passed in 1955, was revised in 1974. The government began to impose some new restrictive policy measures including allowing foreign investors up to 35% equity share in high technology industries, 25% in general manufacturing, and 10% in the traditional industrial sector. Following the adoption of restrictive measures towards FDI, many foreign firms favoured licensing agreements, in particular in the manufacture of durable consumer goods. Although MNCs'

licensing were mainly with the local state-owned firms and in particular with the Industrial Development and Renovation Organisation (IDRO), the majority of licensing agreements were signed with private firms in Iran. Moreover, machinery, chemical and petrochemical and electrical and electronic equipment industries were among the Iran's major industrial sector which used licensing for transferring technology.

As indicated in the analysis of technology transfer mechanism, MNCs usually enter into a licensing agreement with the LDCs' local enterprises, to obtain more income from selling their second-hand technologies which in turn assist them in financing the development of new technologies. Moreover, MNCs can also reduce their production cost through selling their licensed technologies to LDCs and therefore make them more competitive in the international market. Many multinationals considered licensing as a "means of testing production conditions in Iran and getting acquainted with likely eventual investment pattern" [16]. During the 1960s, licensing was mostly used for encouraging the private sector to invest in manufacturing activities primarily in production of consumer goods and later in intermediate and capital goods [17].

Firms were set up under the license and supervision of foreign companies to assemble mainly consumer goods which needed to import parts and materials from the multinationals or their subsidiaries. Therefore, one can say that the domestic firms were becoming heavily dependent on the foreign enterprises for their licensing, know-how, expertise, and supplying required parts and components for the production of consumer goods [18]. It is argued that one of the major reasons for large dependency of most domestic industries on importing the parts and materials was the restrictions imposed by foreign licensors (multinationals). Some of the major restrictions imposed by MNCs in the licensing agreements were to oblige the licensee not to produce the whole or any part of a product similar to, or competitive with, the licensed product; not to use the technology of any competitor; and not to cooperate with other sellers of the licensed product. Due to the enactment of law restricting the MNCs investment activity in Iran to minority ownership, it is argued that they compensated for this by imposing some restriction on the local industries, which made them more dependent on the parts and components [19]. Moreover, the low level of local content in Iranian industries was also caused by lack of a supportive local industrial base to produce the required parts and components in Iran rather importing them from abroad .

7.2 FDI AND TECHNOLOGY TRANSFER IN POST-REVOLUTIONARY PERIOD

After the revolution and following the adoption of nationalisation policies, most foreign investments were also nationalised and some foreign participation cancelled. The volume of Foreign Direct Investment in Iran which had a sharp decline after the revolution and had become insignificant during 1979-80, amounted to Rls. 12 billion in the year 1980. This amount was totally invested by Japan for the completion of the Irano-Japanese petrochemical project. Despite the inflow of this investment by the Japanese, no effective measures were taken by the Japanese investors to complete this project [20]. Iran also imposed restrictions on foreign brand-named goods produced under licensing agreements, ordering licensees to introduce Iranian names. Producers would no longer be granted access to foreign exchange to pay for the use of foreign trademarks. Several reasons were given for the new restrictions, including the cost of payments, the necessity to buy raw materials from abroad, and the use of a foreign name propagated foreign culture [21].

The introduction of Free Trade Zones (FTZs) in particular those located in the Persian Gulf islands, Kish, and Queshm, was among the most important government activities to attract foreign direct investment and transfer of technical and managerial expertise to the country. Moreover, there were other free zones in other areas of the country such as Sirjan free zone in Kerman province (central part of Iran), Chah Bahar free zone in southeast of the country (near the border with Pakistan), Bandar Anzali in the north (a port on the Caspian Sea), Jolfa and Sofian in the northwest (near border with the Turkey), Sarakhas in the northeast (near the border with Turkamenistan), and Khoramshahr in southwest of the country.

The main objectives of these zones are to speed up infrastructural activities, promote economic growth and investment, increase incomes, create productive employment, participate actively in world and regional markets, produce, process and export industrial goods and to expand public services. These free zones offer a number of incentives such as tax exemptions, custom duties holidays of up to 20 years, the permission of 100% ownership of capital by foreign investors, free repatriation of profit and providing transport and other facilities, in order to attract as much as private domestic and foreign investment. For example, the industrial commercial zones in Chah-bahar, due to its strategic position and its access to rich marine resources of the Oman Sea and regional markets, has offered some specific incentive measures in order to attract as much FDI as possible. These incentives include; unlimited partnership shares for foreign and domestic

resources; security of foreign investments and freedom of capital and profit transfer; 15 years tax exemption on revenues; authorised importation of machinery and raw materials without customs tariffs; and free entrance of foreign nationals into the zones [22].

Although these zones had favourable effects in promoting the domestic and foreign investment, it is, however, argued that they were not as successful as FTZs in other developing countries in Southeast Asia such as Malaysia, not only in attracting foreign investment in productive activities but also in encouraging export activities. It is stated that some of these zones had become a channel for imports of mostly consumer goods [23]. As an example, the value of imports increased from $38.5 million in 1989 to more than $ 800 million in 1993 in Kish Island.[24]. Moreover, except the Kish island which had some facilities for a long time, many of these zones lacked adequate infrastructual facilities such as airport, recreational, and modern communication facilities, water, electricity and energy utilities. As constructing these needed a large amount of financial investment, Iranian and foreign private investors did not show any tendency to make such investments, to create an effective and suitable conditions for the extension of productive and export-oriented industries. However, a part of the development and infrastructure expenses of the zones was provided through the temporary transfer of land to investors.

The Qeshm Free Authority (QFA) was established in 1990 on Qeshm Island which is the country's largest free zone, in order to attract more foreign investment mostly in energy-intensive and heavy industries as well as export-oriented industries. Moreover, the vast natural gas reserves of the island, estimated at 2 million cubic meters have been offered at one tenth of the international price to potential foreign investors in energy intensive industries. Although the QFA had some success in developing the infrastructural base of the island, such as construction a 108-room hotel as a joint venture with Malaysia, and establishing a steel complex with an investment of about $250 million from Kobe of Japan, a power plant with Siemens of Germany, a cement factory by a joint venture with China and a fertiliser plant with India; it has had less success in facilitating exports and has been used more as a channel for imports. For example, the volume of imports into Qeshm Island during March 1992-1993 was more than 145,000 tons of goods valued approximately at 700 billion Rls (equivalent to about $ 500 million). Moreover, a glance at the goods imported shows that a considerable part of goods included consumer luxury goods such as perfumes, eau de cologne, artificial flowers, watch ribbons, hair pins, etc [25]. This can be mostly attributed to inward-looking nature of most investment and the

existence of the country's relatively large domestic market. However, effort is currently being made to encourage more export oriented investment to these areas.

According to the Law for the Administration of Commercial and Industrial Free Zones, which was approved by Parliament on August 29, 1993, the zone's trading activity with foreign countries, after customs registration, are exempted from the application of the import/export regulations [26]. The new law also exempted the import of goods manufactured in the free trade zone to other parts of the country from payment of all or part of the customs duties and commercial profit tax upon approval by the cabinet. The new law has also introduced a number of incentives for attracting foreign investment such as a tax holiday for enterprises set up ventures and investment in FTZs for the first 15 years of activity, foreign ownership of up to 100 %, more relaxed rules applying to human labour, the issues of permits and visas for foreign nationals, and possible credit from the central authorities for infrastructural and productive projects. According to recent data, by June 1995, 16 joint ventures had been approved by the council of ministers mostly with European and Asian firms, amounting to $ 900 million, and ten investment projects were being negotiated. The new sectors for which foreign investment have been approved were fibre glass pipes, cassette tapes, heavy diesel engines, special chemicals, passenger cars, powdered milk/baby food, and a hotel. As indicated earlier, it is projected that during the Second Five Year Plan (1995-1999), FDI will amount to $ 2 billion per year [27].

However, following the approval of the law by Parliament on April 1996 which allowed the free transfer abroad and into Iran of hard currency from trade zones, the law has recently been amended by Majlis (Parliament), which appeared to place some restrictions on the law. According to the amendments, Iranian banks set up in the free zones should be 51% owned by the government and that opening Iranian or foreign banks in the zones should be proposed by the central bank and approved by the cabinet. It is argued that the shortage of domestic capital and the absence of essential technology in Iranian industry were among the major factors in making the need for foreign investment. As indicated earlier, following the implementation of the First Five-Year Development Plan (1989-1993), some policy measures were also taken to promote the indigenous technology capability through transferring appropriate technologies to the country. Moreover, the government proposed some guidelines and regulations for the industrial units to facilitate the transfer of the appropriate technology in the Industry Sector. Some of the most important policy measures during the First Five-Year Development plan were as follows:

1. The industrial units should arrange technology transfer agreements with the collaboration of relevant specialists with technical expertise.
2. The industrial units were restricted in the extension of technology agreements with foreign countries.
3. The industrial units will receive new investment and additional credits when they achieve their technological objectives.
4. The industrial units can only buy mass machinery and equipment from abroad when this may lead to the transfer of know-how to the country.
5. The industrial units should have appropriate human resources for receiving and using the technology from the start of the technology agreements.
6. The industrial units should provide adequate facilities for their own R & D and engineering design sections, (e.g. allocating a percentage of their sales in R&D activity).
7. The industrial units should import more modern and new technologies which would enable them to revive their existing machinery.
8. The industrial units should invest more in developing absorptive capacity level for an effective adaptation, assimilation and absorption of the imported technologies.
9. The industrial units which enter into the joint venture agreements with foreign companies (MNCs) should be monitored by legal experts, managers and specialists.
10. According to this plan, priority has been given to those technologies that are less capital intensive and more labour-intensive without any dependence on international monopolies.

Moreover, as indicated earlier, the government's industrial and technology policies during the first five-year development plan mostly emphasised the liberalising of the prices of most industrial products, promoting domestic technological capability and self-sufficiency, and transferring industrial activities to the private sector, in order to improve the competitiveness and productivity. Some of the most important objectives of the First Five-Year Development Plan (1989-1993) in development of technology were as follows:

1. Promotion of technological capability through training the local technicians and skilled labour for efficient adaptation and assimilation of imported advanced technology.
2. Development of indigenous technological capability with an increase in research activities and establishment and further expansion of country's science and technology infrastructure.
3. Providing statistical and information capabilities to facilitate research and development studies.

4. Decreasing the dependency of foreign know-how, machinery and equipment by applying a self-sufficiency strategy in the country.
5. Establishing an appropriate logical policy for technology imports, by setting norms and regulations in order to remove monopolized restrictions on technology contracts.
6. Choosing an equitable technology distribution policy to eliminate social and economic injustices.

Having identified the level of technology in a country, according to the surveys of the Organisation for Economic Cooperation and Development (OECD), there are four kinds of indicator to measure the level of technology in a country. These indicators are [28] :

1. Indicators of social and economic development such as welfare worker systems and social and education systems.
2. An indicator of diffusion such as productivity, organisation, research etc.
3. Indicators of production and distribution such as the amounts of fertilizers used per hectare, the number of kilometres of railway lines, etc.
4. Indicators of scientific capabilities such as the percentage of research workers in that country, and research and development budget per GNP.

According to the above indicators, the level of technology in Iran has been in a relatively satisfactory condition compared to other developing countries. In order to determine the position of Iran in the industrial world, UNIDO (United Nation Industrial Development Organisation) referred to several variables and factors, but information about most of these factors is not available in Iran. One of the most important factors is the ratio of industry value added in comparison to the world norm of industry value added. According to the figures which are published by UNIDO, Iran's portion of world industrial production is about 0.17%. Considering the fact that the population of Iran is 1% of the world population, Iran's industrial value should increase to 1%. Some researchers indicate five other factors for determination of technology level in a country, as follows :

1. Level of literacy, i.e. the proportion of the population over the age of 18 who are literate,
2. The research and development budget as a proportion of GNP.
3. The ratio of heavy industry value added in proportion to the industry value added of that country.
4. The level of higher education, that is the ratio of student numbers in university in proportion to

the population of that country.

5. The ratio of researchers in every ten thousand of the population.

The value of a special coefficient for each of these five factors is needed in order to weight the factors for the determination of the overall technology level in each country. The weighting coefficients for each factor are estimated for Iran as: 0.1 for the first; 10 for the second; 0.33 for the third; 3 for the fourth; and 1 for the last factor. Thus if each coefficient multiply by its related factor, an indication of the level of technology can be obtained. For example, the figure is 15.8 for Iran; 12 for Algeria; 89.1 for USA; 73.1 for Japan and 65.5 for Germany. The percentage of each factor in Iran has been estimated as 50 for the first; 0.1 for the second; 21.2 for the third; 0.4 for the fourth and 1.5 for the last one.

There is another way to determine the technology level in a country. This method indicates the position of the technology components and technology parts in each country. If we consider the ideal situation, 100%, then we have the following figures for each factor for Iran:

1. Research and development less than 5%.
2. Design and engineering less than 10%.
3. Industry units established less than 20-30%.
4. Productivity and maintenance of industrial facilities 70-80%.
5. The level of infrastructure, transportation, and distribution 70-80% of the ideal position.

It can be said that because of lack of knowledge about important aspects of technology, there is less concentration on this in Iran. The table 7.5 shows the technology level in heavy industry, and industry and mining sectors of Iran, considering the four components of technology; techno-ware, info-ware, orga-ware, human-ware. It can be seen that technoware which consists of tools, equipment, machines, vehicles and physical facilities is in a better condition compared with other technology components.

	Technoware	Infoware	Orgaware	Humanware
Heavy industry	58%	22%	30.5%	31.5%
Industry	41.36%	36.36%	31.26%	40.45%

Table 7.5 The percentage of technology components in heavy industry and industry sector

Having surveyed the overall problems relating to technology transfer in the industry sector

during the past years, one can identify to some of the most important problems as follows:

1. Lack of a constant and appropriate industry and technology development policy and strategy.
2. There was neither adequate research and development laboratories, nor was there collaboration with other research laboratories, which led to the lack of absorptive capacity of imported technologies and low quality of their products.
3. Some factories lacked an experienced production manager to control the quality standard of their products.
4. Some industrial units produced large quantities of waste material. One of the methods of prevention of waste would be reduction of losses during the production process.
5. In some factories, the raw materials which were used in the production process were not standardised for purity, quality and quantity. In addition, there should be special machinery for preparing materials before using them in the assembly line.
6. Another problem is that imported technologies which were used in Iran could not adapt to the different weather and geographical conditions, and the different skills of the labour force.
7. Sometimes there was a difference in quality of the parts produced by one factory and the similar items in another local industrial unit, which indicated the lack of a standard and quality control system for most capital and intermediate goods which were produced locally.
8. Heavy dependency on foreign parts and materials seems to be one of the most important problem of Iran's manufacturing. Vehicles, machinery, electrical goods, and many other important industrial items like cars are mainly produced by the assembly of imported kits or parts. Major industry is 56.7% dependent on imports of materials for its production. The percentage rises to a staggering 84.8% for the machinery, equipment, tools and metallic products industries; followed by 79% for the paper and card binding industry; 71.1% for chemicals; 55.7% for textiles, clothing and leather; 54.6% for basic metals; and 35.8% for wood and wooden products. The lowest percentage is 29.1% for the food, drink and tobacco industry. According to another statistic, the dependency on importing foreign inputs for the capital goods, intermediate and consumer goods industries were 85%, 70%, and 65%, respectively [29].
9. Foreign exchange shortage is seen to be another problem for improving the technical

capability of the industry sector. This is because the heavy reliance on imports of primary materials and parts needs a large amount of foreign currency.

10. Machinery wear and tear can be another disadvantage which can increase the cost of production and reduce efficiency and productivity. A large quality of machinery and equipment were imported in the past and as indicated earlier the level of techno-ware or machinery and physical instruments in Iran's industrial sector is in better position in comparison to the other technology components. However, it seems that some of these machines and equipment need to be replaced with new and modern units.

11. Shortage of trained skilled workers and technicians has been another problem of the industrial sector. The lack of adequate engineers and technicians led to low absorption levels of foreign technologies. In spite of several attempts, such as a continuous increase in the budget for education and vocational training, the demand of industrial sector could not be met. This will be further discussed later in this chapter.

12. Another source of difficulties was the lack of linkage between the imported technology and Iran's existing indigenous resources. In other words, the imported technologies have not been compatible with Iran's indigenous resources. It is argued that the technologies developed in advanced countries and being transferred to the developing countries are for their own benefit, and not for the benefit of the developing countries. For example, Iran could gain little benefit from importing the capital intensive technologies which were transferred after the oil boom of 1973, and financed through oil revenues, due to their lack of contribution in creating employment opportunities for the country's relatively large human resources. As it is believed, this led to an acute state of dependent capitalism, with its harmful consequences [30]. Moreover, there were some differences in the cultural, religious and other social aspects of Iran compared with those of the places from where the technology was imported. In other words, the massive importation of intermediate and capital goods, under the implementation of the import substitution policy of that period (1970s), led to an increase in the country's dependence on capital intensive and advanced technologies which created little employment opportunities. Moreover, due to major differences in the physical, socio-economic and cultural aspects of Iran and that of its technology suppliers, the imported technologies were not entirely adapted to the local conditions.

13. The other criticism which is often directed towards the imported technologies is that they included some unnecessary industries for consumer goods which could be

produced locally. Moreover, there were some cases in which similar and identical products and technologies were imported by different local firms. For example, during the period between 1962-77, of the total number of 243 technology contracts, there were about 90 which related to consumer goods, such as air conditioners, refrigerators, food products etc. Therefore, it can be said that a relatively significant share of the country's earnings from oil sales in the past was allocated to imports of consumer goods technologies which were contrary in opposite direction of country's industrial strategy, aimed at replacing the imported consumer products with the similar domestically produced goods.

14. There were not well-designed and overall regulations and guidelines for local industrial firms which were involved in technology transfer activities. This was because of a lack of a specific organisation or institute for this purpose..

15. As indicated in the previous chapter, another major weakness of Iran's industrial and technological structure was the domestic orientation of many local industries. Because of continuous implementation of an inward-looking policies, little attention was made to promote the quality and productivity of local industries to compete in the international market. Although some export incentives were introduced, such as tax exemption for industrial firms which could export 15% of their products in early 1970s, this along with other measures, was not conducted seriously due to the increase in oil revenues in 1973. Moreover, more recent attempts to expand the export capacities of the industrial sector, despite some primary success, could not expand significantly the share of industrial exports. This is mainly due to a low level of productivity and quality of industrial products which can also be a result of inadequate local technological capability.

In a survey of 27 firms which were operating in the Iranian American Joint Venture (IAJV) during (1971-1976), only six adapted their technology to the economic environment of Iran [31]. The lack of technology transfer by these companies was related to the assembly nature of their production process in Iran. The lack of skilled labour and the inadequacy of the supply of parts and raw materials caused many firms to refrain from carrying out the entire production process in Iran. In a few cases where the technology was adapted, it was explained by the firms that their technology was relatively more capital-intensive in Iran compared to their operations in other LDCs. Beyond this, there were some changes in the product design, dealing mostly with

the marketing aspects of the product in Iran.

According to this survey, the major factors which were identified by some foreign firms, and which affected foreign investment in Iran were political stability and market conditions, higher rate of profits, and favourable government policies. These were among the most important factors in encouraging investment by foreign firms in Iran. Moreover, as indicated by some of the foreign firms, among the factors preventing them in investing in Iran were government bureaucracy and red tape, tight price control, restriction of foreign ownership (the maximum ownership of 35% by foreign investors) which was stated by many firms led to reducing their efficiencies. However, despite the maximum foreign ownership allowance of was 35 %, it is argued that most foreign large firms and multinational companies controlled the production process of the large modern industries in Iran through mechanisms other than share holding.

Many foreign firms also complained about lack of adequate transportation and storage facilities. Important tariff reductions and tax exemptions were pointed out by foreign firms among major incentives given by the Iranian government. This survey also showed that foreign firms were not successful in adapting their technology to the economic environment of Iran. This was largely due to the assembly nature of their production, which was incompatible with the lack of skilled labour, and the insufficiency of raw materials and parts in Iran.

7.3 HUMAN RESOURCE DEVELOPMENT AND RESEARCH AND DEVELOPMENT ACTIVITIES IN IRAN

The fact that only 2% of world R&D is done in developing countries and that they receive less than 1% of world patents are seen as causing a low ability to adapt and create new technology and products for these countries (LDCs). As the experiences of some successful East Asian Countries show, research and development activity is essential for every country in order to modify and improve the imported technologies, and also to generate and develop new technologies and products. Moreover, as is also shown earlier, the heavy investment in development of the human resources enable these countries to absorb and assimilate more efficiently foreign technologies. While developed countries expend about 3% of their GNP on research and development, developing countries only allocate between 0.01% and 0.6 % of their GNP on research and development.Thus, improving effective R&D activities and also increasing the number of scientists and engineers has been among major factors for successful

technology transfer in these countries.

According to statistics published by United Nations Education, Scientific, Cultural Organization, UNESCO, a total of $47 million has been spent for R&D activity in Iran in 1972, which was 0.2 percent of GNP. Figures for some other countries such as India were $ 256 million (0.4 per GNP) in 1973, S. Korea $ 128 million (0.7 per GNP) in 1974, and Indonesia $ 47 million (0.2 per GNP) in 1975 [32]. Therefore, it can be said that little attention was paid to the research and development activity in comparison to other developing countries in the 1970s. There was no significant R&D programs by large industrial firms, and most licensing contracts with MNCs lacked a provision for such programs. Moreover, Iran also lagged behind many other developing countries in terms of the number of scientists and engineers. For example, the total numbers of scientists and technicians were 217,632 persons in 1974, in comparison with that of S.Korea with 1,650,094 in 1976 [33]. Therefore, the lack of adequate research and development activity as well as a low level of scientists and technicians can be considered among the most important obstacles in the promotion of the country's technological capability in that period.

As outlined in a UNIDO document, Less Developed Countries (LDCs) also possess only 12.6 percent of global stocks of scientists and engineers in research and development (R&D), of which 9.4 percent are concentrated in a few countries of Asia [34]. For example, as for the number of researchers per million of population, while this number was 4,800 and 3,300 in 1985 for Japan and USA respectively, the average for the developing countries is about 500. In 1987 this number was a mere 82 in Iran (assuming that one-third of all university academic staff are engaged in R&D), which has been very low in comparison to other developing countries [35].

The education system in Iran followed a highly centralised French model during the 1940s and 1950s, but since the 1960s, the American influence became increasingly important, especially in terms of course structure and organisation at the tertiary level. At the tertiary level, by 1979, Iran had 29 universities and 206 institutions of higher education, with about 172,000 students. However, since the 1979 Revolution there has been a significant reform in the education system in terms of its curriculum and text books. The Ministry of Education is responsible for all levels of pre-tertiary education, including teacher training. There have been several modifications in the pre-tertiary level. For example, at secondary level a greater emphasis is placed on technical and vocational training, with the establishment of Factory Joint Technical and Vocational Schools (FJTVS) in 1988. In terms of tertiary education, the Ministry of Culture and Higher

Education (MCHE) which has been formed following the merger of the previous Ministry of Science and Higher Education and the Ministry of Culture and Arts. However, there are a number of other higher education organization, such as the Council of Higher Education Development, and Higher Council of Planning. In 1988, there were over 100 institutions of higher education in Iran with more than 204,862 students; of these, 30 were universities, 14 are university complexes and colleges, 5 were non-government colleges and 36 were higher education centers and technical institutes affiliated to various ministries and government agencies [36].

It can be generally argued that there were several efforts and investments in development of human resources in past decades. According to data published by UNESCO, the percentage of school-aged children in primary and secondary schools increased from 16% in 1950, to 30% in 1960, 52% in 1970 and was estimated at 67% for 1980 [37]. However, as is shown in the following table, despite the sharp increase in the number of elementary, secondary, and vocational and technical education during the period 1959 -1972, the shortage of a skilled labour force and lack of adequate scientists and engineers led to inefficient use of foreign technologies in this period.

	1959		1979	
	Number of institution	Enrollment	Number of institution	Enrollment
Elementary education	9,289	1,327,000	18,030	3,534,000
Secondary education	1,163	253,000	2,425	617,000
Vocational and technical	91	8000	277	57,000
Teacher training	55	4,000	88	26,000
Higher education	-	23,000	-	74,000

Table 7.6: A comparison of number of institution and enrollment rate during (1959-1972)

Source: Bank Markazi of Iran (Central Bank of Iran)

On the other hand, the rush to industrialisation as a result of the oil boom of the 1970s, required the parallel expansion of a skilled labour force and technicians, and due to the inadequate number of technicians and skilled workers, the government had to import about 480,000 from abroad. 25% were skilled, 50% technicians and semi-skilled, and the rest were unskilled workers. According to a report by the Plan and Budget Organisation, the shortage of labour

was estimated to be about 721,000 during the period between 1973-1977. Moreover, as is mentioned earlier, much technology in this period has been transferred mostly by large scale turn-key projects such as petrochemicals, cement, steel, and vehicle assemblies which added very little to the development and spread of local skills and technology. It can also be added that despite the large increase in the government revenues as a result of the oil boom in 1973, in the period between 1974-1978, the government spent only 4.7 per cent of its budget on education compared with 5.6 % in 1971-74 [38].

During the period between 1982 and 1987, the total number of students in primary education (children aged between (6-11) increased from 5,659,000 in 1982 to 7,377,000, in the year 1987. Moreover, this figure increased to 8,817,000 in 1989, and reached 9,863,000 by the year 1993, which covered more than 79% of the children aged between 6-11. According to data published by the Ministry of Education, the number of students in secondary school (high schools) increased from 942,000 in 1980 to 2,244,000 in 1993 [39]. The public budget allocated to the education sector increased from 42.5 billion Rls. to 73.8 billion Rls. In 1988, an average increase of 11.6%. In the school year 1987-88, more than 12 million students were enrolled in primary, junior high school, and high school level. Moreover, the number of students in the institutes of higher education increased from 145,809 in 1984-85 to 250,509 in 1988-89, an annual average growth rate of 14%. The number of university graduates, which was 19,944 in the academic year 1984-1985, reached 28,637 in 1987-1988 and the total number of graduates at university level from public institutions was projected to amount to 192,310 during the First Five-Year Plan (1989-1993). However, in addition to the public universities and colleges, there is a large non-governmental (private) university called "Islamic Azad University" with many branches all over the country, which has operated since 1982, taking tuition fees from the students. The number of students of this university studying in various fields of science and technology in its different branches, recently amounted to about 500,000 students. Thus, the total number of students in the institutes of higher education (public and private) exceeded one million students in 1995.

Moreover, in order to increase the literacy rate which is considered to be one of the most important indicators for the country's social, cultural and economic development, and also in promoting the productivity and absorptive capacity of the labour force to better adaptation of imported technologies, the Literacy Movement Organisation (LMO) was established in 1979. Following organising 532,121 classes for about 8,248,628 illiterates, the literacy rates of adults

increased to 73.2% in urban areas and 48.4% in rural areas by 1985. According to another figure, the overall rate of literacy increased from 47.5% in 1976, to 62% in 1987 covering 23 million of population [40]. However, due to population growth the number of illiterates increased from 14.20 to 14.80 million during 1976-1986 [41].

	1980	1985	1990	1993
Total	7,898	10,561	14,044	20,186
Kindergartens	172	107	227	133
Primary schools	4,799	6,788	9,370	9,863
Junior high schools	1,575	2,210	3,233	4,440
High schools (day and nights)	942	1,589	1,770	2,244
Technical and professional schools	202	195	230	3,404
Colleges and teacher training	6	46	84	102
Others	202	221	285	-

Table 7.7: Number of students by education establishments, 1980-1993 (in Thousands)

One can also refer to the substantial government efforts to expand vocational and technical training for the country's large labour force. In order to formulate specific policies for technical and vocational training, and also coordinate technical and vocational training activities at the state level, special committees were created in 1982 upon the recommendation of the High Council for Coordination of State Technical and Vocational Training. These committees have experts in the areas of industry, agriculture, services, and medicine, and are mostly active in coordinating planning and policy formulation, but also evaluate and supervise the methods of technical and professional training. Furthermore, as indicated earlier, the industrial units were to allocate 0.2% of their total sales for training and research. The total government budgets allocated for technical and vocational training increased from Rls. 42.5 billion in 1983 to Rls. 73.8 billion, with an average growth of 11.6% [42].

Description	Total	Male	Female
Total technical & vocational	21210	17041	4169
Technical school	12241	12211	30
Commercial & vocational	78853	37475	41378
Agricultural school	10828	10828	0

Table 7.8 Number of students at different technical and vocational schools (1989-1990)

However, more emphasis has been placed on training in the universities. The students of engineering and science courses are particularly encouraged to attend training programs of

a few months duration at various state-owned or private industries. The number of technical and vocational students at school level were expected to increase from 213,047 from 1989 to 316,297 in 1993, with annual growth of 8.2%. Therefore, one can see that unlike the relative neglect of training a skilled labour force in the pre-revolutionary period, there have been great efforts for training and education of the human labour force. As recent statistics indicated, about 320,000 workers were trained in 1992 and this increased to 500,000 by 1993. Following the implementation of the First Five-Year Development Plan (1989-1993), some of the most important policies and strategies regarding to human Resource Development (HRD) which were identified in the plan were as follows: [43]

1. Creating scientific and highly specialised centres at suitable universities and improving academic standards at other institutions of higher education and research;
2. Maximising and fully exploiting the country's scientific, educational, specialised, and research potentials (both basic and applied);
3. Creating close ties between universities and other centres of higher education on the one hand, and the production and research departments of ministers involved in production;
4. Making appropriate use of technology, tools and equipment in a way that will ensure the optimal utilisation of the labour force;
5. The provision of detailed educational planning and launching the new educational system, and formulating and implementing higher as well as technical and vocational education systems;
6. Conducting studies on techniques of enhancing productive efficiency and expanding specialised technical and vocational on-the-job training programs in private, cooperative, and public sectors.
7. Establishing close links between the universities and higher education institutes on the one hand with public and private production and research centres.

Moreover, in the first plan special targets have been set for development of the human resources and the expansion of employment opportunities for the country's large labour force. These measures and objectives include; increasing per capita labour productivity by an annual rate of 5.2%; increasing productivity of the labour force through promoting managerial techniques, training the professional and qualified managers for the industrial

sector. In order to achieve this objective, the High Council for Coordination of Technical and Vocational Training was created to monitor and co-ordinate the implementation of HRD programs in different industrial sectors. Despite a significant quantitative improvement in the number of students at all levels, there are some difficulties and constraints such as the lack of a planning system responsible for educational and development purposes; imbalance distribution of human and financial resources among different regions and various school levels; and lack of clear vision about the state's employment policy [44].

The Second Five Year Plan (1995-1999) is also aimed at further expansion of primary and secondary education as well as higher education, professional training and physical education. The total budget devoted to education is to grow by 115% from Rls 4789.3 million in 1993 to Rls 10302.7 million in 1998. The second plan also aimed at creating two million new jobs by 1999 [45]. The R and D expenditure per GNP during the First Five Year Plan (1989-1993) was 0.35%, of which nearly 85% was allocated to ministries and less than 15% to the universities and other institutions. For example, among the total amount of 41,490 billion Rls R&D budget in 1993, the funds of 32,800 billion Rls granted to ministries and about 8,700 billion Rls to universities. (each $U.S. is approximately 1700 Rls in 1993). The First Five Year Plan also aimed at increasing the number of full-time researchers per million of the population to reach to about 300 by the year 1993 from 82 in 1989 [46].

7. 3. 1 The Research and Development Centres in Iran

The overall research and development centres in Iran can be classified in four groups, 10 institutes in medical and related science, 30 institutes in social and human science, 13 institutes in agriculture and natural science and 25 institutes in industrial and technical engineering. Some of the important research and development centres which are managed by different ministries are presented in the following sections. Most of these centres are categorized as centres doing technical and engineering research. However, a few of these centres are not engaged in purely basic and applied research and are not included in groups of social, medical, agricultural and technical science.

Organization for Scientific and Industrial Researchers of Iran (OSIRI) is one of the country's largest research organizations and was established in 1980 as an associate of

Ministry of Culture and Higher Education. This organization has concentrated its activities on the three areas of research, pilot plant projects, and production. The main objectives of this centre include doing research in various industrial and technological projects through providing financial and physical facilities, assisting the production units during earlier stages of their operation and approval of laboratory and pilot plant stages, co-operation with the country's universities and research centres, designing education and training programs for researchers, and spreading the outcomes of the researches throughout the society. This organization also has several branches in major cities including capital and centre of provinces. The director of this organization is deputy minister of culture and higher education. The National Scientific Research Centre (NSRC) which is also an affiliate of the Ministry of Culture and Higher Education, was established in 1984, with main objective of developing special research councils in order to help in solving problems of researchers in various fields, co-ordinating the research activities of various research centres and determining appropriate rules and regulations regarding to establishment, expansion or closure of the country's research centres.

The Centre for Science and Research Policy (CSRP) is the other associate of the Ministry of Culture and Higher Education which was established in 1970, aiming at determining the country's scientific and research policy, and determining research priorities and planning long term programs in order to increase the efficiency of the research system. The Centre for Research and Development of the Science and Technology of Polymeric Material (CRDSTPM) which is also an affiliate of the Ministry of Culture and Higher Education was established in 1986 and is involved in both research and education. Its main objectives include performing basic and applied research in cooperation with other research centres, designing specific education and training programs in planning, development, production, and usage of materials in production, and in the use of goods such as rubbers, plastic and other polymeric materials.

The Centre for Research of Properties and Usage of Materials and Power (CRPUMP) is linked with the Ministry of Culture and Higher Education with the main objectives of doing specific research in usage of material and power in electronic industries, energy generation, ceramic, petrochemical and metallurgy, etc. It is also responsible for enhancing the collaboration between other industrial research centres involving researches in the same area. Research Centre for Industrial & Trade Development was established in 1964 by the

Ministry of Economy to undertake research surveys and feasibility studies for the formulation of industrial policies within the framework of the overall economic policy. The main objectives of the centre were: formulation of policies and programmes in the fields of foreign and domestic trade consistent with the objectives of the country's development plan; and collection and interpretation of economic and technical data for the guidance of potential investors in the private sector.

The Centre for Heavy Industries Researchers (CHIR) is an associate of the Ministry of Heavy Industries and was established in 1984, concentrating in both research and production activities including designing and developing machinery; collecting and publishing data and information about different industrial and production fields of the heavy industries; and providing special technical services in various industrial and production fields. It should be noted that following the approval of legislation by Parliament the Ministry of Heavy Industries has recently merged with the Ministry of Industries. The Centre for Researches and self-sufficiency Services of Iran (CRSSI) was established in 1981 in accordance with the Organization for Expansion and Renovation of Iran's Industries which is affiliated to the Ministry of Heavy Industries. The main goal of this Centre is to facilitate the co-ordination and collaboration between the various research centres and industrial units, in order to reduce technological dependency and achieve Self-Sufficiency, by strengthening the country's indigenous technological capability.

The Institute of Standards and Industrial Research in Iran (ISIRI) which was established in 1959, with the main objectives of the standardisation of industrial, agricultural, and mine products. It is also aimed at ensuring the quality standard of the products for exports. Applied Researchers Centre (ARC) is associated with the Organization for Expansion and Development of Iran's Industries and established in 1974, involved in such activities as education and training, production and research. Centre for Researchers and Development of Technology (CRDT) which is an associate of the Ministry of Mines and Metals and was established in 1983. It is located within the Mobarakeh Steel Complex and its activity is mainly concentrated in solving problems or difficulties regarding the manufacturing of steel as well as designing specific programs for development and modernisation of technological know-how required for producing various steel products. The Centre for Research and Aluminum Engineering Services of Iran (CRAESI) under the supervision of the Ministry

of Mines and Metals was established in 1982, aiming at enhancing skills and technical knowledge in the Aluminum industry. The Research Centre of the Oil Industry was established in 1958 by the Ministry of Petroleum, with the main objective of developing science and technology of the oil- related industries. The Centre for Handicrafts and Small Scale Industry was established in 1964 as an affiliate of Ministry of Economy, with the main objectives of improving the quality of local handicrafts by utilizing the surplus labour in the rural areas, and expanding the handicrafts products.

The Chamber of Industry & Mines which was established in 1964 by the decree of the council of Ministers with main objectives including, improving and expanding the country's industries and mines; co-ordinating the industrial and mining groups activities and promoting the quality of industrial and mining products. The Centre for Power Researchers (CPR) is an associate of Ministry of Power and was established in 1982 to perform research for the electrical industry. There are other research centres which are subsidiaries of one ministry or university or operate independently. For example, The Institute for Finance Studies (Ministry of Trade and Finance), Iran Statistics Centre and the Informatics high-Council of Iran (Plan and Budget Organization), The Industrial Management Organization and The National Iranian Industries Organization (Ministry of Industries).

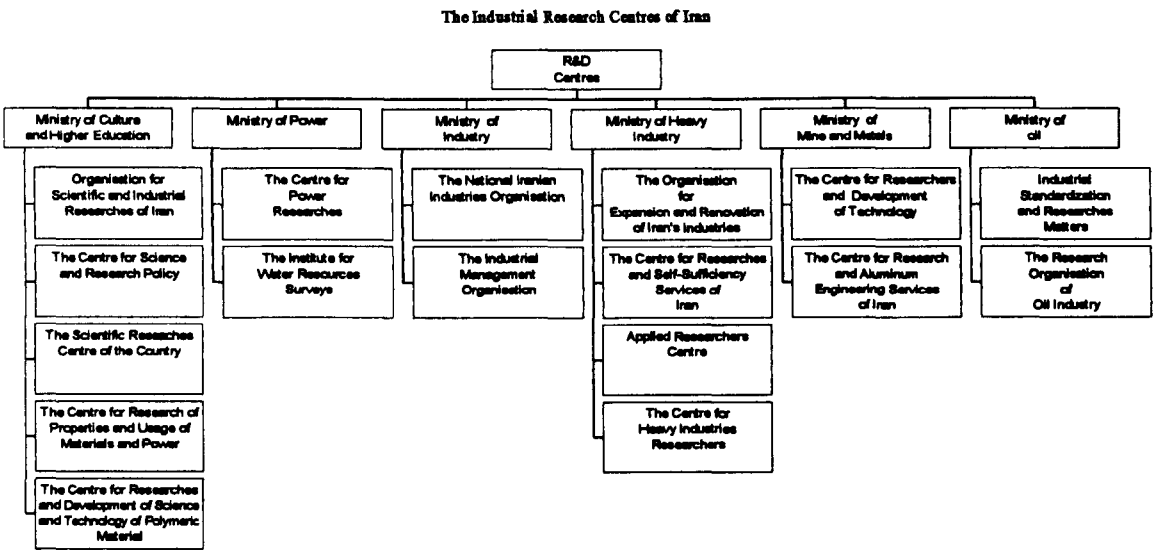


Figure 7.1 The most important industrial research and development centres in Iran

The following table is the comparison between three of Japan's most important research and development institutes namely, Japan Institute of Invention and Innovation (JIII), Japan Research Development Corporation (JRDC) and Japan Information Centre of Science and Technology (JICST), with one of the Iran's major research and development centre, The Organization for Scientific and Industrial Researchers (OSIRI) of Iran in 1983.

R&D centres	The Year of establishment	The number of full-time personnel	The budget in 1983 ($ 1000)
JIII	1904	250	48,181
JRDC	1961	220	33,043
JICST	1957	329	32,348
Total	-	779	113,572
OSIRI	1980	480	6000

Table 7.9 A comparison of the full-time personnel and budget of Japan's R&D centres with the Organisation for Scientific and Industrial Researchers in Iran

According to this table, each person in Japanese R&D institutes spends an average of $ 146,000 per year in Research and Development, while this amount was $12,500 per year per person in Iran. As is shown in the table 7.9, the R&D activities in terms of both the expenditure and number of researchers have been totally inadequate in Iran and steps have been proposed to increase these activities considerably during the new Five-Year plan. The general conclusion from the preliminary investigations of R&D activities in some LDCs and Iran is that the problems of Less Developed Countries in this regard can be summarised as follows:

1. Research objectives in LDCs were determined without considering their technological requirements, which are derived from the social and economic concerns of their society.
2. Most of the research work done in these countries has no connection with production, and the products of this research supplies little to world markets.
3. There is insufficient coordination between the research and development institutes of within LDCs in general and Iran in particular.

Having surveyed Iran's overall human resource development policies during the past years, one can see that despite significant increase in various quantitative educational indicators, some problems such as a relatively high growth rate of population in the 1980s (3.2%) led to an increase in demand for primary and secondary education, low productivity level of labour force,

and lack of relevance of the content of higher education with national needs, and affected the qualitative performance of the educational system. Moreover, the educational system in Iran was not generally designed to produce intermediate skills and proficiency in regard to the needs of industry, agriculture or even service sector and public organisations. As indicated earlier, it is argued that the educational system was too theoretical and academically oriented, and paid very little attention to increasing practical experience for engineers.

In order to tackle these problems and to increase the productivity of the labour force, the first-five year plan aimed at increasing per capita labour productivity by an annual rate of 5.2 %. This target was to achieve through adoption such measures as reduction of over employment in the service sector, increased productivity through managerial techniques, on the job training, and using well qualified and experienced managers for the key positions. Some other efforts have been taken in order to promote the quality of educational system in accordance with quantitative expansion. This including paying more attention to science and engineering subjects in the higher education rather than humanities, and combining vocational-technical programmes with general education in high school (secondary) level..

7. 4 SUMMARY AND CONCLUSION

As indicated earlier, like many other developing countries the acquisition of foreign technologies and technical know-how has played a very important role in industrialisation of Iran in past decades. Despite the massive transfer of technology and machinery and equipment from abroad in past years, it is argued that the actual transfer of manufacturing technology has been neglected and the transfer of industrial technology was taken place mostly through importing machinery and equipment, ignoring the essential know-how. This was mostly due to the problems in transferring the know-how needed for the adaptation and assimilation of foreign technology to local condition. In order to tackle this problem, a number of Research and Development institutes were established to adapt foreign technologies through research and development activity. It can generally be said that despite the massive importation of foreign technologies in the pre-revolutionary period, Iran could not create an appropriate environment needed for the adaptation and absorption of these technologies. As indicated earlier, some general problems, such as lack of an adequate skilled labour force, the implementation of an extreme protectionism policy which led to inefficient utilisation of natural and human resources, lack of sufficient indigenous technological capability, and heavy reliance on importing inputs, parts and equipment

required for manufacturing the outputs and products, were among the major problems contributing to a relatively unsuccessful experience of technology transfer in this period.

Having compared the experience of Iran in technology transfer and FDI with that of East Asian first and second-tier NICs, one may find some common features as well as major differences. As indicated earlier, like S. Korea which adopted a restrictive policy towards flow of FDI in its early stage of industrialisation, FDI has played a less important role as a method for transferring technology into Iran. This was mainly due to a relatively long trend of protectionism and import substitution policies which favoured manufacturing products for the domestic market. While most East Asian first and second-tier NICs designed a long-term and appropriate technology transfer strategy which emphasised more building up a strong indigenous technological base in these countries, however, in Iran such a strategy was not in the main context of development strategy although the necessary conditions were clearly present. As indicated earlier, the lack of an appropriate technology transfer strategy as a centerpiece of an overall development industrialisation policy led to the creation of an dependent industrial sector on imports of parts and components. Despite an increase in Iran's oil revenues in 1973 which set Iran in a relatively better position in terms of foreign exchange reserves in comparison with many East Asian countries, as explained in the previous chapter, Iran could not manage to utilise these large financial resources to establish and develop the strong industrial and technological base needed for a successful industrial and technological development.

The early transition to outward-looking, export promotion policies enabled East Asian first and second-tier NICs to promote their productivity level in order to be more competitive in international market. Moreover, the participation in the export markets encouraged these countries to increase their technological learning and efficiency through effective adaptation, and absorption of foreign technologies. However, in Iran instead, the continuous implementation of import substitution policies gave little incentives for adapting foreign technology to local conditions and achieving maximum efficiency. As discussed in the previous chapter, although ISI policy in Iran was accompanied by the massive transfer of foreign technologies in the early stage, the long-term implementation of this strategy created inefficient local industries which were unable to compete in the international market due to their low level of technological capability.

While many East Asian first and second tier NICs invested heavily in development of their

human resources, Iran lagged far behind in this regard, despite relatively intense efforts to promote the country's level of skilled workers and scientists and engineers. Moreover, as discussed in detail in the previous chapters, many East Asian first and second tier NICs, in particular S. Korea (2.3% of GNP) and Taiwan (1.8% of GNP), allocated a significant amount of financial resources to research and development activities which has played a critical role in the promotion of their indigenous technological capability. In addition, most R&D activities in these countries have been done by private research centres. There has been a relatively low level of R&D expenditure as a percentage of the GNP (0.3%) and most research and development activities are concentrated in government institutes and universities. The government in the East Asian first and second-tier NICs has also played a critical role in directing a set of effective policy measures to accelerate the industrial and technological development in these countries.

In terms of technology transfer, there has been a specific Ministry or governmental institution which has formulated and monitored an appropriate strategy and guideline for their acquiring and adapting foreign technology to the local conditions. The government in these countries has effectively intervened in the promotion of the productivity and technological efficacy of the manufacturing products, which is an important prerequisite for their expansion of exports and for competing in the international market. In Iran, instead, there has not been a specified Ministry or organisation directly responsible for formulation of an overall technology transfer strategy based on the country's needs and capabilities.

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CHAPTER EIGHT:

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Having summarised some of the major conclusions and findings of this research, the following points emerge. As is shown in the analysis of the theoretical framework (chapter 2), the product life cycle theory, technology gap theory and dependency theory can be identified among the most significant empirical validations to apply to LDCs. These theories can explain better the reasons for the transfer of technology across national borders. While according to the product life cycle theory both developed and developing countries can gain benefits from the technology trade, the dependency theorists have emphasised the other side of the coin, that is, the negative aspects regarding international technology transfer. Moreover, unlike the technology gap theory which can be applied most appropriately to developed countries, the dependency school of thought originated in the developing countries and concentrated more directly on the problems and constraints within these countries.

As extensively discussed in the theoretical framework, the dependency theorists argued that the imported technology from the developed countries is often inappropriate for the developing countries and only reflects the actual resource endowments of the developed countries and therefore leads to the technological dependency of LDCs on DCs. However, while the dependency school of thought criticised multinational companies for their unwillingness to transfer appropriate and real technology to the LDCs, it can also be said that MNCs play a very important role in transferring technology to these countries, since they possess the majority of the world's stock of advanced and high technologies.

The conceptual analysis of international technology transfer in the chapter 3 identified and analysed the most important channels by which technology can be transferred across national borders. It can be said that Foreign Direct Investment (FDI), licensing and joint venture agreements are among the most important methods of technology which have been used widely by many developing countries. It is also found that in order to be successful in international technology transfer, LDCs should choose the most appropriate mechanism, based on their absorptive capacity of the imported technology, their technology and trade

policy, and cost benefit analysis. Furthermore, as extensively discussed in the conceptual analysis of the international technology transfer mechanisms, it has been found that while FDI is believed to be the most important and widespread channel of ITT, the joint venture agreement is considered as one of best channels for the ITT, due to its several advantages such as sharing the risks and benefits by both recipient and supplier. Joint venture contracts can also provide an appropriate environment for local training in the recipient country and better absorption and assimilation of imported technology, due to willingness of both parties to a successful technology transfer. It is also argued that transfer of technology through joint ventures enable the recipient country to share in the use of technologies which they could never explore alone. However, one can say that the success of most joint venture agreements to a large degree depends on the compatibility of goals and objectives of both supplier and receiver of technology.

Licensing agreements, on the other hand, are mostly used by those countries which have a relatively higher level of absorptive capacity. LDCs are usually reluctant to use licensing as a channel for acquiring foreign technology due to some restrictions imposed by licensors which affect negatively the successful transfer of technology. However, as discussed in the analysis of first-tier NICs such as S. Korea and Taiwan, these countries have mostly acquired foreign technologies through licensing and importing capital goods, and have successfully adapted and assimilated the imported technology licenses. These countries make the maximise use of licensed technology with little technical assistance from the suppliers of technology (licensors). There are several other mechanisms of International Technology Transfer which were discussed in detail in chapter three. However, the main determinants of these mechanisms mostly depend on the technological policies of the recipient country, its level of local technological capability, the trade relationship between the recipient and supplier, and the motivation, purpose, criteria and bargaining power of the recipient country. Moreover, different kinds of institutional factors may also affect the ability of the recipient country to select the most appropriate channel, such as the restrictive regulations of the recipient country toward transferring foreign technology. Therefore, it can be generally said that choosing an appropriate mechanism can play a critical role in the success of the international technology transfer. It seems that LDCs should choose a method of technology acquisition which not only transfer the machinery and hard-ware, but which can also include the technical and managerial know-how and soft-ware in order to be adapted and absorbed

efficiently to the local conditions.

This research has also extensively examined the success factors for international technology transfer and industrialisation of some of the first and second tier East Asian NICs as well as some other countries such as Mexico and Turkey. Therefore, a comprehensive case study analysis was undertaken based on the experiences of these countries in their rapid industrial and technological development. The extensive analysis of these countries' success factors can be very useful for the other LDCs including Iran in order to adopt a collection of appropriate policy measures which led to rapid industrial and technological development of these successful countries. The reason for choosing the first and second-tier East Asian NICs is obviously because of the significant performance of these countries in the rapid industrial and technological development. It is believed that the successful experience of these countries in technology transfer and more broadly in economic development can give valuable lessons for other developing countries who wish to follow the same path of rapid industrial and technological development. As is already identified, most of these countries are different in some features such as the size of their market, resource endowment, geographical location, and different level of industrial and technological capability. However, one can find the commonality in their success factors in the rapid industrial and technological development.

8.1 SIMILARITIES IN THE SUCCESS FACTORS

As discussed previously in detail, many of these countries adopted a series of appropriate policies and strategies which played a very important role in their successful experience of technology transfer and more broadly rapid industrialisation. Although each country adopted its own specific strategy in accordance with its technical and economic requirements, there has been a common framework for successful transfer and development of technology. As is shown in the following table, the success of these countries has not been the result of a single factor, but because of a series of interrelated factors. However, as explained extensively earlier, some particular factors such as adoption of export promotion industrialisation policy, massive investment in the human resource development and improving education system, along with the acquisition of foreign technologies have contributed most to their industrial and technological development.

S. Korea	Taiwan	Malaysia	Thailand	Indonesia	Mexico	Turkey	Iran
Export-Promotion Policies in early 1960s	A rapid transition to EPP in late 50s	Adoption of EPP in the early 70s	Adoption of EPP in the early 1970s	A late transition to EPP in mid 1980s	A late transition to EPP in mid 80s	A shift to EPP in the early 1980s	A late transition to EPP in late 1980s
Massive investment in the education and training	The very effective role of state policies	The flow of Foreign Direct Investment and technology	The role of FDI and technology transfer	The flow of Foreign Direct Investment and technology	The series of state trade liberalisation and stabilisation policies	The state stabilisation and adjustment policies	The structural adjustment and stabilisation policies
Massive import of foreign technology	The effective Human Resource Development(HRD) policy	The HRD policy and cheap labour in early stage	The HRD policy and cheap labour in early stage	The role of oil revenue in financing development projects	The role of maquiladoras (Mexico'sFree Trade Zones)	The HRD policy and cheap labour	The role of oil income in financing development projects
Heavy investment in development of infrastructure	The flow of foreign technology and investment	A series of government policies such as NEP, ICA,IMP,.	The substantial amount of US and Japanese aid	The state liberalisation and deregulation policies	Large amount of US aid	The large European Union and US aid	Privatisation of state-owned enterprises
The Confucianism	The Confucianism	The role of Chinese emigrants	A relatively skilful and hardworking labour force	The authoritarian government	Large amount of US aid	The role of state economic enterprises	The establishment of Free Trade Zones (FTZs)
Authoritarian government	Authoritarian government	Macro-economic and political stability	Authoritarian government	Authoritarian government	Authoritarian government	The role of state economic enterprises	The large investment in development projects
US and Japanese aid	US and Japanese aid	The role of export processing zones	The effective role of state policies	The large natural resources	The state-owned enterprises	The trade liberalisation policy	The privatisation policy

Table 8.1 A comparison of the important success factors in some selected countries

As discussed extensively in Chapter five, there have been different points of view about the most critical success factor for the rapid industrialisation of these countries. However, it can be said that the adoption of outward looking, market-oriented and export promotion policies have contributed most to the success of these countries in comparison with other factors. However, as already explained in Chapter four, in most countries in the survey, the adoption of export promotion was accompanied with some other policy measures including effective transfer of modern and new technologies, as well as stabilisation, liberalisation and human resource development policies. It should also be noted that the early transition to an export promotion policy in many of these countries, in particular S. Korea and Taiwan, took place when most other developing countries followed the inward-looking, import substitution policies. It can also be said that the conditions and environment for a successful implementation of an export promotion policy have become more difficult for those LDCs as late comers in the current very competitive international market.

Therefore, it is essential for LDCs to promote their technological capability through the adoption, adaptation, and assimilation of new and modern technologies as well as development of their human resources in order to achieve a successful expansion of their

manufacturing exports. Moreover, the experiences of most countries under the survey showed that the adoption of various policy measures including stabilisation, structural adjustment and liberalisation policies enabled these countries to create the stable macroeconomic environment needed for an effective implementation of EPP. As is shown Table 8.1 and explained in detail in chapter five, there have been some other factors with a relatively less degree of importance contributing to the success of East Asian first and second-tier NICs such as the Confucianism ethic, the authoritarian nature of their governments as well as substantial amounts of US and Japanese financial aid.

It can also be said that the adoption of an export promotion policy by each of these countries led to a considerable increase in their GDP growth rate and rapid expansion of their manufacturing exports. However, while the first-tier East Asian countries such as Taiwan and S. Korea shifted to the Export Promotion Policy (EPP) in the very early stages (late 1950s and early 1960s respectively), most second-tier East Asian countries such as Malaysia and Thailand adopted EPP in early 1970s. Some oil-producing countries such as Mexico, Indonesia, and Iran, however, adopted the EPP after a sharp decline in their oil revenues in the mid-1980s. Turkey is also another country which shifted to an EPP policy after a severe economic crisis in the early 1980s. Although the shift toward an outward-looking and export-oriented strategy resulted in a significant growth rate for all these countries, as the experiences of most of these countries indicated, the adoption of import substitution policy in their earlier stage of industrialisation was essential for a successful transition to export promotion policy. The adoption of EPP in most of these countries was accompanied by the implementation of some effective policy measures such as the introduction of a large number of export incentives such as tax rebates, financial credits for exporters, exchange rate devaluation, and establishment of export processing zones. However, as discussed in detail earlier, in some countries such as Turkey and Iran, the adoption of EPP has taken place simultaneously with the implementation of structural adjustment and stabilisation policies in order to provide the macroeconomic stability needed for a successful export expansion. Moreover, these two countries have also taken advantage of the creation of a huge capacity utilisation which had not been utilised beforehand.

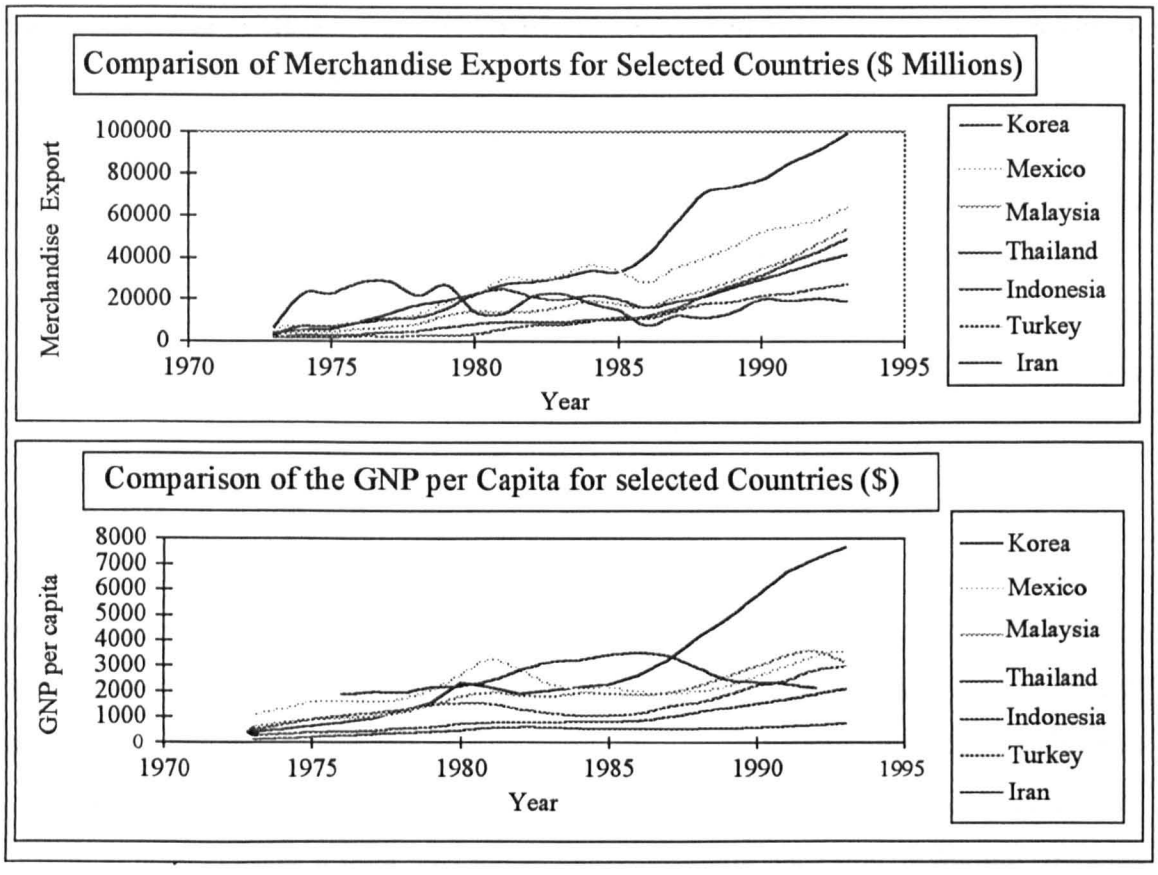


Figure 8.1 A comparison of export expansion and GNP per capita growth for the selected countries during 1970-1995.

As is shown in the Figure 8.1, GNP per capita growth rate has increased with a shift to EPP from the previous import substitution in most of these countries. Although the adoption of EPP resulted in a rapid growth rate and industrial and technological development for these countries, some countries have been much more successful than others in the implementation of this policy. As explained earlier in detail, in some first tier NICs such as S. Korea and Taiwan, the implementation of EPP was much more effective and stronger than the other countries which had followed the same pattern of industrialisation. In S. Korea for example, as a result of some supportive policy measures in the early 1960s, such as favourable credits and tax incentives for exporters, the manufactured exports increased from $ 390 million in 1963 to $89.04 billion in 1994 [1]. S. Korea along with Taiwan are the star performers of EPP, which started with dramatic increase in exports of light industrial products and then shifted toward exports of heavy industrial products [2]. Moreover, the adoption of a strong EPP gave these countries better access to foreign technologies and also led to their heavy investment in absorption and adaptation of imported

technologies in order to increase their productivity and efficiency level to be more competitive in the international market. The strong export-oriented policy also associated with some structural changes in the economy, such as a rise in real wages, shifting comparative advantage from labour-intensive to skill and technology-intensive industries.

As is explained in the case of Mexico, like many other oil producing countries, it changed its previous import substitution policy to export promotion policy when the country faced serious problems caused by the debt crisis of 1982, followed with a sharp decline in oil prices in mid-1980s. Therefore, a series of policy measures were undertaken from the early 1980s in order to make the non-oil industries more productive and competitive. These measures included the introduction of open policies towards Foreign Direct Investment (FDI); implementation of trade liberalisation through reduction of import tariff and quotas; devaluation of the real exchange rate along with sustaining macroeconomic stability to keep the inflation rate at an acceptable level; introduction of various export incentives for local exporters such as large credits for exporters; and provision of the necessary inputs required for production of domestic outputs, and establishment of Mexico's free trade zones known as maquiladoras.

Moreover, the North American Free Trade Agreement (NAFTA) which was established in 1992 between Mexico, U.S and Canada, can be considered as another major factor for promotion of Mexico's manufacturing exports due to its large effects on increasing the level of productivity and competitiveness of Mexico's manufactured products. The adoption of EPP in Mexico has also been associated with much more emphasis on acquisition of the appropriate technology required for increasing the competitiveness of its manufacturing products. The other countries under survey in the country study analysis, such as Malaysia and Thailand, which can be ranked as the East Asian second-tier NICs, shifted to EPP in the early 1970s from the previous import substitution policy. As discussed in detail in the case study analysis, various export incentives were introduced by the Malaysian government including the establishment of export processing zones, tariff and custom duties reductions, providing long-term financing for exporters, upgrading marketing and promotion of skills, and open policies toward the flow of FDI into that country. As a result of these policy measures, Malaysia's manufacturing exports increased an annual average of 15% in 1970s, 22% per year in the early 1980s, and 13.3% per annum during the period between 1986-1992. However, it is believed that Malaysia's most recent export growth has been mainly as

a result of an increasing level of export-oriented FDI which accounted for about 82% of Malaysia's overall exports [3].

There have been similar policy measures for Thailand in the implementation of the EPP, including tax exemptions, electricity rebates, low interest loans, rediscount facility for exporters, establishing export processing zones, full tax exemption on imported inputs used in export activities, and open policies toward the attraction of FDI. This series of export incentive measures resulted in an annual average growth rate of 40% in Thai manufacturing exports during the period between 1968-89. Despite several common features between these two countries, the role of the export processing zones in Malaysia has been more significant than that of its neighbour in the attraction of export-oriented foreign investment. Although almost all of these countries obtained a certain degree of success in the implementation of export promotion policies. However, some East Asian first-tier NICs such as S. Korea and Taiwan have been more successful in comparison with the other countries. Moreover, as explained earlier, one can also find several similarities in the introduction of various export policy measures in these countries. However, while some countries such S. Korea emphasised more the allocation of favourable credits and tax incentives for exporters, others such as Taiwan relied more on fiscal incentives including low interest export loans and the establishment of export processing zones. Furthermore, while S. Korea shifted to the export of heavy and chemical industrial products in its second phase of export-oriented strategy, Taiwan, on the other hand, continued the export of light and labour intensive manufacturing products.

Despite the significant export performance of some successful countries such as S. Korea, this country has recently faced serious problems in sustaining its previous high growth level. While exports grew at an average rate of 26% per year between 1986-1989, the Korean export growth rate declined sharply in the early 1990s and reached only 6.7% in 1992 [4]. Some factors such as labour disputes, rising wages, a high rate of inflation, and a widening trade deficit are among the major factors contributing to this decline. Moreover, due to a decrease in Korea's competitiveness in the world market, the Korean government is undertaking new policy measures such as increasing the share of research and development activity in GNP to 3 or 4 % until 1998, more training programs for its labour force, and more investment in high-tech industrial products, in order to improve its level of

technological capability and competitiveness.

As noted earlier, the first-tier East Asian NICs such as S. Korea and Taiwan have adopted much more strongly the export promotion policy than the second-tier resource rich East Asian NICs. Therefore, it is very important for a specific country to implement effective and strong export incentive measures in order to be successful in export performance. Moreover, as is pointed out earlier, one of the most important factors for the high growth rate and rapid industrialisation of East Asian countries in comparison with their Latin American counterparts has been their early rejection of inward-looking and import substitution policies in favour of outward-looking and export-oriented policies with elimination of several export barriers. As the experiences of the more successful countries showed, the adoption of export promotion policy was not the only important factor contributing to their success, but there has been a package of inter-related policies which led to their significant industrial and technological development. Moreover, it should be noted that some specific criteria for the significant export performance such as the rapid increase in world demand for exports during the 1960s and early 1970s may no longer exist. Therefore, it is very difficult for a country as a late starter in international market to be as successful as those countries which adopt this policy in the very early stage of industrial and technological development. In an increasingly competitive international market, in order to be successful in export expansion, a late-comer LDC needs to allocate a huge investment in the development of its technological capability and promotion of those products in which this country has competitive advantage.

Despite the very significant role of export promotion policy in the rapid industrial and technological development of most successful countries, other important factors have played a vital role in the success of these countries. These include massive flow of foreign technology and investment, effective human resource development policy, along with the efficient role of government in directing these policies. As explained earlier in detail, the heavy investment in education and effective human resource development policy enabled most of these countries to absorb and assimilate imported technology more rapidly and easily. The accelerating use of new technologies forced these countries to improve the quality of their labour force for better absorption, assimilation, and adaptation of imported technologies. Most countries under the analysis have designed specific programs for the expansion of education at all levels and the promotion of training and skills of their labour

forces. However, as explained in detail in the analysis of the selected countries in particular the East Asian first and second-tier NICs, the educational indicators and levels have been varied in the countries of the survey. It can be said that the higher the number of skilled workers, technicians and engineers in a country, the higher the level of technological capability of that country would be. Moreover, as the experience of successful countries in the rapid industrial and technological development shows, the Research and Development (R&D) activities have also played a very important role in the effective absorption and assimilation of foreign technologies as well as promoting their local technological capability.

It can be said that LDCs required a stock of highly educated and skilled-workers in order to absorb and adapt the imported technology effectively. Therefore, they should adopt extensive human resource development programmes such as increasing the number of institutions for higher education (with more emphasis on science and engineering courses), and vocational and on-the-job training which can assist the promotion of the productivity and efficiency of their labour force. In other words, it is essential for LDCs to invest heavily in the development of their human resources including promoting the entire range of engineers, technologists, technicians and skilful labour force. Moreover, they also need to increase their R&D activities through increasing the R&D expenditure as a percentage of GNP. However, each country must adopt its own specific HRD strategy in accordance with its unique technical and economic requirements.

As the analysis of the selected countries showed, many of these countries also employed various methods of acquiring technologies in order to strengthen their technological capability. There were also major efforts to maximise the degree and level of absorption and assimilation of imported technology. The experiences of more successful countries in an effective transfer of technology shows that the adoption of an appropriate technology transfer mechanism based on each country's absorptive capacity and technological capability maximised the efficient adaptation of imported technologies to their local needs and conditions. While some resource-rich countries mainly East Asian second-tier NICs transferred foreign technology mostly through attracting substantial amount of FDI, the other countries with a relatively limited natural resources used other methods including importing capital goods and machinery, joint venture and licensing agreements. However, fewer of these countries formulated an appropriate plan and specific policy for the technology transfer within their overall national development framework. Most of the

countries surveyed imposed no restrictive measures and regulation on technology transfer and flow of FDI. However, some countries such as S. Korea employed a relatively restrictive regulation on FDI in the early stage of industrialisation. Moreover, as indicated in Chapter five, some East Asian first and second-tier NICs established specific institutions or a separate Ministry which were responsible for passing specific guidelines and regulations as well as monitoring technology transfer contracts.

8.2 POTENTIAL PROBLEMS AND CONSTRAINTS

As discussed earlier, many of the countries surveyed, in particular East Asian first and second tier NICs have experienced a relatively similar pattern of rapid industrial and technological development. It can be said that the identification of the most important factors contributed to the success of these countries, and these can provide some useful guidelines and lessons for the other LDCs to adopt for their technological development. However, despite a relatively successful experience of industrialisation, they also faced some serious obstacles in the process of their industrialisation. The recognition and analysis of these constraints can also assist the other LDCs, by avoiding them in their path of technology transfer and development. One of the major common constraints has been a heavy reliance on the import of raw materials and parts and the components required for the production of the outputs. This technological dependency which has been common in many of these countries to different degrees, is considered to be mainly due to inadequate and insufficient supportive industries and weak levels of industrial infrastructure. Moreover, as is discussed in the analysis of theoretical framework, it is believed that the multinational companies and developed countries did not transfer technology properly and therefore this led to technological dependency for LDCs.

As is shown in the case study analysis, almost all the countries surveyed have relied on the import of intermediate and capital goods, components, raw materials, and parts, but with different levels of dependency. For example, 22.4 % of goods manufactured in Korea in 1990, were based on importing foreign parts and inputs, in comparison with 6.2% in Japan, and 1.6 % for US [5]. Most countries being studied have neglected the development of an efficient local supply base of parts and components and suffered from high dependency on foreign parts and components. However, some countries such as Thailand have established

a relatively strong industrial base which is less dependent on the importation of foreign parts and components. Moreover, as discussed earlier, while some countries have provided the foreign exchange needed for importing the required raw materials and components partly from the export of their manufactured goods, some other countries such as Iran, Indonesia and Mexico relied heavily on oil revenues as a major financial support for importing required inputs. Therefore, it is necessary for the LDCs to develop a strong and supportive industry for providing the materials and parts required for producing the outputs and therefore lessen their technological dependency.

As noted earlier, the shortage of adequate numbers of scientists and engineers and lack of skilled human resources has been another major obstacle to the development of technology and its assimilation, and the absorption of foreign technology, in most of the countries being studied. The level of shortage of skilled labour and scientists differs with each country. For example, despite a relatively substantial increase in some educational indicators, such as literacy rate, some East Asian second-tier NICs such as Thailand and Indonesia are lagging behind the first-tier East Asian NICs such as S. Korea and Taiwan in the number of technicians and engineers. For example, while S. Korea and Taiwan have achieved the highest level of educational enrolment in science and technology per 100,000 of their population, with enrolment of 765 and 795 respectively, these figures have been 85 and 16 for Malaysia and Indonesia respectively [UNCTAD, 1991].

Moreover, the low level of research and development activity as a percentage of GNP in some countries such as Indonesia (0.3), Thailand (0.3) and Iran (0.4), can also be considered as another important impediment to the effective transfer of technology and their long term technological progress. Therefore, it is crucial for the LDCs to increase their investment in education and R&D activity in order to accelerate effective and successful technology transfer and promote their local technological capability. The lack of adequate industrial infrastructure and unstable macro-economic conditions have been among the other problems that most countries under survey faced in their experience of industrial and technological development. As is shown in detail earlier, some countries such as Mexico, Turkey and Indonesia, suffered from serious macro-economic instability and financial crises in different period of their industrial and technological development process. These crisis, which mostly occurred as a result of the sharp decline in oil prices in the case of Mexico and Indonesia in the mid-1980s, affected severely the flow of foreign direct investment and technologies to

these countries. Moreover, the lack of adequate industrial infrastructure and the unbalanced distribution of facilities and income in some countries such as Thailand and Indonesia also affected the procedure of successful technology transfer into these countries.

It should be also added that despite the effective role of government in most countries under survey, the state in some countries such as Turkey has been overextended, and this has been identified as a major constraint in the process of industrial and technological development in these countries. Therefore, it is essential for the other LDCs which want to follow the same pattern of industrial and technological development to adopt certain policy measures such as structural adjustment and stabilisation policies to keep the stable macro-economic environment needed for a successful technology transfer and development. Moreover, LDCs should establish and develop institutional infrastructure such as an effective communication systems and transportation networks which are considered as necessary physical conditions for successful transfer of technology and development.

Korea	Taiwan	Mexico	Thailand	Malaysia	Indonesia
Low capability for self-sustaining technological innovation (technological dependency)	Technological dependency (relied on import of raw materials)	Heavy reliance on import of parts and components (technological dependency)	High technological dependency (particular on Japan)	Technological dependency (reliance on foreign inputs and components)	Technological dependency (reliance on foreign components)
Relatively political instability (students protests against government)	Slow speed of privatisation of state owned enterprises	Large foreign debt (debt management)	shortage of adequate scientists and engineers	Lack of adequate technicians and engineers	Low GDP per capita due to its large population
Restrictive policies towards FDI	Relatively low level of local research and development	A relatively long period of protectionism and inward-looking	Limited capability of foreign technology acquisition	Loosing its comparative advantage of cheap labour (wage rises)	Huge foreign debt (about 100 billions), debt management
A relatively unsuccessful experience of Heavy Industrialisation Drive	Lower level of FDI in comparison with some other East Asian NICs	Financial crisis due to 6 years of political instability	Unbalanced income distribution and widespread of AIDS	A relatively unsuccessful experience of Heavy Industrialisati on Drive	Unbalanced income distribution

Table 8.2 Some important constraints on technology transfer and development of some selected countries

Having analysed the key success factors and the major constraints of some selected countries in technology transfer and industrialisation during the past three decades, one can draw some general lessons and recommendations for the other LDCs which decide to pursue the similar pattern of industrial and technological development. One of the major lessons that other LDCs can learn from the experiences of these countries is that they have adopted an appropriate and effective technology transfer strategy which has been supported by some other policy measures including development of human resources and creation of a stable macroeconomic environment. Moreover, the adoption of export promotion policy in most of these countries accelerated the flow of foreign investment and technologies in these countries have also been implemented through the effective role of their governments. Therefore, there is an essential need for every country to design and formulate an appropriate technology transfer policy based on their overall national development strategy aiming at the development and promotion of indigenous technological capability as well as the adaptation and absorption of imported technology and customising it for local market. Moreover, LDCs should also improve the quantity and quality of their human labour as well as the level of their industrial infrastructure which are also essential for an effective and successful transfer of technology into these countries.

8.3 THE LESSONS FOR IRAN

As indicated earlier, the experience of the successful countries in rapid industrial and technological development can provide valuable lessons for other LDCs including Iran. As the analysis of country surveys shows, the adoption of export promotion and outward looking policies has been identified as the most critical success factor for these countries in particular East Asian first and second-tier NICs. The importance of an EPP in the rapid industrial and technological development of most countries under survey suggests that Iran needs to implement a continuous strong outward-looking, export-oriented strategy in order to be able to build up the modern industrial base required for accelerating the pace of country's industrial and technological development.

As explained in Chapter six, due to heavy reliance on the oil revenues, the government in the pre-revolutionary period made little effort to expand the exports of non-oil products. During the post revolutionary period, and in particular during the period between 1980-1988, due to factors such as the Iran-Iraq war, the government's main objective was to

manage a war economy based on an inward-looking, import substitution policy. It was only after the sharp decrease in oil prices and the announcement of the cease-fire in 1988 that the policy-makers in Iran attempted to switch to an export-oriented policy in order to expand non-oil exports. The main objective was to expand the country's non-oil exports and therefore reduce the heavy dependency on oil-income as a major source of foreign exchange earnings. However, it should be noted that, as pointed out in Chapter six, although the emphasis was placed more on the expansion of non-oil exports and introduction of export policy measures during the implementation of the First Plan (1989-1993), the previous import substitution policy has been continued.

Despite the relatively successful implementation of the export promotion policy in the late 1980s and early 1990s which has mainly been because of utilisation of unused production capacities, however, in the later stage, the expansion of non-oil exports encountered serious difficulties, mostly due to the financial crisis of 1993. Moreover, while some countries such as Indonesia and Mexico which are also known as late starters in the adoption of outward-oriented export promotion policies, could manage to a large degree to reduce the dependency on oil revenues through diversifying their manufacturing products, Iran remained heavily dependent on oil as the main source of its income and exports. Therefore, Iran can learn from the experiences of these countries that in order to maintain a successful export expansion, it needs to formulate and design some specific programmes for diversifying its manufacturing products for export. This in turn, required an appropriate technology transfer strategy based on the country's overall industrial and economic development. This can be achieved through the regular and extensive flow of the new and modern technologies based on the country's demands and capabilities; the massive investment in developing the human resources through an effective human resource development plan including education and training of the labour force, on-the-job and vocational training; and increasing the research and development activities in order to promote the indigenous technological capability. Therefore, it can be said that developing the country's indigenous industrial and technological capabilities as well as its human resources can play a vital role for the successful expansion of manufacturing exports. Moreover, the country should also create a stable macroeconomic environment to assist the consistent and effective implementation of EPP.

The other overall lesson that Iran can learn from the experiences of the some successful countries, in particular East Asian first and second-tier NICs, is the role of government in directing a set of appropriate policies and strategies in the rapid industrial and technological development in these countries. The government in most of these countries also formulated and designed a series of consistent long-term (usually five-year) and effective development plans which acted as guidelines for rapid industrialisation of these countries. A significant point in the process of policy making in most of these countries, in particular S. Korea and Taiwan, has been the flexibility as well as the top-down nature of their decision making. The adoption of a top-down approach seems to be essential for a country to catch up technologically with developed countries. As indicated in the case of S. Korea and Taiwan, the policy making in these countries has been efficiently done by a group of experts, economist, professionals, advisors, and administrators, and very quickly. Moreover, the policy makers in these countries have been very flexible in the case of changing the ineffective policies very swiftly. Moreover, the state in most of these countries has played an important role in creating and developing an adequate infrastructure required for efficient absorption and adaptation of foreign technologies into the local conditions.

Another important lesson which the experiences of the countries surveyed particularly the East Asian first and second-tier NICs can provide for Iran, is the important role of human resource development policies in the successful technology transfer and development in these countries. As pointed out in Chapter five, a strong linkage has been found between the development of human resources in these countries and their indigenous technological capability. Therefore, the existence of well-qualified and educated labour force seems to be essential for a country wishes to be successful in technology transfer and development. As it was also pointed in Chapter five, the heavy investment in promoting the education at all levels enabled most East Asian first and second-tier NICs to assimilate and absorb imported technologies more effectively. Moreover, most of these countries also placed their emphasis on increasing research and development activity in order to promote their technological capability.

In spite of some significant achievements in the expansion of educational indicators during the past few years, for Iran as a large country with a population of more than 60 million, many under the age of 16, this has not been adequate. Therefore, more effort and investment needs to allocated to education at all levels, in particular to higher education. Moreover,

further steps need to be taken to establish a strong linkage between universities and institutions for higher education, and industrial enterprises, in order to meet their demands and needs. It should be also added that Iran needs to improve the share of R&D as a percentage of GNP from current 0.4% to about 1% of its GNP for next five years in order to make maximum use of imported technologies as well as developing its indigenous technological capability. Moreover, as indicated in Chapter seven, there has been almost no substantial research and development activity by the private industrial enterprises in Iran. Therefore, priority should be given to the allocation of more R&D budget for universities and those research institutes which are undertaking applied researches.

Iran can also learn from the experiences of some successful countries in their rapid industrial and technological development, that importing technology to these countries was not an alternative, but complementary to indigenous technological capability. Therefore, it can be said that an appropriate technology transfer strategy for LDCs including Iran can be a simultaneous adoption of transferring the required technologies from abroad and strengthening the local technological capability.

8.4 THE RECOMMENDATIONS AND POLICY IMPLICATIONS

Having concluded the analysis of success factors of some selected countries in their experience of technology transfer and industrialisation, there are a number recommendations and suggestions for LDCs in general and Iran in particular as follows:

1. As the experiences of successful countries such as S. Korea indicate, the establishment of a special centre for technology transfer appears to be essential to organise studies to determine which areas Iran should promote for the advancement of technical education and technological innovation to meet its national needs and objectives. This centre can be either an independent Ministry such as that of S. Korea and Malaysia, (Ministry of Science and Technology), or an organisation under direct control of the President. The main activity and responsibility of this centre can be concentrated on some important issues as following:
    - Providing and formulating the appropriate policies and plans for the development of science and technology;
    - Designing an appropriate technology development strategy as a part of the

country's overall economic development plan;

- Formulating a suitable strategy for an effective adaptation and assimilation of imported technologies;
- Designing a strategy for the creation of technology culture and providing a suitable environment for the growth of local talents, creativity and innovation in the country;
- Formulation of an appropriate strategy for the training and development of the skills of human resources in the industrial sector;
- Providing adequate and necessary information on the availability and development of appropriate technologies;
- Creating co-operation between industry and the research and development institutes on the one hand and the government on the other hand;
- Formulating effective regulations for importing technology and the evaluating technology transfer agreements; and
- The identification of priorities, capacities and needs for an effective and successful technology transfer.

As is indicated earlier, in order to be more successful, the science and technology strategy should be linked and connected with the country's overall development strategy.

2. In addition to the above mentioned responsibilities for this centre, it seems also essential to establish a science and technology planning council which can be administered under the direct control of the main centre, with specific responsibilities for ensuring an overall plan for integrating the human resources and infrastructure needs to optimise effectively the transfer of appropriate technology to Iran, and to advise on priority areas for innovative technological development. This overall national plan should link the programme for industrialisation, with plans for the development of engineers, scientists, and technicians; plans for adaptation and innovation of technology; and plans for expanding infrastructure facilities and services. Moreover, it is also recommended to set up a National Science and Technology Information System, in order to promote the access to information on Science and Technology issues, in particular those related to technology developments. An effective information system is also essential for efficient absorption, and the

adaptation of imported technologies to local conditions. It can also facilitate the rapid and effective dissemination of information on research within the country, and also to constitute a source of information on research outside the country.

3. As is shown earlier, the adoption of export promotion policies is among the most important success factor for industrial and technological development of some NICs in East Asia. The export promotion policy enabled these countries to make the best use of their relatively cheap labour in order to compete in the international market. The export promotion policy also encouraged them to increase their efforts for better adaptation and absorption of foreign technologies. Therefore, for Iran as a country which is highly dependent on the oil revenues, it seems essential to emphasise more the expansion of non-oil exports through the greater emphasis on the export promotion policy. This is mostly because the country cannot rely on oil revenues in the long term as the main source of foreign exchange due to declining oil resources and prices. Therefore, the development of a non-oil export sector capable of replacing the oil income is very important for the long-term and overall prosperity of the country. Despite the government efforts to shift to export promotion policy from the import substitution policy, Iran still needs to place more emphasis on creating an appropriate environment for the expansion of exports. As explained in detail in Chapter six, in spite of a primary growth rate of non-oil exports in the early stage of the First Five-Year Plan, there has recently been a declining trend in the country's overall non-oil export performance.

   One can refer to some factors such as lack of effective export incentive measures, and continuous heavy dependency on oil revenues, as well as an unstable and inconsistent fiscal and Monterey policies, to be major obstacles in the expansion of the country's non-oil exports. However, non-oil exports are projected to reach the total value of $ 27,524 million during Second Five-Year Plan (1995-1999). In order to achieve this target, it seems necessary to intensify various export incentives, including tax and custom duty exemptions, export credits and loans to local exporters, the expansion of FTZs with more emphasis on attracting export-oriented FDI, and a stable and coherent macroeconomic policy based on simultaneous devaluation of exchange rate and low inflation rate.

As is mentioned earlier, some oil producing countries such as Mexico and Indonesia, which share common features and characteristics with Iran, could manage to sustain a relatively successful non-oil export expansion, in particular the manufacturing exports. This is mostly due to the adoption of a series of appropriate measures, undertaken by these countries, such as the introduction of various export incentives including tax exemptions, financial credits, a gradual and effective devaluation of their exchange rate, elimination of the export biases, establishment of export processing zones, and attracting a large amount of export-oriented FDI, creating a relatively stable macroeconomic environment, increasing productivity level, adopting open-door policies towards technology transfer and FDI, strengthening the industrial and technological infrastructure and promoting the skills of their labour force in order to increase the adaptability level of imported technologies, developing the quality standards of their industrial products, and maximising the use of their comparative advantage in order to compete in international market. It seems that the experience of these countries in relatively successful implementation of an export promotion policy can have some valuable lessons for other developing countries with similar situations such as Iran.

Therefore, it is recommended that Iran pursue strong outward-looking, export promotion policies with little or without simultaneous introduction of inward-oriented, protectionism and import substitution policy measures. Moreover, as the experience of some successful countries in the implementation of export promotion policies shows, it would be better for Iran to strengthen primarily those industries and areas in which it has already a comparative and competitive advantage, such as labour-intensive and resource-based industries as well as some of its traditional handicrafts, such as carpet. In the later stage, it will be necessary to develop some of its high-tech and capital intensive industries. This in turn, would need a larger investment in developing the country's infrastructure including communication system, transportation networks, as well as upgrading the educational indicators and skill-level of the labour force in order to assimilate and absorb the new and modern technologies to the local conditions. It is also essential for Iran to sustain the stable macroeconomic condition needed for an effective and successful implementation of EPP.

4. As is indicated earlier, despite a great increase in education and training facilities and a relatively substantial body of skilled labour, technicians and engineers in Iran in particularly in the post revolutionary period, the country still requires many more than the current number of technicians and engineers, in the view of the expansion and diversification of the industrial products and promotion of the country's capacity for efficient assimilation and absorption of the advanced technology. Moreover, as indicated earlier, due to the lack of practical experiences for engineers graduated from universities, it seems essential to revise the educational system so that instead of great importance being placed on memory work, much more attention should be paid to practical and empirical work, with modifications to the methods of teaching, and probably to the curriculum, for science and technology. Furthermore, as the successful experience of the East Asian NICs showed, the large investment in their human resource development has played a very important role in the rapid industrial and technological development in these countries. However, much of the public investment focused on the lower level of education (primary and secondary level) in the early stages of their industrialisation, and in the later stage, on the expansion of the higher education level. Therefore, it seems necessary for Iran to invest more in education at all levels through increasing public expenditure on education as a percentage of country's GNP. It is also essential to expand further the number of universities and institutions of the higher education in order to increase the number of university graduates required for industries' needs, in particular in the area of science and engineering.

More steps need to be taken to bring university education closer and more relevant to the needs of industry. These can include a wider use of sandwich courses, and projects which contain exposure to practical training in real-life situations for undergraduate students. The experience of some successful countries has shown a very close relationship between the universities and industry in these countries, mainly through the joint engagement in applied research and pilot plants which were financed by government and industrial firms and carried out by research institutes and universities. In some countries the university professors were also involved in consulting and managing some industrial projects. In addition to the expansion of their education level both quantitatively and qualitatively, the high degree and intensity of

the on-the-job training in these countries also significantly affect the technological capability of their human resources. Therefore, it is essential for Iran to increase on-the-job training for its labour force to enable them to adapt efficiently the imported technologies, and thus increase technological capability. It seems necessary to establish and develop some specific institutions concentrating more on co-operation between the industries, universities and the private industrial enterprises.

5. Having considered the country's vast natural and human resources, it is essential to maximise the efficient use of the country's potential natural, mineral, and human resources. As an example, the substantial amount of gas, which has made Iran the owner of the second largest natural gas reserves in the world, could be used as an alternative for the oil revenues as well as input and basis for competitive petro-chemical and metallurgical industries. If Iran takes most advantage of its potential and significant endowments, and what is essential, implements a constant economic policy framework, it can achieve an equitable and average growth rate of around 5 % per year on average for the period 1995-2000. In order to achieve this figure, which is the same target growth rate projected in the Second Five-Year plan, as is estimated by the World Bank, it will require the investment to GDP ratio to rise to an average of 25% and national savings to reach an average of about 28% of GDP. As noted in Chapter six, the rapid growth rate of about 9% and 10 % in the year 1990 and 1991 was mostly as a result of the utilisation of unused capacities. Therefore, it seems essential to design a specific plan for the maximum utilisation of country's potential resources.

6. As the experience of some of the successful countries in East Asia showed, these countries have made extensive use of the various methods of technology acquisition, including formal and informal channels, which have played a critical role in promoting technological capability and industrial and technological development. While many of these countries acquired foreign technology through the importation of intermediate and capital goods and machinery, turn-key contracts, in the earlier stage of their industrialisation, Foreign Direct Investment (FDI), joint venture and licensing agreements have been among the major channels of obtaining technology in the later stage. However, one can see that FDI has played a very important role in the acquisition of foreign technology and managerial expertise in most of these countries.

Iran has also employed different methods for obtaining technology and know-how, mostly including setting up joint venture agreements with foreign firms, turnkey, technical assistance and licensing agreements, and attracting FDI. Although the government has taken several measures such as establishment of Free Trade Zones (FTZs) in some islands of the Persian Gulf and other areas in the country and liberalising some of regulation to encourage FDI, it seems that additional measures are needed in order to boost FDI into the country. This can be done through further open policies towards FDI, expansion of FTZs, additional tax exemptions and free custom duties, and providing adequate infrastructure and facilities for foreign investors in these areas. Moreover, as indicated in chapter six, much of the FDI which flew to the FTZs has been inward-oriented and included to some extent consumer goods. Therefore, it is necessary to introduce some specific measures to encourage more export-oriented FDI. Therefore, it is crucial for Iran and the relevant authorities to clarify and formulate constant and stable regulations and policy measures to enhance foreign direct investment based on the Second Five Year Plan objectives.

7. As already noted, it seems essential for Iran to put more emphasis on the export promotion policy as well as the human resource development policy which in turn are a prerequisite for the industrial and technological development of the country. As the experience of the East Asian countries shows, research and development activities have played a very important role in the promotion of indigenous technological capability as well as absorptive capacity for importing advanced technology in these countries. In order to become competitive in the international market, Iran has to develop further its research and development activities through the allocation of more R&D expenditure as percentage of GNP particularly industrial research. Iran needs to improve and expand its R&D level and activity in order to be able to acquire high and advanced technologies more effectively. Therefore, more investment should be allocated for R&D activities involved in the adaptation and assimilation of foreign technologies rather than on initially adopting them. In addition, measures are necessary to encourage R&D institutes to become strongly involved in supporting local industrial and technological development. It is also necessary to expand the industrial research institutes regarding the needs and skills of local industry, university and the government organisations. Furthermore, special attempts are needed to co-

ordinate the research activities of industrial firms, public institutions and research centres and universities. It seems also essential to encourage private industrial firms to allocate more investment in the R&D activities. This can be in the form of allocating a larger percentage of their sale in research and development activities.

8. The state has also played a very important role in East Asian NICs in providing the effective and stable macroeconomic environment needed for successful implementation of a set of appropriate policies which led to the rapid industrial and technological development of these countries. The state in these countries can also be characterised as strong, efficient, market friendly, and relatively less interventionist. The government in these countries changed the previous policies very quickly when they found them to be ineffective. The government in Iran, can also effectively be involved in such a features as identification of the country's potential capacities and needs, formulation of appropriate policies for science and technology development and their goals and objectives, recognition of priorities, and designing a set of appropriate policy measures needed for successful industrial and technological development. As indicated earlier, the government can also play an important role in the rapid transition to an export oriented policy. The role of government during this transition period towards a more outward-oriented economy is to use the country's oil based resources to improve an infrastructure network needed to improve the industrial products capable of competition in international markets. Moreover, the government should also implement appropriate policy measures to train adequate technicians and engineers for a successful absorption of imported technology. As the experiences of East Asian countries indicate, the government in these countries invest in those industries in which the private sector may be reluctant to invest.

Although the experience of successful East Asian NICs cannot be easily replicated, due to some dissimilarities and special circumstances unique to these countries, some very important success factors of these countries which were discussed extensively earlier, such as an effective and supportive government role, export promotion policy, and human resource development policy, can be extremely useful for other LDCs including Iran who want to pursue the similar path of rapid industrialisation. However, it seems necessary to add that the mere replication and imitation of these successful countries' pattern and policies without considering the local conditions and the

country's potential capacity and needs could lead to negative results.

9. The cultural and social value system is one of the critical factors for efficient assimilation and adaptation of foreign technologies. The Confucian culture and ethic, which can be characterised through some aspects such as hard-working, self-discipline, hierarchy and obedience and high respect for education, is considered to be another success factor for the East Asian NICs. As explained earlier in the pre-revolutionary experience of Iran, in the massive transfer of technology which mostly occurred after the oil boom of 1973, most imported technologies could not be absorbed and adapted to the local conditions of Iran due to some major differences between social, cultural, and traditional values of Iran and those of donor countries. Moreover, the pace of change caused by big push industrialisation policy was so fast that it caused a serious social crisis which eventually led to the Islamic Revolution of 1979. Therefore, it seems crucial for the country to develop a strategy and guideline for creation of an appropriate environment and technology culture needed for effective adaptation and assimilation of advanced technologies.

As already mentioned, the suggested centre for formulation of country's overall science and technology policy could also take this responsibility. This can be in the form of a specific department, under the supervision of the main centre, which might be called inter-cultural communication (the exchange of ideas and information that are dependent on culture) between the donor and receiver of technology transfer. It is mainly because of this problem that Iran has not obtained the best from agreements made for joint enterprises for the establishment of technology in the past, which might be due to the lack of understanding by foreign firms of the country's culture and social value system and vice-versa, and also inadequate local capability to absorb the imported technologies. Therefore, special studies should be undertaken in order to establish procedures for selecting technology that would produce far less cultural shock. This institute could also formulate the overall strategy needed for the creation of an appropriate policy environment and technology culture, encouraging research and development and innovative activities and team works, promotion of capacity for changing some of the customs and working habits of the labour force in the direction of efficient absorption and assimilation of imported technologies.

10. The current Second Five-Year Development Plan has put more emphasis on self-sufficiency in agricultural products. In spite of significant achievement in the growth of agricultural products during the implementation of First Plan (1989-1993), it is still not adequate enough to make the country self-sufficient and independent in importing agricultural products. Moreover, having benefited from the existance and availability of diversified natural and mineral resources, this can well provide the basis for the country's development and expansion of industrial outputs. Therefore, much effort needs to be made to design the policies which make the maximum use of the country's large agricultural potential capacities and natural resources. Moreover, as the experience of successful countries, in particular that of resource-rich countries shows, the development of the agriculture sector in these countries was a prerequisite for their success in industrial and technological progress. Moreover, adequate attention should be paid for a balanced and equitable distribution of income and facilities throughout the country. Therefore, more emphasis should be placed on improving the infrastructure of those areas of the country which are less developed in comparison with the more developed regions of the country.

11. Technology transfer should also be in accordance with the country's national goals and priorities. As the experiences of the East Asian countries showed, most of these countries suffer from technological dependency or heavy reliance on importing foreign parts and materials for producing their manufacturing products. As discussed in Chapter six and seven, Iran is also heavily dependent on the import of foreign parts and materials, which in turn is dependent on the foreign exchange earned from oil revenues to finance the import of these materials. This heavy reliance on importing material parts which are mainly financed by oil incomes caused some serious problems for country's industrial products. As it can be seen that the overall performance of the industrial sector was affected whenever Iran was faced with a sharp decline in oil prices and the consequent decrease in its oil revenues. While the successful East Asian countries could improve their manufacturing exports to finance the import of intermediate and capital goods, Iran instead relied continuously on the oil revenues to pay for these products. Therefore, it is necessary to develop the supporting industries capable of providing a proportion of the country's requirements.

12. As indicated earlier, having surveyed the technology level of the Iran's industrial sector, considering the four components of technology, it has been found that the percentage of orgaware, which consists of management practices, has been lower in comparison with the other components of technology. Despite the significant development and expansion of programs for training the industrial managers during recent years, this has not been adequate enough for the further development of the country's industrial sector. As the experience of some successful countries in technology transfer and development shows, the success of these countries to a large degree relied on the effective and high managerial expertise in these countries which were involved actively in the process of long-term technology transfer and development planning. Therefore, it seems essential for Iran to establish specific institutions to train well-qualified and high professional managers with high capability in team- work and problem solving.

13. In order to accelerate the technological development of the country, it seems essential to implement a plan of action to set in place the major perspectives relating to technology development. This plan should include a number of basic principles some of which have already been identified. As mentioned earlier, research and development activity is essential for promoting the technological capabilities needed for the efficient absorption of modern imported technologies. R&D is also among the major methods for making industries competitive in international markets. Therefore, it should be rooted in an overall national technological plan, and more investment is needed to be allocated to R&D activity both by public and private sectors. As the experience of some successful countries with rapid technological development indicated, adaptation of existing know-how through development research with supportive basic research has been among the most effective ways for successful technological development. As already indicated, another major principle for the technology development plan is the development of human resources through the training of skilled engineers and technicians needed for efficient adaptation and assimilation of imported technologies.

14. The transfer of appropriate foreign technology and know-how can play a significant role in the industrial and technological development of every country. As the experience of some countries, in particular East Asian first and second-tier NICs

surveyed in Chapter four and five showed, many of these countries adopted open-door policies towards flow of FDI which has been among major source of foreign technologies, managerial and marketing skills for these countries. In Iran, however, there has not been a significant effort to attract much FDI. Like S. Korea, which adopted a relatively restrictive policy measures toward FDI in the early stage of Industrialisation, FDI has played less important role in transferring technical know-how in Iran in past years. However, as explained in detail in Chapter seven, some steps have recently been taken within the country's First Five Year Plan (1989-1993) to boost FDI. These include establishing several Free Trade Zones (FTZs) and Economic Especial Zones (EEZs) and the introduction of various incentives tax exemption and free custom duties, and the enactment of new law for foreign investment in FTZs, which also offered several new incentives for foreign investors. However, as is also noted in chapter seven, despite a significant increase in the flow of FDI during the period of First Plan, it seems that the country needs to attract a larger amount of FDI, which can also be considered as a major source for the flow of technical, managerial and marketing skills. Therefore, further effective policy measures as well as a consistent and stable macroeconomic environment will be needed in order to achieve the Second-Five-Year (1995-1999) objective target of $ 2 billion of FDI per year.

15. As the experience of the East Asian countries shows, importing foreign technology, and the development of local technological capability in these countries have not been alternative but complementary activities. Therefore, it can be concluded that Iran should adopt a strategy of technological transformation which pursues the following two closely related and mutually compatible objectives: on the one hand plans must be prepared soon for making technology an element indigenous to Iran. This cannot be done without long range planning for that purpose and without the realisation that it does involve more effort and thought than obtaining technology from foreign sources. The promotion of the country's indigenous capability can also take place through the creation of a research and development infrastructure with appropriate linkages to the production structure and thereby lessen their technological dependence. Secondly, it is also necessary for the country to adopt open policies toward the massive acquisition and diffusion of foreign technologies which promote its capability to compete in international market. Therefore, if both of these processes;

strengthening the local technological capability, and importing appropriate technology from abroad; are achieved simultaneously, each one can help the other as is shown in the diagram:

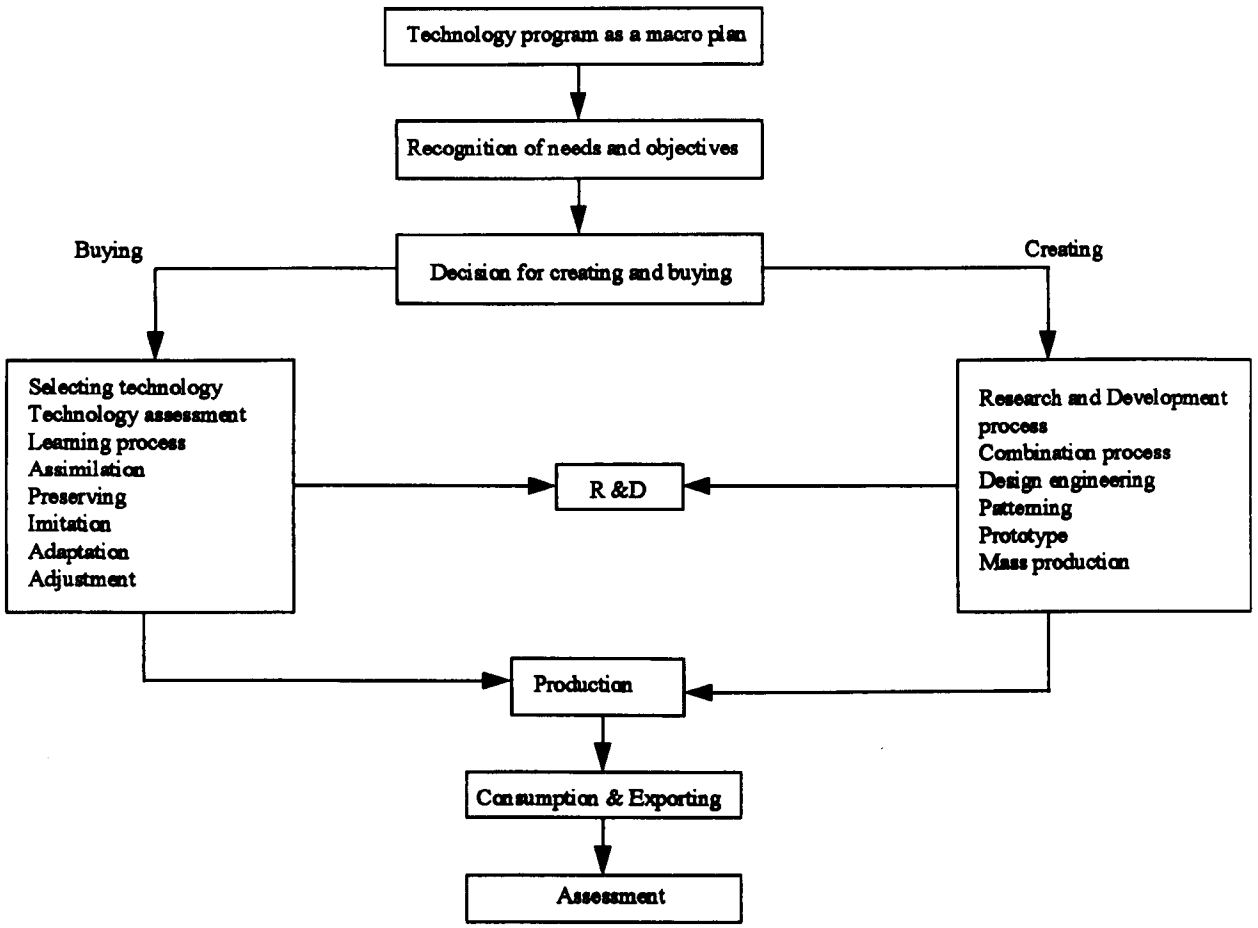


Figure 8.2 The appropriate technology transfer strategy for LDCs

16. As already identified, for a developing country such as Iran, in order to be able to compete in the current very competitive international market, it needs a large investment in development of local technological capability along with increasing research and development activities both in public and private sectors. As the experiences of some successful countries indicate, they could enhance the level of their competitiveness by introducing various incentives for public and private research institutions and universities to place greater emphasis on R&D activities and also establishing some industrial parks and science cities to promote their local technological capability. The establishment of the industrial parks will result in a strong industrial and technological base as well as utilising efficient methods in

production and management which in turn can increase the level of the country's competitiveness. Industrial parks in these countries are also affiliated, formally or informally, to universities and research institutes, and dedicated to science and technology for products and manufacturing.

As an example, one can refer to the Hinchu Science-Based Industrial Park which was established by the Taiwanese government in 1980, and can be considered as one of the most successful examples of a high-tech park in Asia. Therefore, it is recommended that industrial parks should be established in Iran with the financial support of government, and effective and close cooperation with private industrial firms sought in order to promote the capability to produce high-value goods competitive in world market. Moreover, despite a significant improvement in the level of country's industrial and technological infrastructure, it seems that there is still some further investment required to develop the technological infrastructure, including communication systems, transportation networks, and a well-structured informatic in system.

Finally, it is noteworthy to mention that it is not intended here to present an extensive and detailed plan for the future of the country, which is already formulated broadly in the Second Five-Year Plan (1995-1999). However, the above points can be considered as the overall recommendations and suggestions which may be used as complementary for the country's future trends in technology transfer and more broadly industrial and technological development.

As the analysis of some successful countries (including S. Korea and Taiwan as the first tier East Asian NICs and Malaysia, Thailand and Indonesia as second tier NICs, Turkey and Mexico) in industry and technology development shows, some similarities are found between each of these countries and Iran's overall situation. As a major oil producing country, Iran shares similar characteristics with Indonesia and Mexico which have substantial oil reserves. However, as explained extensively earlier, while these two countries have developed a significant non-oil manufacturing base as a result of a successful shift to export promotion policy, Iran is still lagging behind in this regard. Therefore, Iran can benefit from the specific experiences of these two countries which could reduce their heavy reliance on oil revenues successfully.

There are some other common features between Iran and the other countries which have been surveyed in detail earlier. For example, the experience of Turkey which is one of the Iran's neighbours and among its major trading partners can also have very useful implications for the current and future trends of the country's overall national development. As elaborated in Chapter four, Turkey is among the successful countries to diversify and increase its manufacturing exports after switching to an outward-oriented, export promotion policies in early 1980s. Moreover, Iran can also draw very effective policy guidelines from the successful experiences of the East Asian first and second-tier NICs in rapid and significant technology transfer and development. It should be noted that despite the useful and valuable lessons which the successful experiences of each of these countries can provide for other LDCs including Iran, however, this does not mean that LDCs generally and Iran in particular should adopt completely the same patterns and models of these countries. As indicated in Chapter four and five, there might be some major differences in terms of infrastructure capability and science and technology level among different LDCs which make the condition difficult for pursuing the same path and the whole policy packages of the successful countries. Moreover, it cannot be ensured that the adoption of the same policies and models of these countries would lead to the similar results for other LDCs including Iran. Therefore, it is essential for the policy makers of LDCs to consider and assess their needs and capabilities before any decision in replicating the model of the successful countries. In other words, what is more important for LDCs is that once they should select a set of the appropriate policy measures of the successful countries, and adapt these policies to their own socio-political, cultural, and economic environment.

8. 5 CONTRIBUTION OF RESEARCH TO KNOWLEDGE

It is generally necessary for every research to identify some of its most important results and findings which can make some original contribution and useful implication for the specific area of research. There has been some increase recently in research in the general area of International Technology Transfer. However, many researches carried out in this area have generally been at the micro-level, and have focused more on investigating the problems related to technology transfer between firms. In other words, very little effort have been made to find an overall technology transfer policy for LDCs in general and Iran in particular. Therefore, this research has attempted to fill this gap through adopting a macro-

approach in finding the most appropriate technology transfer strategy for LDCs in general and for Iran in particular, based on the experiences of successful countries in technology transfer and development.

A comprehensive literature survey has been done in terms of theoretical framework as well as conceptual issues of technology transfer in order to identify the most important theoretical base which can be applicable to LDCs. Despite the existence of several school of thought such as neoclassical and structuralist, who discussed the different aspects of technology transfer and its role in industrialisation of LDCs, no specific and precise theory of technology transfer has directly been applicable to the overall conditions of LDCs. However, it has been found that the policy makers in LDCs can use some useful implications from the existing theoretical framework of technology transfer and development, in particular the views of dependency school of thought.

In terms of conceptual issues of technology transfer, as discussed extensively in Chapter three, a systematic model for technology transfer process has been developed in order to analyse in depth the process of successful technology transfer. Moreover, technology transfer procedures have also been formulated by using a matrix, which could provide the most appropriate direction for the acquisition of foreign technology in a LDC. A comprehensive analysis of technology transfer mechanisms has also been carried out in order to identify the most appropriate channel for an effective and successful technology transfer and development. It is realised that the choice of appropriate mode of acquiring foreign technology mainly depends on the technical capability of the recipient country as well as its overall national industrial and technology development policy.

An extensive and empirical case study has also been undertaken based on the experiences of some selected countries, successful in technology transfer and industrialisation. Some of the most important success factors of these countries in effective technology transfer and development are identified as critical success factors in order to apply them to the other LDCs including Iran. The adoption of a set of appropriate policies, in particular outward-oriented, export promotion policies are determined as the most key success factors for the rapid industrial and technological development of these countries. Moreover, the most appropriate technology transfer strategy for LDCs can be recognised as the parallel use of

imported technologies along with the development of their indigenous technological capability.

This research has also investigated an in-depth analysis of the industrialisation policies and technology transfer status in Iran during the pre-revolutionary and post-revolutionary period, in order to identify the strengths and weaknesses of Iran's past and present overall national industrial and technological policies, which in turn could have useful insights for the its future plans and policies. Finally, some very useful and important lessons and policy implications are drawn based on the analysis of the success factors of some selected countries which have some common characteristics with Iran. The overall industrialisation strategy for the future of Iran is suggested to be a strong outward-oriented, export promotion policies as well as a stable and consistent macroeconomic, liberalisation, and foreign exchange policies which are necessary and pre-requisite for smooth and successful implementation of EPP. Moreover, as indicated earlier, primarily, in the first stage and for a short period, it might be better for Iran to concentrate on developing its labour-intensive, resource-based industries based on small-scale and intermediate technologies, and also on the expansion of exports of those products in which Iran has already a comparative advantage such as carpets, etc. However, for the long-term period and in the later stages, it seems essential for the country to develop its capital intensive industries, based on high and modern technologies, in order to be more competitive in the international market. It is hoped that the findings and results as well as the overall recommendations of this research can be useful for the policy makers in LDCs in general and Iran in particular in designing the appropriate overall national development policy framework.

8. 6 SUGGESTIONS FOR FURTHER RESEARCH

This research has attempted to identify the appropriate plan and policy frameworks for an effective technology transfer and development for LDCs in general and Iran in particular. Therefore, a comprehensive case study was adopted based on the empirical and practical experiences of some selected countries in successful technology transfer and industrialisation. The success factors of each country have been systematically analysed and compared in order to find the best policy and strategy which can be applicable to the other LDCs in general and Iran in particular. However, every research has some limitations in

particular in terms of time, the availability of adequate and sufficient data, and the specific area of investigation. Therefore, it is important to consider these restrictions, in particular that of time limitation, in order to identify some area of research which has been less investigated and needs to be further analysed for new researchers who wish to continue in the same area. Despite the attempts of this research to cover as many aspects and dimensions of International Technology Transfer and its role in the industrial and technological development of the LDCs as possible, it could not encompass every feature of ITT.

For example, this research has avoided the political dimension of International Technology Transfer. Due to the importance of the political aspects of ITT and its effects on the successful technology transfer and development, and also because of lack of an adequate research in this area, it seems necessary for other researchers to fill this gap. Moreover, because of some limitation in terms of sufficient data, this research has adopted a relatively qualitative approach in terms of identification of the most critical success factors of the chosen countries. There can be some areas for new researchers who are more interested in adopting a more quantitative approach in particular in terms of firm-level and micro-point of view. However, as indicated earlier, there is increasing research on the TT experiences of some specific firms and companies in LDCs. In terms of Iran, further research may be needed to analyse other aspects of technology transfer into Iran. For example, one area which is little examined is the study of International Technology Transfer to Iran from the transferor point of view, the question of the motivation, benefits and the overall reasons and factors which encourage a developed country or MNC to transfer technology to a LDC such as Iran. Another area of research which would be helpful is assessing and examining the formulation of an appropriate legal framework for the international and domestic regulation for the effective technology transfer and development of LDCs such as Iran.

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APPENDICES

APPENDIX A:

KOREA'S INDUSTRIALISATION AND TECHNOLOGICAL DEVELOPMENT

The Republic of Korea is a developing country that has achieved a remarkable economic growth over the last three decades. Since 1965, Korea has been transformed from an underdeveloped, agricultural country to a newly industrialised country (NIC). It is believed that the course of industrial growth of Korea has been one of the outstanding success stories of international development. Real GNP has grown more than 8 per cent per annum since 1970. The rapid economic expansion was accompanied by a favourable qualitative change in the industrial sector whose GNP share rose from 25 per cent to 43 per cent in about two decades. It can be said that the main engine of rapid industrial development has been a smooth and rapid acquisition, assimilation and development of industrial technology under well-coordinated industrial and technology policies [1]. Hence, with its relatively fresh experience of industrialisation, the Republic of Korea may be able to provide some important lessons for industrial and technological development of other developing countries [2]. It could be extremely useful for government policy makers and advisors in other, less developed countries to study the evolution of Korean policy in order to gain ideas that may be applied to their own situations [3]. As Kuznets (1994) points out, Korea is the model for LDCs because Korea's economic development has been outstanding. Korean development therefore provides a model for other countries intent on accelerating the pace of their own development [4].

In an attempt towards national development goals, Korea has recorded substantial achievements, through a series of trials and errors, in building a technically-qualified work force, improving national scientific and technical capabilities, focusing R&D investment, and establishing necessary administrative and support system. The total science and technology drive was aimed at reforming the economy from a labour-intensive to a technology-intensive structure, and later to a brain-intensive structure. In other words, these efforts have been oriented towards accelerating the transition of science and technology's role from one of supporting national economic development to one of directing this development towards establishment of a technologically self-reliant society. The process of Korea's industrialisation, can be generally divided into five distinct phases. Each phase of Korea's

development has been unique and has its own characteristics.

A.1 REBUILDING AND RECONSTRUCTION: 1953-1962

Many people characterise the Korean industrial policy during the 1950s as one focused on import substitution. If one defines import-substitution industries as those that produce and sell for the domestic market, the Korean industries established during the 1950s were, for the most part, import-substitution industries. During this period, progress was made in reconstruction, including the restoration of transportation and communication networks. The government also completed a land reform program that had been delayed by the war. The most notable feature of the Korean economy during the 1950s was its dependence on US economic aid. The total aid from US and international organizations reached approximately $3 billion during this period. Although this aid was heavily biased toward the short term objective of economic stabilisation, it tied the country over during a difficult period and allowed it to make many important investments that formed the basis for subsequent development [5]. During this period, industrialisation was carried out under the protection of tariffs and quantitative barriers to imports. These measures were supplemented by local procurement programs implemented by the US Army, which led to the development of the plywood, tyre and construction industries [6]. During 1953-57, GNP in real terms grew at about 5 percent per year. During this period, foreign aid was an important factor in the nation's economic growth. A respectable but not outstanding rate of industrial expansion was achieved during the latter half of the 1950s, with import substitution for light manufactured and nondurable consumer goods playing the major role [7]. During the period 1953-62, the Korean economy had generally experienced slow growth under an import substitution strategy. At a same time, however, the rapid rise in the level of education and the relatively equitable distribution of both income and wealth paved the way for future development [8].

A.2 TRANSITION FROM LOW TO HIGH GROWTH, (EXPORT TAKEOFF) 1960-69

The 1960s can be regarded as the take-off stage of industrialisation in Korea. During this period, Korea was almost completely dependent on the help of advanced nations in the area of production facilities and technologies. Emphasis was placed on fostering strategic

import-substitution industries such as energy, fertiliser and cement while focusing on the development of export-oriented light industries. This period was characterised by primary emphasis on the importation of advanced technologies for application in the production processes of Korean industries, supplemented by problem-solving activities as the need arose in the field [9]. In 1960, the Korean economy was dominated by agriculture and mining. With few exceptions, the manufacturing sector supplied only simple consumer products. However, major industries established since 1960 range from chemicals and electronics to automobiles and heavy electrical equipment. Exports exceed 40 percent of GNP, with manufactured products constituting over 90 percent of the total [10].

The 1960s can also be said to be the period of formation of the external basis for the development of science and technology in Korea. The Korean government enthusiastically promoted the development of S&T to support socio-economic growth. As a result, the main policy was concentrated on technology investment, which attained 0.3 per cent of GNP, and on manpower development and training of skilled workers [11]. In 1960's, the Korean government established a series of Five Year Economic Development Plans, the first of which was launched in 1962. The theme of the First Five Year Economic Development Plans (1962-1966) was modernisation of the nation by industrial development. It was the implementation of these plans that resulted in the outstanding economic development of Korea in the 1960's. Top priority of the plans was given to increased exports of manufactured goods. The plans thus necessitated use of a number of process "know-hows" and manufacturing technologies to permit the high volume of industrial production. However, in those years Korea did not have the technology to back up varied manufacturing activities.

Generally, the level of industrial technology available domestically was too low to be efficient in producing export goods. Obviously, what was needed then was prompt importation of key technologies, followed by their adaptation and improvement to suit Korean conditions. Also needed were the infrastructure and support systems that would enable those industrial activities to proceed smoothly. Evidently, one of the supporting means called for industrial research and development institutions. Therefore, in Korea, during the 1960's, a number of industrial R&D institutes have been established. The Korea Institute of Science and Technology, (KIST) was one of the first and most important industrial research institutes which established for the transfer of research results to

industrial commercialisation. In 1976, KIST took an active part in establishing the fourth Five Year Economic Development Plan in so far as the technological aspects of the plan were concerned. In 1977, KIST conducted studies for the establishment of promotional policies for the long-term development of science and technology, and, in 1978, studies for a long-term strategy for technology development.

In the 1960s, the education and training of technology human labour had been led by the government. The establishment of the Korea Advanced Institute of Science (KAIS) as a postgraduate school in applied science and engineering was a turning point. KAIS led the nationwide upgrading of graduate education and contributed to the establishment of a mass supply system of high-quality scientists and engineers [12]. During the 1960s, Korea was also completely dependent on advanced countries for production facilities and technology. Therefore, the basic objective of the Korea's first five-year plan (1962-1966) was to develop a base for a self-sustaining economy that would not be dependent on foreign aid for its growth. The plan also emphasised the expansion of the industrial base, a rapid rise in exports, and improvement in technology [13]. The choice of the appropriate technology to adopt was a very important task for economic development. The choice of strategic industries for economic development was affected by the possibility of success in technological adaptation [14]. In the 1960s, the number of foreign technology agreements was rather limited, and during 1962-72, only about 320 agreements were made, with payments during this period of about $ 10 million [15]. During this period, the state encouraged exports and industrialisation by protecting infant industries and stimulating exports by offering favourable credits and tax incentives to selected firms. Export-oriented industrialisation, and a state policy combined with the free play of market forces, underlies Korea's phenomenal growth [16].

It can be said that since the early 1960s, Korean industrial policy has had two proximate objectives: encouraging exports and promoting infant industries [17]. Therefore, during this period (1962-1970) Korea's role as an exporter of manufactures was firmly established. The share of manufactured goods in total exports increased from 17.6 percent in 1962 to 76.1 percent in 1970 [18]. The economic development plan during the 1960s also included programs for establishing infrastructure projects and targets for the private sector. Infrastructure projects were financed through the government budget. The government allowed private ownership and management in all industries except for import public

utilities. However, the government intervened in major decisions on investment, finance, imports of foreign capital, and location of major industries, even if the firms were privately owned. In effect, the Korean economic system in this period was a variant of authoritarian capitalism, in which enterprises were privately owned but management was shared between the government and the owners [19]. Therefore, one can say that Korea's rapid economic expansion in the 1960's was led by significant increases in export production financed principally by domestic savings channelled through government controlled financial institutions [20].

The second five-year plan (1967-71) identified labour intensive manufacturing as the source of the most rapid economic growth and encouraged investment in export industries at the expense of the other sectors. During this period, modernisation of the Korean industrial structure continued through a build up of the petrochemical, steel, electronics, and machine industries. The Second Five Year Economic Development Plan (1967-1971) also pushed forward the continued expansion of basic chemical industries, petro-chemicals, and the iron and steel industry. Efforts were also made to promote the development and expansion of export industries such as textiles and plywood. During this period, the GNP grew at an average annual rate of 10.5% while the industrial sector grew at the high rate of 22.2% [21]. It is argued that the strategies Korea adopted in the early 60's were to concentrate on industries aimed for import substitution and to select and develop technologies to support those industries. Korea's industrialisation process during this decade was also characterised by emphasising the selection of a few strategic leader sector industries, along with adaptation and assimilation of their technologies in order to proceed to the next more sophisticated technologies [22].

A.3 HEAVY AND CHEMICAL INDUSTRIES DRIVE (1973-1979)

One can consider the 1970s as the period of building and expansion of the technology foundation of the country and the growth stage of Korean industrialisation. The early stage was characterised by the effort to go one step beyond importing foreign technologies. Serious efforts were made to improve imported and domestic technologies while continuing to build Korea's technological capabilities through education and training [23]. On the nature of basic industry and infrastructure, the export-oriented industrialisation of the consumer goods sectors and the technology-intensive heavy-chemical industries became the

principal targets of economic development activities. At the same time, great emphasis was placed on the introduction of more advanced technologies through imitating and developing the imported and existing technologies. So, by the early 1970s, Korea was well on its way toward rapid industrialisation, characterised by a transition from labour-intensive, low-technology industries to labour and capital-intensive high technology industries such as heavy and chemical industries [24]. The government had selected six strategic industries including steel, machinery, shipbuilding, electronics, petrochemicals, and non-ferrous metals. The Korea Institute of Science and Technology (KIST) had performed R&D in these fields until the mid-1970s but could not effectively meet theses industries' massive technology demands [25].

In Korea, in the early 70s, basic design technology has not been developed in most of the important industries. Despite the transition to the export-led industrial development strategy in mid-1960s, large chemical firms was encouraged by the import substitution strategy which initially relied on joint ventures and turnkey installations. Shipbuilding, like construction operations, was undertaken on the basis of designs provided by customers with virtually no local technological inputs except for actual construction [26]. As it is noted Korea could achieve import-substitution and export promotion simultaneously by moving into an emerging role in the world market for standardised capital and intermediate goods [27]. Korea's decision to switch to development of Heavy and Chemical Industries (HCI) in the mid-1970s, demanded the introduction of new and higher level technologies [28]. The HCI drive drastically transformed the structure of the Korean economy, but there is still disagreement about its ultimate contribution to Korean development [29]. The shift from general export promotion to a sector development strategy, focused on heavy and chemical industries (HCIs), also presented a major change in policy in favour of specific industrial targets and a wide-ranging commitment by government in using trade and financial policies to lead resources to the HCI sector. Designed in part to accelerate changes in Korean comparative advantage, the HCI drive provided extensive support to large-scale, capital-intensive industries [30].

It can be said that the shift to HCI promotion drive was mainly because of two reasons. Firstly, Korea could no longer maintain its comparative advantage in light manufacturing industries mainly because of growing competition from other developing countries with lower wage rates comparing with that of Korea. It was also believed that the negative

effects of the rising protectionist barriers of labour-intensive light manufacturing products by industrialised countries that began after the first oil shock could be offset by exporting higher valued-added heavy and chemical products [31]. The second reason for adopting the new policy (HCI) was the importance of improving defence-related industries which emerged as a result of China's re-entry into the international community and fears of a possible withdrawal of US troops from Korea. Therefore, it appears that not only did market forces play a relatively peripheral role in the adoption of the HCI program, but political factors had a significant influence. The heavy and chemical industries that were the program's priority targets would provide the industrial infrastructure for defence technologies transferred from the United States, such as making tanks, and aircraft [32].

The HCI drive can also be viewed as a new phase of Korea's export-led strategy, which Korea moved from exporting low value added, labour intensive products towards exports of higher value added, technology intensive goods. As a result of Heavy and Chemical Industry (HCI) policies, the manufactured exports rose from 24% in 1973 to 46 % in 1979 and accounted for more than half of Korea's exports in 1984. On the other hand, the HCI imports fell from 39% in 1974 to 24% in 1980 [33]. More importantly, HCI became the springboard of the renewed Korean export offensive in the mid-1980s. The Pohang Iron and Steel Corporation (POSCO), for instance, was central to Korea's transition from an exporter of labour-intensive commodities to an exporter of higher-value added, technology-intensive products, sharpening Korea's competitive edge in such industries as shipbuilding, automobiles, construction, and electronics [34]. HCI enabled Korea to become by the late 1980s the world's second largest shipbuilding power and a major exporter of construction and engineering services [35].

Moreover, the other incentive to the development of heavy industry in Korea was believed to be a shift within the world manufacturing industry. Beginning in the mid-1960s, some heavy and chemical industries manufacturing moved their operations from industrialised countries to the newly industrialised countries, including Korea [36]. Despite of some significant achievement through the implementation of HCI drive, there is a belief that the HCI drive was overambitious and resulted in serious misallocation of resources. It is believed that the HCI drive resulted in substantial unusable capacity and concentrated investment in the economy's most capital intensive industries. More fundamentally, the HCI program substituted bureaucratic judgment for market tests and absorbed too much of the

economy's resources. In contrast to previous years, investment was not sufficiently conditioned on the test of export performance [37].

Nevertheless, in evaluating the policy, it must be observed that many of the goals of the policy were in fact achieved. Exports of heavy and chemical industries did not quite reach the target of 50% of all exports by 1980, but exceeded the target only a few years later and reached 56% in 1983. In a comprehensive, dynamic perspective it is difficult to demonstrate that an alternative policy would have worked better. Nevertheless, there is evidence that the HCI push produced, at best, mixed results, and that some of Korea's recent success in heavy industry could have been achieved at lesser cost. For example, South Korea's steel industry has been successful because, unlike India and Brazil, it has pursued a competitive industrial policy, not an orthodox version of import substitution strategy. South Korea pursued its secondary ISI strategy, through Heavy and Chemical Industry (HCI) drive, to upgrade its industries and poise them for export market. As Song (1990) indicates, the premature heavy industrialisation programme in South Korea, while a deviation from the norms of structural balance and comparative advantage, was really a response to import dependence on raw material, and intermediate and capital goods [38].

A.4 UNSTABLE GROWTH AND RECESSION, 1978-82

In the Fourth Development Plan, covering the period 1976-81, the government continued to give priority to the development of heavy industries; particularly machine building and chemicals, which were also designed as priority sectors during the preceding plan. During this period, attention also turned to the development of the high level industrial technologies needed in technology- intensive industries. This economic development plan marked a significant advance in the efforts to solve the technological problems of labour-intensive industries in preparation for the sophistication of industry anticipated for the 80s [39]. Under the Fourth Development Plan (1977-1981) the investment in manufacturing reached to $ 10.3 billion which was two-thirds higher than in the previous plan. Within manufacturing, the Fourth Plan allocated two-thirds of investment to HCI, but this was only 3 per cent higher than HCI's share under the Third Plan [40]. Korea's Fourth Development Plan of (1977-81) also projected average annual growth in manufacturing of 14 per cent. Manufacturing was expected to increase its share of GDP from 27 to 40 per cent as agriculture's share declined from 26 to 18 per cent. Overall, HCI was projected to increase

its share of Korean exports from 34 to 50 percent between 1975 and 1981, with machinery and electronics accounting for half of these exports. However, Korea faced an unstable growth rate and recession in the late 1970s. Real exports fell for the first time in 1979, and in 1980 economic growth was negative for the first time since the outbreak of Korean war. GNP dropped by 6.1 per cent. The fifth plan, which came into effect in 1982, was to be devoted to reducing government involvement in the economy and so creating the conditions for high and stable growth rates.

A.5 STRUCTURAL ADJUSTMENT AND LIBERALISATION POLICIES

During this period price stability was emphasized for its positive effects on resource allocation, income distribution, the balance of payments, and for reducing external debt pressure by increasing international competitiveness. Major stabilization policies included restrictive fiscal and monetary policies supported by an informal income policy. Moreover, from the early 1980s, Korean technology development focused on new knowledge intensive industries, including bio-technology, computers, semiconductors, and telecommunications. This suggests that in the early 1970s and 1980s changes occurred in patterns of direct investments from Japan and the United States [41]. In the 1980s, Korean industrialisation reached the point of self development, with the industrialisation of the previous decades of a foundation. A virtually independent capacity for development in light industry and a limited dependence on foreign technology in the heavy and chemical industry were characteristics of Korean industrialisation in the 1980s [42]. According to some analysts, the 1980s were a lost decade for Korean industry with respect to upgrading R&D, modernising plants and equipment, introduction of new technologies, and the development of new product [43].

The goal of economic development in the 1980s was the achievement of the high level industrialisation of an advanced nation. Accordingly, technological development strategies have been adapted to this purpose. In the establishment of a national infrastructure for technological development, the main focus has been placed on developing technologies for knowledge intensive industries, and this course has been pursued strategically with a long-term perspective and in conjunction with the development of the necessary high-level manpower [44]. In the 1980s, the country took another step forward towards the goal of being an advanced industrialised country. In the achievement of this goal, science and

technology played an active part, leading, rather than supporting, economic growth. Considerable support was provided for graduate education, basic as well as applied sciences, and university research in basic science [45]. Over a period of two decades, since it embarked on a strategy of outward-looking development, Korea has been successful in sustaining rapid growth through the promotion of exports. During the 1981-84 period exports of goods increased at an average annual rate of 14 percent, amounting to almost $30 billion in 1984. The share of exports in gross national products (GNP) rose to more than 40 percent by 1984 [46].

In the 1980s, Korea has also pursued a slow, but deliberate liberalisation policies, began with a package of measures aimed at minimizing government controls over credit allocation, and at reducing HCL drive. Support for strategic industries was decreased and reversed. Intervention since 1980 has only focused on the restructuring of distressed industries, support for development of technology, and the promotion of competition. In contrast to the liberalisation experiences in South America, there is little urgency to this effort. Korea's economic policies becomes as much a model for successful liberalisation as its past policies now are successful export promotion [47]. Concern for improving technological capabilities was evident in Korea's Sixth Plan (1987-91), which called for increasing research and development expenditures from 2.0 to 2.5 percent of GNP by 1991 and stressed the development of basic research [48]. It is also evident in the Seventh Plan (1992-1996), which further expands the research and development share of GNP and produce a sharp rise in college and university enrolments.

Korea has intensified its import liberalisation policy in the 1990s, especially regarding agricultural products. Korea's new competitive strategy calls for more active human resources development and higher-quality education. It seems that Korea now faces difficulties in establishing a competitive edge in capital and technology intensive differentiated products. Korea in 1990s is at different stage of development in which sophisticated technologies must be imported to upgrade its industrial structure. It introduces the concept of structural competitiveness to explain the rapid development of South Korean steel industry. Three elements of structural competitiveness are: state autonomy, sound economic policy and indigenous technological capability. These elements have a significant bearing on the bargaining capacity of the state, autonomous investment decisions, labour control, the acquisition and absorption of modern technology, and ultimately international

competitiveness. Global competitiveness of South Korea does not contradict the technological dependence of developing countries. Rather it suggests the kind of socio-institutional and economic policy contexts that are often necessary to foster competitive industries.

In the next 15 years, the republic of Korea's major goal is to make a smooth transition from newly industrialising country to an advanced society. The role of science and technology in a future Korean society may be broadly stated as one of meeting felt needs by technological innovation and scientific advancement and realising long-term national goals for the next century [49]. Duhlman and Westphal (1982) argue that as the Korean experience demonstrates high indigenous levels of all types of technological mastery which has been mainly confined to production engineering has been sufficient [50]. South Korea has demonstrated an impressive capability, especially in heavy industries, in choosing which technologies to import, of adapting foreign technologies to local conditions, of improving on imported technologies and of generating new technologies domestically [51].

A.6 THE SUCCESS FACTORS OF KOREA'S INDUSTRIALISATION

The successful industrialisation of Korea has been called "the Han-River Miracle" a description arising from the high speed of its economic development during the short period of thirty years since the early 1960s. The economic and industrial development of South Korea has been regarded as a spectacular success among less developed countries. The Republic of Korea impressive economic growth record over the past three decades has produced a new orthodoxy interpretation of the secrets of Korean success. The literature on Korean economic development refers to a number of factors, all of which no doubt played an important role in Korea's successful development. Of course, no single factor can account for Korea's success over the last years.

Having surveyed the success factors of Korea's rapid industrialisation, one can point out some internal and external factors. The external factors include massive US aid in the 1950s and easy access to the US market in the 1960s and 1970s. One of the internal factors is the nature of state intervention in South Korea [52]. There are three other elements have been primarily responsible for Korea's success including an outward-looking development strategy, a high level of the education of the people, and a favourable international economic

environment [53]. Haliday (1987) has also indicated three general factors for Korea's success: a special relationship with the U.S, close links with Japan, and a system of state-directed development, or command capitalism. The US economic aid to South Korea reached to almost $6 billion between 1945 and 1978, almost as much as the total aid provided to all African countries during the same period [54]. Lie (1992) identifies four major factors as an adequate explanation of Korean " miracles". These factors are cheap labour, land reform and the consequent changes in the class structure, the developmentalist state, and the international political economic environment. All four were necessary causes of Korean industrialisation and economic growth [55]. As one can see in the Lie's point view, the chief comparative advantage of Korea in the world economy was its cheap labour. One can also say that the secret of Korea's success lay in the combination of long working hours, cheap labour, and the organisation of this cheap labour force into highly efficient system of production [56].

Among the most important factors of Korea's spectacular success, it seems that Confucianism has been one of the most important one. Koreans work hard because of the Confucian ethics, resulting in their economic success [57]. In Korea, where Confucianism was accepted in a more extreme form than in China, this social norm has been an underlying strength in terms of acquiring learning from imported technology and in the development of its own indigenous capability. Recalling Max Weber's thesis of the contribution made by the Protestant work ethic to the rise of capitalism, social scientists are willing to find a parallel work ethic in the case of Korea [58]. Confucianism also stresses learning, and the literacy rate of Koreans is high. The female literacy rate in 1986 was 90 per cent, while the rate of high school attendance in 1988 was 93.5 per cent [59]. Among the countries surveyed by the International Labour Office, South Korean workers had the longest working hours in the world, averaging 54.0 hours per week in 1987 [60]. However, Confucianism is a facilitating factor but not the major contributor to Korea's success. Confucianism has been with Korea for hundreds of years, and, in fact, it has been considered an obstacle to modernizing the Korean economy because it tends to look down on business, people engaged in commerce in general, and specialists such as people engaged in manufacturing. As a matter of fact, Weber and others have used Confucianism to explain China's economic backwardness.

Another important factor in progress of Korea is said to be the loyalty and dedication of its

people to their work, and persistence with which development programs have been carried out. Korea has also shown to the developing countries that borrowing of technology from advanced countries can be a way towards development. As Enos and Park (1987) believe, in Korea, local effort has been the most significant factor in its success in acquiring technology. It appeared that the Koreans' technical sophistication and commitment to industrial development allowed them to extract better conditions, ensuring a swifter and more effective transfer of technology than that obtained by other developing countries [61]. The strong link between export growth and productivity performance is another important point in Korea's success. Both in Japan and Korea, those sectors with the highest rate of productivity growth have also known the highest rate of export growth. This does suggest that export-oriented policies of both countries have been an important ingredient in their successful catch up in productivity with industrial countries [62]. Korean experience, unlike the Japanese, shows that sectors with high levels of protection have experienced the highest rates of productivity growth. These results seem related to the particular Korean policy, where a number of temporarily protected sectors, such as machinery and transport equipment, and electrical machinery, were supported through an infant industry policy, aimed at achieving productivity growth and competitiveness in the long term. It appears that this policy has worked rather well for Korea.

Another factor of South Korean success, as Amsden (1989) noticed, is the existence of professional managers and salaried engineers. Both state and corporate bureaucrats require personnel to exploit the borrowed technology and make appropriate decisions. Amsden writes: "The hypothesis is that leading firms in late industrialising countries, if they are to penetrate world markets, must adopt usually pro-active production and operations management policies" [63]. She also refer to the massive increase in the number of engineers and technicians which increased tenfold between 1960 and 1980. Another outstanding features of Korea's development is the dominant role of large companies (Chaebol) in the economy. The relationship between the government and business was similar to that of principal and agent. The government formulated economic plans, and business was induced through a carrot-and-stick approach to carry them out and to meet the quantitative targets set by the government [64]. In the late 1980s, Hyundai, Samsung, Lucky-Goldstar, and Daewoo, the top four chaebol, were regulars in fortune's list of the 500 leading industrial groups outside the United States [65]. Samsung, Korea's top chaebol, was listed by Fortune

as the twentieth largest non-U.S. international company in 1987, which produced more than three thousand different products. It owns Korea's largest semiconductor company, its largest electronics firm, its largest semiconductor and trading company. Hyundai, the second-largest conglomerate, has forty-five subsidiaries, Korea's biggest automaker, its biggest shipbuilder, and its leading civil engineering firm. Daewoo, the fourth largest conglomerate, made up of thirty companies is in mineral extraction, civil engineering, textiles, chemicals, trading, consumer electronics, hotels, securities trading, machinery, automobiles, semiconductors, computers, and defence industries.

Robert Wade (1992) pointed out four indicators for S. Korea's success . Firstly, the gain in its relative economic command over world resources measured by the increase in per capita income expressed in U.S dollars. Secondly, he refers to rapid transition from import substitution policy to export promotion policy in the early 1960s as another most important factor of Korea's success. For example, Korea's rank as an exporter of manufactured products to the U.S. increased from the 40th exporter of manufactures to the U.S in 1962 to the fifth biggest exporter in 1986. The third indicator of Korea's success as wade added is industrial transformation.This refers to the rise of skill-intensive, high-value-added industries that are competitive at world market standards of cost and product specifications, having a sizable impact on the world economy. For instance, Korea has recently been the world's third biggest producer, after Japan and U.S of advanced semiconductor memory chips.

The final indicator is the removal of poverty, the elimination of severe economic hardship, the expansion of positive rights. The Korean experience would confirm, Wade added, that much of the improvement in productivity commonly described as the result of "learning by doing" is the result of efforts to get more knowledge of production materials and of the ways they may be combined to permit machines to ran faster speeds, for example, efforts that are not (formal) R and D intensive but that are certainly production engineering intensive [66].

Koo (1994) summarised the success factors of Korea in the following characteristics:

- a sustained, exceptionally high rate of growth;
- a structural transformation of the economy, in terms of both output and employment;

- with a substantial decline in agriculture and a rise in manufacturing; and
- the growing importance of trade as a result of outward-looking, export-oriented growth policies [67].

Having surveyed the success factors of Korea's success in rapid economic and industrial development by many authors, it is essential to focus on the some of the most important factors of Korea's success, that is, the role of state, the importance of technology transfer, export promotion strategy and the role of human resource development.

A.6.1 The Role of State in the Korea's Industrialisation

The most important ultimate cause of Korea's success has probably been government policy. As most studies have considered Korean rapid development not just as the result of market forces, but primarily as the result of strong government policy directed through the market. It is believed that the republic of Korea has been one of the most highly interventionist economies in the developing world, and the content of its export orientation has been strongly influenced by the nature of its interventions [68]. Many researchers and writers have emphasised the positive role of the South Korean government in its rapid industrialisation. As Amsden (1989) has argued, state is the most important factor of Korean industrialisation. South Korea must be seen as a late industrialiser which the state has been the only organisation capable of raising the necessary capital to initiate industrialisation based on borrowed technology. In short, the state has been the key to late industrialisation. In Amsden's view, the Korean state is interventionist. She writes: "In Korea, instead of the market mechanism allocating resources and guiding private entrepreneurship, the government made most of the pivotal investment decisions. Amsden claims that " the government was merely a banker, ... but an entrepreneur, using the subsidy to decide what, when and how much to produce". Amsden also sees the drive for economic development on the part of the South Korean government as a product of nationalism and a concern to legitimate its authoritarianism and militarism [69].

In South Korea, the state has gone much further than supporting industry with simple subsidies, or what Amsden refers to as deliberately getting relative prices wrong. Where it has sought to induce new sectors or restructure existing ones, state agencies have identified foreign technologies and expertise that have been introduced to support domestic

developments. It is believed that Korean state's role, apart from the promotion of shipbuilding and steel industry has been to create a modern infrastructure, to provide a stable incentive system, and to ensure that government bureaucracy will help rather than hinder exports [70]. The state in Korea has intervened in the various aspects, particularly in the scientific and technological development. The government has taken various steps to develop indigenous technological capability. It is believed that the South Korean government policies helped Korean firms obtain technologies which they would not have obtained, mainly because of multinational firms' unwillingness to transfer important technologies and the excessive competition among local firms. It is also observed that the Korea's successful absorption of foreign technology has to a large extent been due to the interventionist role of the state in the acquisition and development of technology [71]. The state policies has also employed in order to shape pattern of technology transfer through foreign direct investment and technology licensing. Of these two, technology licensing arrangements have played the dominant role in Korean technology transfer policy strategies.

The government has also played an important role in accelerating the speed of transition from import substitution to Korea's export-led industrialisation [72]. Moreover, the dominance of industrial policy with view to industrial upgrading has been the most distinctive feature of Korean state intervention. The state has also promoted the overseas training of Korean managers and engineers, and it has encouraged the use of technical assistance from overseas, particularly in the form of independent consultants. The state has also been closely involved in negotiations to acquire technology licenses. As Choi (1994) indicated, Korea has grown fast because its governmental policies were "market friendly" or "market conforming". He refer to three aspects of Korean government policies as being "market friendly": the relatively small degree of price distortions, the government policies in promoting exports, and little support of government of those industries which were found to be unsuccessful in the world market [73].

Having compared the industrial development experience in Korea and Japan, one can see several similarities in the government role in the success of these two countries. State intervention of both countries extended deeply into economic affairs such as planning sectoral development, mobilising capital, and controlling the corporate investment pattern [74]. However, in Korea, government management in the 1980s has become so widespread that the government is held responsible for everything that happens, good or bad. The linear

drive for development led by government, which characterised Korea for over 25 years, seemed suddenly to come apart, and government was blamed by all sides [75].

A.6.2 The Role of Human Resource Development in Korea's Industrialisation

One of the other important factor of success of Korea's industrialisation is its large investment in human resource development. A large part of Korea's success in acquiring, diffusing, improving and developing technology in the mature stage is due to its heavy investment in human resources [76]. It is also believed that the formation of trained and skilled labour force has been one of the outstanding facts about Korean technological development. Skilled workers, along with scientists, engineers and technicians have played a vital role in accelerating Korea's assimilation of imported technology and also development of its technological capability.

Korea has spent a huge investment in human resources during its rapid economic and industrial development. The amount of total expenditure, both public and private, on education has regularly exceeded ten percentage of GNP, the highest level among all developing countries. The share of education in the total government budget, for instance, rose from 2.5 per cent in 1951 to over 22 per cent in the 1980. Government expenditure, however, accounted for only one-third of total expenditure in education, the remainder being paid by the private sector and families, reflecting the high respect for education held by Korean society. The percentage of high school graduates advancing to colleges or universities in Korea has been the second highest in the world after United States in 1990 [77]. It is argued that the major contribution of education has mostly been in its interaction with other sources of growth in particular with technology acquisition [78].

As a result of Korea's large investment in its human resources, in comparative terms, Korea had the highest number of secondary students in the late 1970s as a percentage of the total post-secondary age population; the highest number of scientists and engineers per million people; and the highest number of scientists and engineers in R&D per million people. In the 1980s, the great focus in human resource development has been on higher education. Enrolment ratios in higher education increased over 70 percent in six years between 1980 and 1986. As a result, the number of scientists and engineers in Korea has more than doubled since 1980 [79]. Total expenditures for education amounted to 13.3 per cent of

GNP in 1984, including both private (6.9 per cent) and public (6.4 percent) spending. This is much larger than the Japanese figure of 5.7 per cent in 1982, the American figure of 6.7 per cent in 1981, and the Singapore figure of 4.4 percent [80]. Moreover, Korea 's adult literacy rate (93.7 per cent) which has almost been as high as Japan (99.7 per cent) for 1985 and more than twice as high as India (43.5 per cent) is one of the most important element in assimilating foreign technologies [81].

The flow of scientists has also played a key role in technology transfer. The setting up of the Korea Institute of Science and Technology represented the first attempt to bring some of the science graduates back to Korea. The number of overseas- trained Korean scientists and engineers is still relatively small, though the number increased sharply in the 1980s. Compared with the more than 50,000 scientists and engineers in Korea, there are between 5000 and 7000 members of the Korean scientists and engineers in the United States, and an estimated 3000 in similar organisations in Europe and Japan. The numbers of Korean graduates returning is increasing, though many want to return to the universities rather than to industry, and the balance of skills is not always ideal, with the social sciences being the largest decline in 1985. In the electronics area, Goldstar had 50 employees with overseas doctorates working for it in 1989, compared with 38 for Samsung and 18 for Hyundai [82]. While Korea's pool of engineers and scientists is proportionally larger than that of most developing countries, it is rather small in comparison with that of Japan and United States, who are Korea's main competitors in high technology. For every 10,000 people in the Japanese labour force, there are 240 engineers. In the United States, the proportion is 160 per 10,000. But in Korea, there are only 32 per 10,000 workers [83].

Overall, it can be said that human resource development, foreign technology imports, capital formation and indigenous R&D efforts are four major inputs to the promotion of technological capability. First, human resource development through education may be a most basic and crucial form of input, as technological capability is embodied in people. Second, capital formation, particularly in the form of imported capital equipment, is another important input, as it embodies both technology and technical knowledge that structure the activities involved in carrying out the conversion of inputs to outputs. Third, technology transfer from developed countries includes not only technical information but also training at both supplier's and recipient's sites, contributing to the acquisition of technological capability. Finally, technological capability may be acquired through and lead to indigenous

R&D efforts. Therefore, it was Korea's heavy investment in human resource development that made it possible to acquire technological capability rapidly and, in turn, to achieve rapid industrialisation during the mature stage. Korea invested heavily in human resources development even well before launching its industrialisation program.

A.6.3 The Importance of Technology Transfer in Korea's industrialisation

Technology transfer is of great importance to South Korea and the importing foreign technology has played a significant role from early stage of its industrialisation. Since 1962, the Korean government has offered several incentives to foreign investors and technology owners, realising that the acquisition of the advanced technical and scientific knowledge and skills of industrialised nations is vital to the rapid growth of the Korean economy. Korea has imported 1,467 items technologies between 1962 and 1979. This is, however, only one-tenth of Japan's for the period. Further, according to statistics compiled by the Federation of Korean Industries (FKI), 22% of the imported technologies were out of date and 51.4% of the companies are not sufficiently capable of absorbing and adapting new technologies [84]. These statistics point to the fact that the effort and investment directed towards research and development for adaptation of technology had been much less than satisfactory [85].

According to study by the Korean Development Institute, technology contributed to about 6 per cent of economic growth during the period 1966-76, a relatively low rate compared with those figures for some developed countries such as Japan and U.S. with 22 percent and 28 percent respectively for the period between 1963 to 1982. However, one should note that, during this period, the Korean economy was dominated by light, labour- intensive industries such as textiles, electronic parts and construction. It was, however, anticipated in the study that the contribution of technology would rise to an average value of about 13 percent from the late 1970s to the 1990s due to structural change in from labour intensive to technology intensive heavy and chemical industries [86]. Another statistic indicates that between 1962 and 1984, there were 3,073 technology import agreements made between Korean industries and foreign technology owners including U.S. $ 1,043 million in royalty payments. Korea is evaluated as having a most favourable environment to receive foreign advanced technology [87]. For technology outputs, the number of foreign patent applications in Korea was about 3000 in 1976 and increased to 20,000 in 1988. Due to the poor performance of patent activities, Korea is heavily dependent upon foreign technologies,

so that the technology balance of payments in 1988 shows that technology imports were 100 times as great as technology exports.

Having regulated the acquisition of foreign technology and reviewed foreign technology agreements, some special policies have been adopted by the Korean authorities. The Technology Development Promotion Law, which provided for various incentives and fiscal and other concessions, was legislated in 1967 and revised in 1972 for the promotion of indigenous technology and adaptation of foreign technology and innovations. A Technology Transfer Centre was also established to assist in the examination and review of foreign technology agreements to provide technological information to local industry. By the mid-1970s, the policy toward foreign technology was primarily aimed at improving the bargaining position of local companies in Joint ventures and licensing agreements. Since the foreign capital inducement Law was enacted in 1962, there have been 5,443 cases of technology transfer approval, which entailed royalty payments of about $ 2.9 billion by the end of 1988. As industries develop, the demand for technology increases at a faster pace, and the technology so imported to satisfy such demand increases dramatically.

Korea imported most of its necessary technologies from Japan which has the closest geographical, cultural and educational proximity with Korea. Despite some differences in management styles such as Japanese groupism and bottom-up decision making versus Korean individualistic dynamism and top-down decision-making, Koreans have successfully adapted to the Japanese systems in their own way. The top-down decision making system was probably necessary for Korea to catch up with the Advanced technologies in a short period of time in a less expensive manner. Through economic expansion, Korea has heavily invested to strengthen its institutional capability to absorb foreign technologies. It is interesting to note that although 53 per cent of technology imports are from Japan compared with 25 per cent from the United States, the royalties paid to the latter are much larger than those paid to the former. This suggests that the technology imported from the United States is of higher level and more expensive than that from Japan. Korean technology transfer has been accelerated since the government has adopted an automatic technology inducing approval system for all industries in 1980. Furthermore, the approval system was changed to a report system in 1984 to make technology transfer much easier and more efficient [88].

An important feature of foreign technology transfer to Korea has been the relatively low

local content in several industrial sectors. The emphasis on export-oriented production often led to the acceptance of a high production of imported inputs for intermediate product. In 1990, 22.4 percent of goods manufactured in Korea were based on foreign technology, compared to 6.2 percent in Japan, and 1.6 percent in the U.S . Also of Korea's total exports in 1990, 55% were based on foreign technology. [89]. As Amsden (1990) also refer to the high dependency of Korea on imported technology in most industrial sectors except textiles. She believed that Korean managers could never hope to manage in a tight, Taylorist top-down fashion, at least not initially, because no one at the top knew enough about the process (of production) to do so. Under these conditions, it was imperative to rely upon motivated workers, even if they possessed little more than formal schooling, to exercise the most fundamental skill of all, intelligence [90]. She also argued that the key to late industrialisation has been the ability to learn from the experience of foreign companies and adapt their technologies and expertise for one's own productive purpose.

It is however theorised that the development miracle of South Korea is the result of reductions in technology adoption barriers in that country. Korea was able to acquire most of its technology with relative ease. Unlike Japan, much of its growth originated in traditional sectors of the economy, where production techniques were widely available [91]. In these sectors, the still low-skilled Korean workers were able to absorb the technology with relative ease and to make small improvements and adjustments of the technology. The main type of technology in the republic of Korea initially consists of simple processing and assembling technologies. One of the most serious problems in the field of S&T is the inferiority and insufficiency of the basic technology necessary for system design and the production of parts and materials [92]. Over the period 1976-88, Korea's technology capability showed fast improvement, the overall level rose about 1.8 times as high as in 1976. It is most impressive that Korea caught up very quickly in technology inputs. Korea's technology-inputs capability passed Italy around 1985 and even Canada's around 1988. However, there is a large gap between technology-inputs in the process of fast industrialisation. It may take a long time to build an efficient innovation system, particularly starting from almost none. As in their study of Korea, Enos and Park (1987) have identified seven stages for Korea's technology transfer, including Planning, negotiations between suppliers of the technology and recipients, plant and equipment design, procurement and construction, installation and start-up, production and innovation, and finally subsequent

innovation [93].

Another study indicated three phases which mostly chosen by Korean firms for technology acquisition, including implementation, assimilation and improvement of technology. In the first phase, the implementation of production is based on assembly of foreign components and parts. The assimilation phase is accompanied by diffusion of technical expertise to other firms in the industry while, in the final phase, the gradual improvement of foreign technology is associated with both product improvement and cost reduction. There were also generally two basic approaches used by the Korean government to speed up technology transfer in Korea. The first approach was to localise foreign products based on technology new to Korea. This involved reverse engineering, the employment of Koreans trained overseas in foreign companies, and other methods. A second approach by the Korean government was to restrict the access to certain sectors. In sectors chosen for domestic localisation, imports of the finished product were prohibited or severely restricted, and only local or joint-venture companies were allowed to enter [94]. Korea's experience on technology transfer shows that it had very restrictive policies toward formal mechanism of technology transfer (i.e. DFI and FL) but relied more on informal mechanisms (i.e. through the importation of capital goods and turnkey agreement) in early years of its industrialisation. However, Korea has also used some other methods for transferring foreign technology such as reverse engineering which is only possible when a country has highly trained human resources and entrepreneurship that enable it to assimilate and adapt foreign technologies embodied in physical items or technical information available in literature. As Westphal and Dahlman (1981), in analysis of the methods of technology transfer by Korean firms, found that through the process of export expansion, local Korean firms acquired substantial amounts of intangible technology and know-how by informal channels, such as exchanges with marketing agents from the advanced nations who have constant contact with product [95].

As discussed earlier, Direct Foreign Investment (DFI) has been a very limited source of technology for Korea [96]. During the 1960s, there were not much foreign investment in Korea, primarily due to questions about Korea's political instability and economic uncertainty. Moreover, in addition to relatively political and economic instability in the early years of its industrialisation, one can also refer to some other reasons for little role of FDI in Korea. This included Korean's suspicions about the real motives behind FDI, and also the fact that the promotion of labour-intensive light manufacturing industries in the early stage

of economic development required less sophisticated technology, management, or marketing skills [97]. However, After 1960, regulations were slowly liberalised and the normalisation of relations with Japan in 1965 was of especial importance in this respect. In the 1970s, joint ventures received higher priority than wholly owned subsidiaries. Due to a Korea's open policy for DFI in 1980s, Korea has received an increasing amount of DFI, which Japan accounts for over 68 percent in the number of cases and 55 percent of the value, followed by the U.S. In 1987, the Foreign Investment Law was changed to remove most of the restrictions closing off certain sectors to foreign direct investment, and limiting the amount of investment allowed. As a result, the share of manufacturing industries open to foreign direct investment increased to 95.2 percent [98].

According to a report published by Korean Economic Planning Board in 1993, between 1962 and the end of January 1993 there were 2,258 direct investments from Japan, amounting to a total of approximately $ 2.9 billion. Direct investments from Japan and the United States together account for 80% of all foreign direct investment. These patterns clearly show that Japan and the United States are the two major investors in Korean manufacturing industries. Foreign investment from both countries are concentrated in high-technology industries, with this pattern slightly stronger for the United States. However, it is argued that Korean policy makers preferred foreign loans to foreign direct investment. As a result, the share of foreign direct investment in total foreign capital inflow (except foreign aid) between 1962-83 was a mere 5% [99]. Even when foreign direct investment was allowed, foreign majority ownership was practically banned, with some rare exceptions, outside the Free Trade Zones. The fact that only 6% of MNCs in Korea are wholly-owned subsidiaries, compared to 50% in Mexico and 60% in Brazil, suggests a substantial degree of state control over foreign direct investment in relations to ownership [100]. Another example shows that FDI's contribution to the growth of GNP in Korea in the 1972-1980 period amounted only to 1.3 percent, while its contribution to total and manufacturing value added was only 1.1 percent and 4.8 percent, respectively, in 1971, and 4.5 percent and 14.2 percent, respectively, in 1980 [101]. However, FDI has been a particularly important vehicle for technological development in the establishment of much of the chemicals sector and, more recently, of major elements of the electrical and non-electrical machinery sectors. FDI has also contributed to technological development in the basic metals sector, but there is no foreign equity in the integrated steel mill [102].

As it is mentioned earlier, much of the foreign technology has been transferred to Korea through importing capital goods. Such a policy to maintain its independence from foreign multinationals has been relatively effective in acquiring technological capability, since Korea's well-trained human resources and their entrepreneurial spirit enabled the country to learn quickly from foreign capital goods [103]. During the period between 1962-1986, transferring technology by the capital goods imports was 21 times that of other means of technology transfer in terms of the value. Another example shows that imports of capital goods were more than 20 percent of the value of investment in South Korea throughout the 1970s. The imports of capital goods in Korea has also been accounted for 30 to 35 percent total imports over last two decades, reflecting the continuous diffusions of foreign technologies [104]. Therefore, one can say that in Korea, the transfer of technology has been heavily biased towards the importation of technology embodied in machinery and equipment. For most of major industries such as textiles, chemicals, shipbuilding, automobiles, electronics, heavy machinery, and iron and steel, technology was transferred through purchase of equipment. This embodied form of technology transfer was supplemented by the acquisition of design, joint ventures, licensing and the hiring of foreign experts. No systematic approach to technological capability development is evident. Different enterprises have followed different strategies. For example, in shipbuilding, designs are supplied by clients who purchase them overseas; in the electronics industry, licensing is widely practised. In the automobile industry, one enterprise (Daewoo) went into a joint venture with general motors, while another (Hyundai) produced Fords under licence. More recently, Hyundai has gone back to a joint venture with Mitsubishi for body design technology [105]. However, there were some heavy restrictions in use of technological licensing in some industries where local technological capability is consider to be advancing. It is also argued that the choice of production technology has depended more on market and export demand than long term technology policies [106].

According to survey of 112 exporting firms in 1976 which show that of total technology which was acquired from foreign sources by these firms, 20 percent was from foreign suppliers or buyers, 16 percent through foreign licences and technical assistant agreements and 13 percent from employees who had somehow gained experience abroad [107]. In addition to the methods of technology transfer which discussed earlier, there were some other pattern of technological development in Korea such as the so called imitator pattern.

In this method, local firms started with small and rather primitive technologies developed by themselves and gradually upgraded both processes and products through operating experience and using technical information and ideas that came from observing foreign technology. It appeared that many small scale capital goods producers initiated new product lines by imitating foreign equipment by copying imported models and using information from sales catalogues or from visits to foreign manufactures [108].

In sum, the Korea's experience of technology transfer indicates that developing countries can obtain most of important know-how and technical knowledge through some informal mechanisms such as reverse engineering free of charge. However, this is to large extent relied on technological capability of these countries. Moreover, Korean experience shows that high indigenous levels of all types of technological mastery are not necessary for the initial stage of industrial development. In the Korean case, a mastery that has been mainly confined to production engineering has been sufficient. The Korean example also suggests that by relying on foreign sources of technology, it is possible to choose a technology without having first mastered its use. [109] What is unique about the South Korean experience is not the importance of indigenous effort to assimilate technology. What is unique about the South Korean experience is the speed and effectiveness of acquisition and interplay between technological development and trade in the elements of technology.

A.6.4 The Role of Export Promotion Policy in Korea's Industrialisation

The Export Promotion Industrialisation (EPI) policy is believed to be a major factor of success for East Asian Newly Industrialised Countries (NICs) in general and Korea in particular. Korea wisely chose an outward-looking (EPI) strategy, that is, providing incentives for export activities in the early 1960s. Korea chose this strategy at a time when it was not universally recognised that world trade was growing fast and when inward-looking strategies, prescribed by economic development theories of the 1950s and 1960s, were still popular among most developing nations. It is important, however, to identify the Korea's success in diversifying manufactured goods for exports was another factor for the success [110].

It is believed that the phenomenal growth of the economy in Korea started with the transition from an inward-looking, or Import Substituting Industrialisation (ISI), strategy

to an outward-looking, or an Export Promotion Industrialisation (EPI) strategy. The turning point in this transition was a series of policy reforms around 1965, whose most important ingredients included the introduction of a unified, realistic exchange rate regime, trade liberalisation involving cuts in tariffs and the elimination of most quantitative restrictions, and a substantial increase in real interest rates. These policies are regarded as having radically improved the performance of the economy for the following reasons: Firstly, realistic exchange rates, by making export activities as profitable as they should be, allowed Korea to follow her comparative advantage in labour-intensive industries, and therefore to obtain the gains from foreign trade. Secondly, trade liberalisation improved the efficiency of the economy by putting competitive pressures on domestic producers. Finally, the rise in interest rates enabled the economy to invest more by mobilising more savings, on the one hand, and to use capital more efficiently by fixing the relative price of capital to near its realistic level on the other [111].

Since the adoption of export-promotion strategy in 1961, Korea has enabled to make efficient use of its resources in line with its comparative advantages. Through this strategy, Korea fully exploited economies of scale and took maximum advantage of a continuous inflow of foreign technology and know-how. As a result of (EPI) in Korea, the share of export in GDP increased from 10 percent in 1965-66 to over 45 percent by late 1980s [112]. By adopting an export-led growth strategy, Korea has succeeded in exploiting its comparative advantage and overcoming the constraint imposed by the size of its domestic market. The rapid growth of Korean exports and imports over the last decades has generated sizeable benefits for both Korea and its trading partners [113]. In Korea, the outward-looking orientation (EPI) has also played a central role in country's industrial takeoff, and is widely cited as a model for other developing countries. The success of Korea's (EPI) has often been ascribed to its "modestly pro-export" bias [114]. Neoclassical writers usually attribute the success of Korea's industrialisation to the adoption, in the early 1960s, of a neutral, hands-off, outward-looking (EPI) policy. Export activity has proved to be a very important means of acquiring technological mastery. As a result of exporting, Korean firms have enjoyed virtually costless access to a tremendous range of information, diffused to them in various ways by the buyers of their exports. Exports thus appears to have offered a direct means of improving productivity, in addition to the indirect stimulus derived from trying to maintain and increase penetration in overseas markets. It is argued

that the strong export-orientation of the Korean economy facilitated the rapid acquisition of technological capability at least in two ways:

1. As producers entered the international market, the keen international competition forced them to invest more in technological efforts.
2. Informal technical assistance offered by foreign buyers to ensure that Korea-made products met their technical specifications provided invaluable help to Korean firms in acquiring the necessary technological capability.

In other words, Korea's outward-looking policy appears to have been another important mechanism affecting the demand side of foreign technology transfer. Export promotion continually places pressure on firms to acquire foreign technology and to use it effectively in order to be able to compete in foreign markets. On the other hand, there is a growing body of empirical evidence that adoption of an export-oriented strategy leads to rapid technological development of labour-intensive industries. It is argued that the process of exporting leads firms to acquire new skills by workers. Hence pursuing an outward-oriented (EPI) strategy can be viewed as a general incentive that accelerates the accumulation of human capital and technology [115].

The adoption of export promotion policy in Korea was in the expectation that it would accelerate growth by relaxing the foreign exchange constraint and increase efficiency through resource allocation in line with comparative advantage. Therefore, since the adoption of export promotion strategy , exports have led the country's economic growth. Export expansion promotes growth because it is associated with outward looking or export-oriented policies that generate learning effects, encourage skill acquisition, and create the closer ties with more advanced economies that are needed to master up-to-date technology [116]. Exports also led to the establishment of new industries and promoted the acquisition of technological capability in existing industries. Exports were concentrated in industries in which South Korea either already had or could easily acquire the needed technological capability. It was in the late 1960s, however, that export activity became important in establishing new industries in which South Korea did not already have technological capability. The export-oriented industrialisation strategy adopted by Korea started with the labour-intensive light industries and was extended into the capital and technology-intensive heavy and chemical industries [117].

The EPI strategy in Korea largely operated on the accumulation of production capability until the mid-1970s. It was also during the mid-1970s that the government began to give serious priority to technological development, and export activity likewise became an internal part of its efforts to promote the acquisition of technological capability more generally. Following the Heavy and Chemical Industry drive of mid-1970s, the Korean manufacturing exports were mostly dominated by heavy industrial products. However, an increase in Korean exports in 1980s was most visible in such products as various kinds of consumer electronics, semi-conductors, other computer related products, telecommunications equipment and passenger cars. One can also say that the increasing of Korean manufactured exports were mainly the products of heavy and chemical industrial policy drive which had implemented a decade earlier.

It is argued that Korea was able to adopt (EPI) strategy more readily and more successfully than, for example, the Latin American countries for two reasons. Firstly, Korea's comparative advantage in the initial stage of development more clearly lay in labour-intensive manufacturing industries than in most other developing countries. Secondly, an export-led growth strategy enabled the country to exploit its comparative advantage. The strategy also made it possible for Korea to employ completely the abundant factor (i.e., labour) and to remove the constraints posed by the shortage of other factors (i.e., natural resources) [118]. Korea has successfully exported its technologies to other less developed countries in particular those in Southeast Asia and the Middle East since the late 1970s. This has helped Korea to accelerate the adjustment of its industrial structure to the more advanced level. As a matter of fact, Korea has been transferring self-developed technologies particularly in the areas of pulp, paper manufacturing, electricity, electronics and machinery as Korean technologies are considered to be more fitted to less developed countries than those of developed countries in terms of cost and factor intensity [119]. Korean technologies are said to be more appropriate than those of the United States and Japan in meeting the needs and conditions of other Asian developing countries, particularly those of labour surplus countries. This is because Korean technologies are considered to be more labour-intensive and of smaller operational scale than those of United States and Japan. Korea's experience in technology acquisition and assimilation will also be learnt by many Asian Developing Countries.

In sum, under Korea's strategy of export-led industrialisation, export activity has been important in exploiting static comparative advantage, export activity made it possible to start new industries much earlier than they could otherwise have been established without offering economies of scale. In turn, for all industries and for a long time after their inception, export activity added to technological capability, reflected in a wide variety of more technological change [120]. One can also say that Korea's spectacular export performance led to increasing confidence in the government's ability to initiate and direct national development strategy. Particularly, the take-off period demonstrated that a favourable macroeconomics framework, combined with aggressive export-promoting intervention could lead to rapid growth [121]. Despite of the fact that EPI strategy has been a very important method of rapid industrial development, but it should also be noted that in the very highly competitive international market environment and many strong competitors, this strategy is sometimes seemed to be a high-risk strategy.

A.6.5 The Role of R&D

As it is explained earlier in the role of human resource development policies in Korea's success, the Korean government continued its industrial restructuring policy with active R&D and human resource development (HRD) programmes, given that without such programmes it is impossible to move up the technology ladder and upgrade industrial activities. As the survey by OECD notes that Korea has moved very fast in increasing its share of R&D expenditure as a percentage of GNP, which reached 2.12 in 1989, which has been the highest ratio among the East Asian Newly Industrialised Countries (NICs). Korea has also made significant progress in expanding engineering education and the government played a very important part in increasing R&D activity [122]. The Korean government has also supported institutional R&D through a number of government assisted organisation in order to promote country's indigenous technological development. Among the largest are the Korean Institute of Science and Technology (KIST) and the Korean Advanced Institute of Science and Technology (KAIST). The establishment of Korea Institute of Science and Technology (KIST) in 1966, and its growth over the last decade or so, has marked a major turning point in the formation of Korea's research and development system. Generally, the shortcomings of research and development activities in developing countries seem from the small scale of their research agencies. Before the establishment of (KIST), most research activities in Korea were carried out in a incomplete way by public or government research

agencies operating on a small scale [123].

The remarkable increase in R&D expenditures has been mainly due to the sharp increase in the contributions of the private sector. The Korean government made serious efforts to encourage private investment, first by offering tax incentives. Though tax incentives for R&D activities had been offered in the 1970s, they were not sufficient to induce enough private R&D investment. In the 1980s some new incentives were added and existing ones were strengthened. There were also long-term, low-interest loans have been made available to those enterprises seeking to utilise in R&D for their newly developed technologies . As a result of these incentives, the share of the private sector in total R&D expenditure increased from 48 per cent in 1980 to 70 per cent in 1984, although the actual performance by industry is somewhat lower than these figures. The different arises from the fact that industry gives R&D to government-sponsored research institutes and universities [124]. Moreover, the number of research institutes in business firms increased from 72 in 1982 to about 1200 in 1991, and private investment in R&D activities increased from about 297 million dollars in 1982 to about 3044 million dollars in 1990. During this period the national innovation system was built up, triggered by the governments science and technology policy [125]. One can also note that in 1983, there were 114 independent institutions responsible for 29 per cent of R&D, 216 universities and colleges were responsible for 10 per cent of R&D, and 723 companies accounted for 60 per cent of R&D expenditures [126]. Most Korean firms, of all size, are rushing to form R&D organizations, partly because the government offers them tax incentives. By 1991, there were over 1000 private research institutes in Korea and the rate of investment in R&D is mushrooming rapidly [127].

In 1992, the Korean government launched an ambitious national R&D program, the HAN project in order to increase the competitiveness of domestic industries by increasing the indigenous science and technology capability. The sluggish domestic economy since 1989 and growing protectionism against international technology transfer is considered to be the main motivation of Korean government to formulate the HAN project. The total investment for the project has been estimated to be about $ 4.6 billion for the next decades of total investment, the public and private sectors have also been expected to make 56% and 44% respectively. It is hoped that the dependency of Korea's industry on foreign technology will be substantially reduced with the successful implementation of this program.

Although the large investment of Korean government in R&D activities, however the total resources devoted to R&D in Korea are small compared to those in some developed countries. In 1990, Korea spent only $ 4.7 billion while Japan spent $ 83.5 billion and the US spent $ 145.5 billion, France spent $ 22.5 billion, and the U.K spent $ 18.9 billion. Korea's total R&D expenditure of $ 4.7 billion may not be enough to insure the increase of innovation. Furthermore, the total number of researchers in R&D subsystem and the number of engineers of high quality in the Engineering & Production subsystem may not be sufficient to produce successful technological innovations. For example, the shortage rate of engineers reached 12.6 percent in 1989 [128]. It is also believed that in terms of both government and private R&D, the 1980s were a lost decade for Korean industry from the point of view modernising plants, equipment and technology. There were also some trials and errors through the science and technology policy in the past national R&D programs [129]. Researchers in the R&D subsystems have little experience in the customer market. Because they lack knowledge about the marketing concept and marketing research, those in Engineering & Production cannot provide information on customers' continuously changing needs to the R &D subsystems [130].

In Korea, R&D funding was divided among universities, government-funded institutes, and firms. Although universities employ 79 percent of the Ph.D-level researchers, they received only 6.8 percent of the R&D funds. Government-funded institutes employing 15 percent of the Ph.D-level researchers spent 22.1 percent, and firms, with only six percent of the Ph.D-level researchers, spent 71.1 percent. Therefore, without the development of a viable R&D infrastructure and an industrial structure that encourages technological innovation, Korea's objective to become competitive in high technology products, is likely to be unsuccessful. Capital, efficient assembly, cheap labour, and hard work, the old ingredients of success are no longer enough. It can be said that, in many High-Tech areas, Korea's technology in assembly work is not too far behind that of advanced countries. Korea, however, is more than ten years behind in the area of research and development. The government has formulated a long-range plan known as "Science and Technology Toward the 2000s". The major thrusts and direction of the plan are to strengthen Korea's R&D capability, to localise innovative technologies and to specialise in certain areas such as informatics, chemicals, precision machinery, bio-technology and new materials where the country can establish comparative advantage by the year 2000. According to the plan, R&D

investment will be boosted from 2.3 per cent in 1988 to 5 per cent of GNP, and the ratio of R&D personnel increased from 13 persons per 10,000 population to 30 persons.

A.7 INDUSTRIAL AND TECHNOLOGICAL POLICIES OF KOREA

Given a phenomenal industrial growth in the past decades, Korea's industrial and technological policy is an informative subject that may offer useful implications for policy makers in other developing countries [131]. As discussed earlier, Korean industrial policy is notable for the important role of government in the economy. The political insulation and centralisation of decision making allowed the S. Korean state to implement a flexible industrial policy and by, extension, promote technological capability. Intervention in favour of emerging industries and specific promotion programs played an important role in Korean industrial policy during the 1970s. As newly industrialising countries like Korea mature, they will increasingly face industry specific pressures to intervene in support of declining industries, reflecting what has become common place in recent years in industrialised countries [132]. The Korean government planned intensive policies and strategies for the development of science and technology with many innovative supporting measures. Particular attention has been made directed towards the use of high technology, for this was the path chosen by Korea to industrialise and to evolve an outward oriented economy. While less sophisticated technologies can surely serve the needs of some aspects of national development, Korea determined that the high technology path could afford them the most options in reaching development goals. In any case, the government believed that the industrial structure needed "upgrading" and that the new directions required large-scale risky investments which would not be undertaken by private firm without decisive government leadership.

The technological development strategy pursued by Korea in the process of its industrialisation has been the introduction of appropriate technology from developed countries for assimilation and improvement while simultaneously promoting the development of a domestic capacity for technological development. The introduction and utilisation of foreign capital and technology from industrialised countries played a significant role in the technological development process in Korea. Moreover, other technology policies including the establishment of modern research and development institutes, large investment on the development of Korea's human resources, along with policies to promote

technological innovation have also been crucial to the success of the industrialisation of Korea [133]. There has been a gradual change in the centre of gravity of Korean industrial policy towards less selective intervention and more functionally-based industrial incentives at the beginning of the 1990s. the Korean government has also changed the direction of science and technology policy from a bottom-up to a top-down approach. The bottom-up approach in the past turned out to be unsatisfactory for increasing national competitiveness. In selecting key technologies, priorities were established by a long-term century through the cultivation of indigenous industrial technology and enhancement of national competitiveness [134]. Moreover, Korea's science and technology development policy also emphasised more on the development of capacity for the proper selection, assimilation and adaptation of imported technologies.

Year	Industrial development policy.	Technological Development
1960s	Establishment of the foundation for industrialisation. Fostering (ISI) strategy. The transition to (EPI) policy.	Expanding education and training in science, technology and skills. Facilitating the importation of advanced technologies.
1970s	The heavy and chemical industries drive. Promotion of small and medium-sized industries.	Strengthening local technological capability through promotion of R&D activities.
1980s	Liberalisation and privatisation policies. Enhancing the quality of manufactured exports through their diversification.	Extensive programs for training qualified scientific and technological human resources. Liberalisation of technology imports.
1990s	Promotion of high-Tech	More investment in developing modern and sophisticated technologies.

Table A.1 Korea's industrial and technological development policies during the past three decades

All in all, various stages and processes of Korea's industrial and technological development strategies and policies during the past three decades can be shown in the table A.1. In sum, the Korean experience shows that technology policies on foreign technology transfer, technology diffusion, and R&D should change over time in response to changing externa environment. It is also indicated that technology policies become effective when three major components; policies to promote demand side of technology, policies to promote the supply

side of technology, and policies to provide effective links between demand and supply sides are well balanced.

A.8 THE PROBLEMS AND OBSTACLES OF KOREA'S TECHNOLOGICAL AND INDUSTRIAL DEVELOPMENT

There are some very serious obstacles to Korean long-term plan in competing with developed countries such as Japan and United States along the frontiers of high technology. One of the main obstacles is the massive financial resources which such an effort would demand. Korean companies will have to find new sources of capital if they want to compete in high technology products market [135]. A second key bottleneck is South Korea's continuous dependence on imported components, parts, general machinery, and basic materials. Most machines for Korea's growing industrial sector are bought abroad. Imports from Japan alone now make up a third of the value of Korean exports. The third critical constraint on Korea's industrial structure is its low capability for self sustaining technological innovation. Almost all of Korea's key advanced technologies are licensed, purchased, or copied from Japan and the United States [136]. The heavy technological dependence on foreign sources, particularly the Japanese, stems from the government's relatively low spending on R&D, preferring the easy route of licensing, buying or simply stealing finished technologies.

The weak capability for technological innovation has made government officials worried about whether Korea will be able to transform itself into a High-Tech industrial power in the next decade. Korea's technology in assembly work is not too far behind that of the advanced countries, however, it is believed that Korea is more than 10 years behind in the area of research and development [137]. Korea is facing the difficult task of moving its manufactured exports towards high and advanced technology-intensive products by improving both product specification and conformance to standards. Korea has a number of advantages in its favour as it attempts to make this shift. A long term commitment to education at all levels continue its benefits and increasing investment in research and development, combined with continued rapid growth act as a great move towards technological change. However, the authoritarian style of Korean management, poor labour

relations and the low quality of components supplied locally are major problems, and companies and government will have to make efforts to overcome them [138]. The economy has recently encountered with large trade deficits, rising labour costs, and a declining rate of increase in industrial investment. However, it was argued that new plan had to make a fundamental contribution to long-term national goals, but not to be mixed up with short-term industrial policy as firms had been seriously losing competitiveness in the world market. In fact, it is increasingly difficult for the country like Korea to push economic capability by depending upon the import of foreign technologies [139].

A.9 LESSONS FROM KOREA'S EXPERIENCE IN INDUSTRIALISATION AND TECHNOLOGICAL DEVELOPMENT

It is believed that Korean experience of industrial and technological development may provide valuable experience for other developing countries. One of the most important lessons from the Korean experience, as explained extensively earlier, is that the success of the Korean economy is not the result of any single factor. It is the result of a combination of many factors and supportive government policies. Rapid growth is not only the result of hard-working workers or government policy. But as Edward Mason notes, too many other factors were also involved in the Korea's significant development [140]. The Korean experience should be of particular interest because the Korean economy is large, capitalist, and market-oriented and it has been one of the world's fastest growing economies during the past 30 years [141]. The Korean experience shows that a development strategy is a complex set of interrelated policies rather than a simple matter of trade regime, as is often implied by debates between the proponents of outward-looking and of inward-looking strategies. The Korean experience can also show the importance of a long-term dynamic perspective in managing industrial transition. A constant upgrading of the industrial structure based on the development of local technological and managerial capabilities was seen by Korean policy makers as the best way to achieve sustained growth and efficient structural change, and hence higher living standards. The state's control over technological transfers and foreign direct investments, and the state's commitment to long-term lending through state-owned banks and various special investment funds, have been vital in this respect.

The Korean experience represents that patterns of technology transfer cannot be explained simply by concentrating on what has been transferred from donor countries, such as the United States and Japan. Rather, we need to turn our focus to the host country and to the policy strategies that have been adopted to shape patterns of technology transfer. In short, the question turns from the economics of what, to the policies of how, technology transfer is accomplished [142]. The Korean experience also suggests that a rethinking of the concept of competition is necessary. Ultimately, competition is a means to achieve efficiency, and not an end in itself. Korea's experience in the past decade has also shown that there is a strong relationship between commodity exports and royalty payments for introduced foreign technologies. Such a relationship leads us to believe that an adequate supply of proper technologies is an essential factor that enables industry to produce goods and services for the international market. Therefore, Korea's science and technology development policy has emphasised development of capacity for the proper selection, assimilation and adaptation of imported technologies [143].

It is believed that industrial development in Korea has also been influenced to a great extent by the guidelines of the Five-year Economic Plans since the early 1960s. Building on the industrial reconstruction of the import substitution period, export promotion strategy was remarkably successful in promoting industrial, export and economic growth. According to source-of-growth estimates, where import substitution accounted for one-third or more of the increase in GDP from 1955 to 1963 and export expansion less than 10 percent, their roles were reversed in 1963-1973 when the contribution of import substitution fell to 10-11 percent and that of export expansion rose to 36-40 percent. Korea's experience also demonstrates that a high level of technological mastery in all aspects of the uses of technological knowledge is not required for sustained industrial development. This is evident from the fact that its mastery has progressed much further in production engineering than in project execution [144]. The Korean experience may be unique in the sense that it was supported by a set of typical institutions, but this does not mean that it is irrelevant for other countries which have different histories. Practically all successful industrialisation after the British one was based on conscious efforts to import and modify more advanced institutions.

Follower nations might also learn from the HCI promotion drive, for instance, Firstly, the

Korean HCI promotion was implemented within context of the broadly defined, outward-looking (EPI) strategy. Therefore, from the very beginning, it was different from import-substitution efforts made under an inward-looking strategy. Operating under an outward-looking development, structural problems that were causing economic inefficiencies were bound to surface much faster than they would under an inward-looking policy. The old-fashioned ISI strategy is not adequate, there is a need for selective protection that briefly control market forces. Built into these two diametrically opposed arguments is the debate on outward versus inward-looking strategies, that is, whether industrialisation is best attained through trade (Export-Oriented Industrialisation) or through domestic production for the home market (Import Substitution Industrialisation). Secondly, late developers can benefit from previous development experience provided they choose the right model. More importantly, however, the nature of industrial policy should reflect the characteristics of each country and the economic environment. At the same time, the choice of policy instruments or the nature of industrial policy should be adapted appropriately to changes in the environment and to different stages of development. Another general lesson from the experience of Korea is that it is difficult to implement an industrial targeting policy that is not basically in line with where the private sector is planning to go anyway. But it is worth noting that in Korea, where there were large firms interested in developing heavy industry behind protective tariffs, the HCI program became very large and absorbed more than half of all the industrial investment for several years [145]. Korean experiences also suggest the following directions towards the goal to a high technology society:

1. The private sector should be encouraged to finance its own R&D activities. Initiatives and a sense of responsibility on the part of entrepreneurs should be fostered in the process.

2. Small and medium sized enterprises, as well as the major ones, should be included in efforts to utilise an advance technology.

3. Industrial productivity is enhanced by the development of many minor technologies rather than a limited number of major technologies. The strategic goal should be commercialisation of technologies rather than simply the development of the technologies themselves.

4. Research and Development activities involved in the assimilation of foreign

technologies should be given high priority. Creative adaptation is far more significant than mere imitation. Thus, far more capital should be invested in adapting imported technologies than is spent on initially adopting them.

There are also other lessons from Korea's economic growth. Firstly, a stable policy environment provides a solid stage for adjusting to internal and external shocks. Secondly, investment in both physical and human capital is a key for economic growth, In Korea, increased factor inputs alone accounted for an average annual growth rate of over 5% during the 1970. Korea's experience should not be construed as an example that a country in the midst prolong economic crisis, can simultaneously undertake structural adjustments together with restrictive macroeconomics policies, transfer resources abroad and revive stagnant growth rate [146]. Korea has become a significant industrial power mainly as a result of its proficiency in production. It thus appears that mastery of production engineering alone is nearly sufficient for the attainment of an advanced stage of industrial development. In the course of its industrialisation, Korea has effectively assimilated various elements of foreign technology. Transfers of technology have contributed importantly to this process. Korea has also been pursuing high level economic development over the last several decades. It can be said that , in a country like Korea with its limited territory, few natural resources and high population density, it is skill and brainpower which provide the base for national development. Therefore, Korea put a high priority on industrial development, with the emphasis on the development of technology. Korea has also used the lessons of Japanese experience very effectively in developing its own policies in the past. The Japanese model remains attractive at this juncture, but some important differences are becoming significant. In its early stages, Japanese industrial policy relied on some of the same instruments that Korea later adopted to encourage investments in infant industry and to develop home markets as a base for international competitiveness. But in its later stages, Japanese policy has moved away from intervention, focusing instead on information sharing and co-ordination, and on indirect, functional support for new activities. In this context, and deprived of its earlier powerful tools, Japanese industrial policy has relied heavily on the co-operative relationships that connect Japanese business and government, and Japanese business and labour [147]. The success of Japan, Korea, and Taiwan has been attributed by many economists to liberalisation or the freeing of markets from government control. Liberalisation did indeed occur in Korea about 1965 insofar as the exchange rate was

devalued, commercial lending rates were raised, and certain imports were decontrolled [148].

Korea's enhanced technological capabilities is also reflected in a recent survey of 1,110 professors, researchers and business experts by the Korea Advanced Institute of Science and Technology. The questionnaire survey on the perception of the community regarding Korean technological capabilities reveals that the average time lag in the development of technologies between Korea and Japan is four years. It also shows that Korea is five years behind the world leaders in advanced technology [149]. The experience of the Republic of Korea, also offers several policy implications for other less developed countries. Firstly, small entrepreneurial firms can be an important source of innovation and employment generation, even in less developed countries. Thus, the government in less developed countries should foster the formation of small entrepreneurial enterprises. Secondly, the public policies that promote the formation and growth of small entrepreneurial enterprises should be implemented early enough to create an environment for entrepreneurs to exercise their innovative sprit. Thirdly, small entrepreneurial enterprises that lack the expertise and resources to negotiate and import foreign technology through formal channel can benefit from informal transfer of technology through economic activities of foreign enterprises [150]. However, Lee (1992) believed that Korean model can not easily be replicated in many of the developing countries because the conditions that fuelled Korean growth do not exist in most developing countries [151]. Therefore, even though there seem to be some general features in the Korean experience that can be applied to the other LDCs, one should say that there are so many circumstances that are crucial yet unique to Korea. Hence, the Korean model is not easily replicated in other developing countries because it is heavily defined by institution. Some important institutional indicators such as education, literacy rates, ability in tax collection and organisational structure suggest that Korea has the highest institutional capability required to upgrade industrial technologies. However, institutional capabilities for technological development are very much influenced by the country's industrial strategies and policies. Korea has largely patterned its technology importation policies after Japan which further strengthened institutional technology capability.

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APPENDIX B:

TAIWAN EXPERIENCE OF TECHNOLOGY AND INDUSTRIAL DEVELOPMENT

The successful experience of Taiwan, which has had one of the most rapid growth rate during the last three decades, has attracted several decision makers in other developing countries in order to replicate its model to their own country. Taiwan GNP growth rate increased from an average of 7.5 per cent in 1950s to an average of 9.7 per cent in 1960s, and 9.6 per cent in 1970s, and reached an average growth rate of 7.8 per cent in 1980s [1]. The success of Taiwan's economic and technological development, as investigated by many scholars, can be attributed to several factors which are more or less common factors of success among Asian Newly Industrialised Countries (NICs). Some of the important factors of Taiwan's rapid economic growth can be listed as follows [2]:

1. The existing of well-developed infrastructure and human resource laid by Japan between 1895 and 1945.
2. US and Japanese economic aid (mostly 1950s and early 1960s).
3. Early emphasis on agriculture, including land reform, the spreading of improvements in technology, and the increase of inputs, such as water, fertiliser, and pesticide.
4. The experience of the people who are willing to learn and to work hard. (Confucianism)
5. The presence of a large group of trained and experienced professionals emigrated from the mainland.
6. Export promotion policies
7. The role of foreign technology.
8. Social and macroeconomic stability.
9. The government role.

According to the Kao (1991) the man-made "miracle" of the economic development in Taiwan can be concluded into three main forces [3]:

1. Appropriate strategy of the government for economic development.
2 Sensitivity of the industrial and commercial circles in catching the advantageous opportunity for investment.
3. Hardworking labour dedicated to production.

Brick (1992) has also pointed out to general factors such as a relatively modern infrastructure founded during the Japanese colonisation period; generous American military and economic assistance in post world war era; a Confucian work ethic and authoritarian political tradition. But the most significant factor in Taiwan's success as he believed is the fact that the island has taken full advantage of the opportunities free world trade has offered, that is, the export promotion policies [4]. Another study emphasised factors such as the ability and orientation of the government, the pursuit of an essentially free enterprise system, the impressive investment in human capital particularly in areas vital to economic transformation, and the critical role of post-war mainland immigrants, which produced the domestic environment and the incentive for transforming Taiwan from an agriculture economy to an industrial economy within the short period of a quarter of a century [5]. Tsai (1995) refers to some success factors for Taiwan's economic miracle, such as the successful land reform policy, the timely availability of US aid in the period 1950-1965, the upgrading of education, a stable social and political environment, the high employment rate, well-planned investment in infrastructure, outstanding management skills, and government guidance. But the most significant factor of Taiwan's success, as he added, has been the effective development and utilisation of its human resources [6].

According to the Lin (1994), the success of the Taiwan's rapid growth can be attributed to many factors such as appropriate industrial policy, a stable fiscal and monetary policies, social reform, human resources and technology development in the country [7]. In a survey of industrial policy, productivity growth, and structural change in manufacturing industries in both Taiwan and S. Korea, Dollar and Sokoloff (1994) believe that a rapid accumulation

of physical capital, human capital, and technology have been the most important factors of the rapid industrialisation in both countries. They also refer to some other success factors, including high savings rate, strong investment in education, and export-oriented growth strategy that accelerated industrial and technological development in both S.Korea and Taiwan. Private initiative, they argue, was key to the accumulation of these factors, although it was government policies in both countries which played a key supporting role in providing a favourable environment for saving and investing [8]. The economic success of Taiwan can also be explained by the work ethic of the people, with their hardworking, productive and relatively high average standard of educational attainment. Confucianism, which advocates obedience, hard work, and respect for the learned, has been commonly regarded as the consistent factor for this characteristic of the labour force in Taiwan. However as was mentioned in the case of South Korea, it has been said that the weak investment in high technology sectors in Taiwan can be attributed to the same source, that is, Confucian culture. It is also argued that the success of Taiwan can be specifically attributed to cultural factors favouring development, excellent management of the economy, the favourable international and technological climate for growth, and quite simply hard work and dedication [9].

The role of an authoritarian government has been another internal factor affecting Taiwan's success. As Pang (1992) through an analytical framework from the state-centric approach discovered that the most crucial factor determining Taiwan's success was a relatively capable and autonomous state. He added that all of the other factors contributing to the miraculous accomplishments on the island could to a certain degree and in a certain way be linked to this central factor [10]. It is believed that a soft authoritarian regime like that of Taiwan, might be useful in ensuring the stable political and social environment necessary for economic development and modernisation. Moreover, the land reform and developing of agricultural sector in early years of Taiwan's development has also been among the internal factors of success [11]. One can also add the role of the educated elite in the second largest migration in Chinese history as another element in Taiwan's prosperity. Most of these migrants probably understood that the government's legitimacy would depend on a great extent on its economic performance.

B.1 THE ROLE OF EXPORT PROMOTION POLICY

One significant success factor of Taiwan's rapid growth has been its export promotion policy. As most studies such as Kuo (1983) refer to export promotion policy as a major contribution of to rapid development of Taiwan [12]. It is believed that the adoption of the export-led industrialisation was formed by the fact that Taiwan is a small island with limited natural resources, and also by immediate pressures, such as unemployment, shortage of foreign exchange, and even the advice of the U.S. aid. It is also argued that the shift of industrialisation policy from import substitution to export promotion during the late 1950s and the early 1960s was an important factor in supporting export expansion and increasing the production and growth rate [13]. The export-expansion strategy was clearly instrumental and helpful in Taiwan's success. Since adopting export-oriented strategy in the mid-1960s the growth national product (GNP) of Taiwan has grown by an average of about 8.9 percent per year, with the annual growth rate of industrial manufacturing, averaging 13.4 percent in real terms. As a result, the share of exports in GNP increased from below 10 percent in the 1950s to 60 percent in the 1980s. The value of exports increased from U.S.$ 0.2 billion in 1965 to U.S. $50 billion in 1987 [14]. As a result of the adoption of export promotion policies, Taiwan moved from being the world's sixty-fourth biggest exporter in 1962 to being eleventh in 1986. By early 1988, Taiwan also ranked sixth in the world in terms of product value, accounting for almost 4 percent of total world production. The Taiwan's major exports in 1986 included electronics products (15.7 percent), garments (13 per cent), textile products (10.2 percent), metal and articles (5.3 per cent), and other manufactures (10.8 per cent) [15].

Having considered the rapid growth rate of manufactured output, the share of manufactured products in total exports rose from 28 percent in 1960 to 77 percent in 1970 and reached to 95.9 percent by 1993 [16]. During the early phase of export promotion policies, exports were encouraged by allowing a rebate on customs duties paid for imported materials used for export production, tax incentives, low interest loans and credits for exporters, direct subsidies, and government-sponsored export promotion and marketing facilities [17]. Taiwan's intense dedication to expanding its exports since the 1960s can be readily discovered in its ever present slogan of "everything is for export" which appeared on most

of the public buildings. However, it should be noted that Taiwanese firms' race to maximise their export productions has brought about serious environmental impacts. One of the key factor of Taiwan's export expansion strategy has been its relatively cheap labour force in early stages of industrialisation. In other words, for a labour surplus economy, like that of Taiwan, the most advantageous factor in competing for export markets was the labour force. Slowly increasing real wages was the key factor in promoting exports. Taiwan's abundant and cheap labour force, co-ordinated with simple processing technology makes its labour-intensive, nondurable consumer goods industries (e.g., textiles, clothing, and electronics) very competitive in world markets [18]. However in the later stage of industrialisation, because of a gradual rise in real wages, the country found it more difficult to compete with low-cost producers in some countries of Southeast Asia and China. Therefore, in order to remain competitive in the international markets, Taiwan changed its industrial structure by emphasising the higher value-added, more skill-intensive and capital intensive manufacturing, and expanding into business and services [19].

A particular feature of export expansion in Taiwan is that small and medium enterprises (roughly with employees of less than 100) have played an important role in developing foreign markets. For the period from 1978 to 1985, export earnings of small and medium enterprises constituted about 65% of total export earnings in Taiwan. Furthermore, these small and medium enterprises depend very heavily on foreign markets. More than 70% of their total sales came from exports in 1981-1985, and their dependency on exports has increased steadily since 1972. Under the terms of export promotion, export firms benefited from low-interest export loans, custom duties rebates, and sales and stamp tax exemption [20]. It is believed that the participation of small and medium firms in exports, comparing with exporters of the S.Korea, made Taiwan's exports flexible and able to respond quickly to market conditions [21]. The establishment and expansion of Export Processing Zones since the 1960s, has been the next significant step towards increasing exports [22]. In fact, Taiwan was the first country which introduced these zones in order to attract foreign investment by which export-led industrialisation was expected to be encouraged, thereby resulting in employment creation, foreign exchange earnings and transfer of technology [23]. The inauguration of these zones accelerated the flow of foreign technologies to Taiwan through training of local personnel and introduction of new manufacturing and marketing techniques.

However one can say that little direct technology transfer took place in the export processing zones. This was because of the predominance of assembly processes, the outward-oriented enclave character of these zones, the lack of complex production processes and the absence of local research and development activities. Most of the products manufactured in these zones are characterised as labour-intensive and generally low-skilled, assembly or processing of parts or materials imported by foreign enterprises, such as consumer electronics, garments, toys, and electrical machinery. Therefore, it is believed that these zones have little effect on productivity improvement [24]. The zones operated like foreign enclaves, minimising the amount of contact between the local economy and foreign market, except in terms of the workers who moved in and out of the zones in response to new or better opportunities. Over time, however, it was the mobility of the labour force that proved to be one of the main vehicles for technology and skills transfer, especially in terms of middle-level management and technical personnel [25]. A percentage of local personnel who initially were trained to work in the zones went on to start up their own companies or brought their skills in to local economy for use in domestic firms. Under the its six-year plan (1991-1996), Taiwanese authorities has committed a total of US$ 303 billion for 775 projects including a high-speed railway, highway expansion, petrochemical plants, infrastructure for heavy industries, and the development of science and technology. It is expected the GNP increased from US $ 8000 in 1990 to US $ 14000 in 1996 and exports will reach US $ 122.8 billion and imports US $ 120.7 billion in 1996, placing Taiwan among the top ten countries in the world [26].

B.2 THE ROLE OF TECHNOLOGY TRANSFER AND FOREIGN DIRECT INVESTMENT

The other significant factor in the Taiwan's successful experience has been technology transfer. The acquisition of foreign technology has been a very important part of Taiwan's science and technology programme, as Taiwan accelerated the transition from mass production of labour-intensive consumer goods to the manufacture of sophisticated capital and technology-intensive products. The key to Taiwan's ability to make effective use of foreign know-how was in its policy that adopted. Foreign technology was essentially viewed as a means to overcome domestic limitations for entering overseas markets [27]. Taiwan

has employed various methods to transfer foreign technologies. These methods were included licensing agreements, imitation, copying, or technology cooperation agreements [28]. It is believed that importation of capital goods has been one of the most important method of technology acquisition in Taiwan. Modern technology in Taiwan was embodied in machinery and equipment imported from abroad. The rapid pace of export-led industrialisation led to an increase in rapid rate of capital formation and technical progress through financing the importation of capital goods [29]. Technical co-operation particularly with Japanese and American firms has also been another important mode of acquiring foreign technology for Taiwan. This included purchase of patents, assistance of technicians, provision of technical information and blue prints, and personnel training abroad. The most important reasons for Taiwanese firms to enter into technical co-operation agreements with foreign firms were the development of new products, product quality and management. The practices of American and Japanese companies differ considerably in this regard. For Japan, technical co-operation became a vehicle to penetrate the Taiwan economy. In other words, Japanese firms used such agreements as a means to tie up local firms, by requiring them to buy parts, components, or raw materials [30].

Most cases of technical co-operation with Japan were focused on labour-intensive industries. Even though it led to transferring labour-intensive technology to Taiwan, however, it also makes upgrading Taiwan's industrial structure and technological capabilities more difficult because technological dependency has hindered local R&D. It is believed that the Japanese enterprises had the lowest amount of research and development activities, with only 29.8 percent, in comparison with 76.5 percent of the other foreign enterprises [31]. It is argued that most Japanese firms transferred technologies to Taiwan through joint ventures and licensing agreements, in order to penetrate Taiwan's domestic market for exporting to the United States and other countries. As Americans imposed quotas on Japanese imports, the Japanese assembled their parts in Taiwan for shipment to the United States [32]. In other words, one can say that Japanese firms encouraged technological dependence instead of transferring technology. It is believed that this failure by Japan to transfer its expertise has contributed to the fact that Taiwanese technology was relatively weak over a wide field. Many products which were imported from Japan, for example in electronics field, which could be produced in Taiwan if the technology were available [33]. However, it can be said that the Taiwan economy is much more linked with Japan's

economy not only in trade relations, but also in terms of acquisition of technology. The number of technical co-operation agreements with Japanese firms has been 1,733 since 1988 more than three times that of US firm 586 cases. The geographic proximity (lower transport costs) and socio-cultural similarities (relative ease with which Taiwanese and Japanese work with each other) have been among the most important reasons of facilitating Japanese capital and technologies into Taiwan.

Foreign Direct Investment (FDI) has also been another major source of technologies for Taiwan. It is believed that FDI contributed to Taiwan's economy mostly by introducing new technology. FDI fostered competition in the domestic market, helped to open up more foreign markets, and diffused new technologies. Between 1952 and the end of 1985, the number of approved investments from overseas Chinese and foreigners, grew to close to 3,500 projects with an approved investment volume of US $ 5.2 billion. At the end of 1985, 47.4% of total foreign investment (without the foreign Chinese) came from the USA, 20.7% from Japan, 14.2% from Europe and 11.8 % from other countries [34]. There were also about 3102 new cases of FDI with total amount of $ 11,331 million approved in period between 1986-1992 [35]. Political stability and domestic economic conditions in Taiwan have been among the important factors for Taiwan's ability to attract FDI. In a study of finding the major factors influencing MNC's decisions to invest in Taiwan, political stability was the third most important reason, after low labour costs and tax incentives [36]. According to another survey issued by the Business Environment Risk Index, Taiwan's risk-index ranking has been ninth among forty-eight countries when factors like political stability, attitudes toward foreign investors, degree of nationalisation, administrative efficiency, financial structure, communications, availability of long or short-term loans, and the overall economic situation are taken into consideration [37]. It is also believed that the supply of high quality human capital has been among the important factors for U.S. multinational companies to invest in Taiwan [38]. The example of the Singer company investment in establishing a sewing machine industry in Taiwan can be among the successful cases of Taiwan's technology acquisition through FDI. It is believed that the Singer company's investment in Taiwan sewing machinery in 1963 created significant potentials through providing technical assistance, and thereby contributed to its growth. Some factors contributed to Taiwan's success in growth rate of its sewing industry. Firstly, Taiwan's sewing machine assemblers and parts producers were receptive to new ideas and willing to

change. Second, the technology provided by Singer involved little or no capital expenditure, and hence its diffusion was not only easier but cheaper [39].

In the past, over 90 percent of direct foreign investment in Taiwan went into manufacturing, partly because of restrictions on entry into other sectors, such as finance and insurance. Between 1952 and 1986, electrical and electronic appliances claimed the largest share of foreign investment, 30 percent of the total, followed by chemicals (15 per cent) services (11 per cent), machinery, equipment and instruments (10 per cent), basic metals and metal products (7 per cent), non-metallic minerals (6 per cent), and banking and insurance (5 per cent) [40]. Taiwan has also invested in other countries particularly some of the other East-Asian countries (ASEAN). Taiwan has been the largest and second largest foreign investor in the Philippines and Thailand respectively and also one of the top investors in Malaysia and Indonesia. Taiwan firms have also sold technology to local firms in these countries. After 1991, however, mainland China became the most popular country for Taiwanese investors [41]. For example, Taiwan technology dominates the booming shrimp-farming industry in the Philippines and Thailand. Taiwan outward investment in manufacturing comes mostly from young home-based multinationals in the electronics and petrochemical industries. Taiwan's investments abroad has been motivated mainly by the economic factors such as the need to source cheaper inputs and products (mainly in ASEAN), to access new technologies (mainly in developed countries), to avoid protectionism (in developing countries), and to access new markets (throughout the world). The government in Taiwan had maintained a moderate to conservative attitude in monitoring, regulating, and controlling foreign investment despite its constant efforts of improving the investment climate. The state had defined what had been conducive to the society and economy through its evaluation of domestic and international situations and used various policy instruments under its control to utilise the foreign capital to achieve its goal. Although there were limitations to such state regulations and control, Taiwan had prevented the dominance of MNCs in most of its manufacturing industries.

Therefore, it can be seen that the participation of foreign capital in Taiwan's domestic firms did indeed lead to their use of foreign technology. More than anything else, FDI contributed to Taiwan's economy by introducing new technology. That is, FDI constantly fostered competition in the domestic market, helped to open up more foreign markets, and diffused

new technologies. Taiwan has followed a relatively unrestricted and open FDI policy. For instance, Taiwan permitted the importation of second-hand machinery as investment capital, which neither harmed the local machinery industry nor impaired the efficient use of that particular capital [42]. Taiwan's policy in FDI and technology transfer also provided a reasonably good infrastructure and incentives for export-oriented environment which helped create many jobs. Thus, it become clear that Taiwan similar to other successful NICs, has achieved considerable success in assimilating foreign technology because of the suitable combination of well-implemented out-ward looking government policies and the strengthening the domestic technological capability.

B.3 THE ROLE OF GOVERNMENT'S INDUSTRIAL AND TECHNOLOGICAL POLICIES

The other important factor of Taiwan's success is the role of state in providing basic infrastructure, controlling taxes and giving incentives and subsidies for the industrialisation of the country [43]. The state is also perceived to manage the processes of foreign technology acquisition in such a way as to maximise the impact of this technology on the local economy [44]. The state played a crucial role in the initial stage of the Taiwan's industrial development in the 1970s, and has continued to provide help and subsidies until the present time. Substantial government investments in infrastructure and human capital provided a vital prerequisite for rapid development. One can refer to two overall reasons for the crucial role of state in development of science and technology in Taiwan. The first reason as discussed earlier is the government in Taiwan was able to make heavier investment to develop the infrastructure. The other reason was the belief that market forces alone cannot lead to the desired speed and pattern of science and technology development [45].

The significant role of state in the successful experience of development of Taiwan has been due in part to the government's ability to modify policies and strategies when changing conditions so required. That is, when previously prescribed policies and measures could not resolve new problems or difficulties, policy makers were always ready to propose new strategies and introduce new policies. Therefore, the formulation and implementation of these strategies and policies were products of informed and precise political and economic

calculations of the policy makers in Taiwan. Hence, the experience of Taiwan's success is called a man-made miracle. Having surveyed the active role of government as the entrepreneur and organiser in promoting the petrochemical industry, Chu (1994) shows that state have been leading the development in the early stages of Taiwan's industrialisation. He concluded that the success of Taiwan and other Newly Industrialising Countries (NICs) can mainly be explained to the use of both market mechanism and state intervention [46]. In Taiwan, as in the other NICs, national government controls, along with the strengthening of local technological capability, have played an important role in term of successful technology transfer. The government had recognised very early that science and technology was to become a major thrust for economic growth and national competitiveness. Therefore, improving and promoting industrial technology and local technological capability was regarded as an integral part of the country's national program. The government policies to promote some strategic and defence related industries in early 1980s which had a significant impact on the development of high technology industries in Taiwan can be a good example, explaining the critical role of state in enhancing technological capability in Taiwan [47].

One of the most important government industrial strategies has been the financial and tax policies designed to encourage domestic firms to adopt new technologies and innovations. It can be said that the finance system in Taiwan played an important role in its success. The Taiwan government employs a credit financial system, rather than the usual capital financial system favoured by developed countries. In Taiwan, the government uses interest rates and foreign exchange controls to influence decision making in the private sector. This seems to be another effective way of persuading industries to cooperate with the government's development strategies. Moreover, in terms of the technological development, a number of related policies have been implemented aimed at improving the process of technological capability. These policies, including reducing taxes on importing technology and regulating the activities of foreign firms regarding direct investments, accelerated the flow of foreign technologies to the country. In Taiwan, the key to the exploitation of technology has been the adoption of strategies and policies by the government and firms to gradually reduce price distortions and barriers to competition, with the purpose of achieving a better functioning market economy, on the one hand, and the improving the quality of human resources to increase the efficiency of the work force, on the other. As a result, sustained economic growth along with equity in distribution has been attained with the continuous absorption

of new technologies.

Although Taiwan was rapidly liberalising its economy, the government continued to play a guiding role in economic restructuring. In particular, since the 1980s it has intensified efforts to ensure that transfers of technology enhance the country's technological capabilities. The government in Taiwan pursued the strategy of industrial upgrading and technological development of the country also by encouraging local research and development activities and relaxing and liberalising many of regulations governing foreign direct investment. As Denis Simon (1988) indicated, Taiwan has been fairly successful in promoting technology transfers to help upgrade its industrial structure [48]. In order to assess technological policy and to evaluate technological upgrading plans, the Science and Technology Advisory Group (STAG) was formed in 1979. There were other organisations such as National Science Council, the Council for Economic Planning and Development, the Industrial Development Bureau of the Ministry of Economic Affairs, and the Industrial Technology Research Institute which founded to participate in the formulation of science and technology policy in the country. The role of Industrial Technology Research Institute can be compared with that of the Korea's Advanced Institute of Science and Technology (KIST) [49]. ITRI'S most important role has been as a partner in high-priority government-inspired projects. Once the technology was received and mastered, ITRI then worked to diffuse the technology into the local market. ITRI's acquisition and development of new industrial technologies has led to structural changes and prosperous growth in many of the Taiwan's industries. In line with the government initiatives, ITRI has also provided technical assistance to small and medium-sized enterprises. It has also trained specialists in industrial technology to meet the needs of the Taiwan industries.

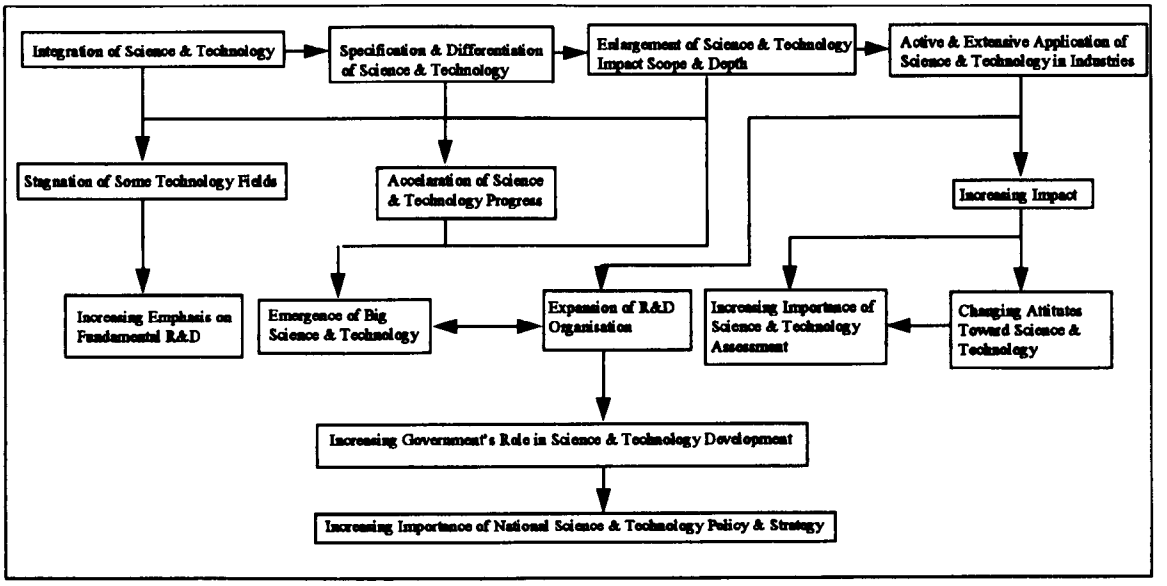


Figure B.1 Characteristics of Modern Science & Technology and Government's Role

Source: Ching, J.T. Technology in Society, Vol.10, No.10, pp: 185-204.

In Taiwan, technology transfer has been carried out through many other channels including seminars, workshops, training, consultation services, industrial transfer and join introduction of foreign technology. In 1992, the Industrial Technology Research Institute conducted over 600 technical seminars, conferences, exhibits, and provided technical services to over 10,000 companies. ITRI has also been benefited from corporations with many international organisations. As an example, the Taiwan semiconductor Manufacturing (TSMC), was completed in 1987 by joint venture with Philips of the Netherlands [50]. The government also built an approximately 35 square mile industrial park to assist the development and growth of high-tech industries. Unlike the earlier established Export Processing Zones, only high-tech corporations were allowed to operate in the park. There were a number of incentives such as low interest loans and generous tax advantages in order to attract foreign investors and overseas Chinese entrepreneurs to establish high-tech businesses in the park. Moreover, the park provided a base for Taiwan's shift from labour to knowledge-intensive production. The state has used a variety of means to ensure that the process and nature of technology transfer in the park will accord with its own objectives for future development of the country. The government also established funding for venture capital, financed high-level research and development projects, and offered elaborate management and marketing assistance in order to promote the development of strategic industries such as computer and electronics industries [51]. The state has also provided a set of attractive incentives and

regulation for accelerating the flow of foreign technology and also for an effective and successful technology transfer. For example, according to the 1964 statute, an agreement for the purchase of a product or process technology can be made only if one of these conditions are met [52]:

1. the agreement involves the production of a new product;
2. the new technology will increase the volume of production, improve quality, or reduce production costs; or
3. the new technology will lead to improvements in management or operation efficiency.

The state also provided technical support to the industry sector through government-owned R&D institutes and universities. The state also invested, selectively, in a small number of companies working in scale-intensive, high - technology upstream sectors such as semiconductors [53]. Other activities of the state to improve the technological environment include development of a strategic plan for the creation of a viable informatics industry on Taiwan. The success of Taiwan's informatics and electronics industry has relied on the fine co-operation between government and the private sector. Once the private sector acquired the necessary conditions for development, the government adjusted its mission and role, preventing industrial policy from becoming rigid and avoiding the disastrous results arising from protectionism. Therefore the government in Taiwan by using an effective set of policies attempted to link the acquisition of selective technology with ongoing efforts to build up an indigenous science and technology capability. As a result, the government offered a large number of incentives to local industries to expand their investment in research and development activities in order to promote technological self-sufficiency. The state is also in charge with the task of further improving the environment and infrastructure. The state has encouraged the private sector in order to cooperate actively in building up indigenous S&T capacity. However, most of Taiwan's firms remained small or middle-sized, and lacked the capital to invest in R&D facilities and programs. Because of the limited size of the domestic firms in Taiwan, there has been little incentives for foreign companies to transfer technology through formal channels such as FDI and licensing. As a result, the "learning by doing" phenomenon has been fairly widespread among the Taiwanese local firms.

B.4 THE ROLE OF HUMAN RESOURCE DEVELOPMENT

The government of Taiwan has also made major investments in education and training, especially in the fields of engineering and science. As explained earlier, it is widely believed that the high educational and skill levels of Taiwan has been a major element of its success [54]. It is believed that education in engineering and other applied sciences is the most effective way of closing the very wide technological gap between the developed and the developing countries. Modern economic development is based essentially on technological knowledge. Taiwan's priority on technological education has therefore been as an indicator of its rapid industrial development. The government developed education at all levels to promote the overall quality of Taiwan's human labours. The strong educational policy the government adopted greatly improved the quality of the labour force and hence contributed to industrial development. An effective and modern primary education system was established during the period of Japanese occupation. Government policy has been important in promoting the educational level. Aside from its decisive role in shaping the entire educational system, the government has also devoted substantial amounts of money to education. Government expenditure for public education increased quickly in real terms from NT $ 4.4 billion in 1952 (1.7 percent of the GNP) to NT $ 162 billion (5.2 percent of the GNP) in 1988. The number of schools at all levels increased from 1,769 in 1952-53 to 6,684 in 1990-91, and the percentage of the population with higher degrees rose from 0.12 percent in the early 1950s to 2.27 percent in the early 1990s. The quality of education as measured by the level of public expenditure per student improved substantially. Public expenditure per student in real 1986 prices rose markedly from NT $ 2100 to NT $ 16,000 at the primary level, from NT $ 9,500 to NT $ 26,600 at the secondary level [55].

Attending college or graduate school has also been the ultimate goal of the majority of the most of Taiwanese students. Between 1952 and 1988, the total number of college students rose rapidly, from 10,000 to 496,000. The number of graduate students grew from 0.1 to 4.5 percent of this total. While in 1952, there were only four universities and four junior colleges, by 1989, Taiwan had 42 universities and 75 polytechnics or colleges [56]. Moreover, there was a sharp increase in the number of graduates in science and technology, which the ratio of S&T graduates to total graduates rose from 43.3 % in 1972 to 57.4 %

in 1992, and the majority of all graduates since 1981 have been S&T graduates [57]. The growth of educational opportunities has significantly improved the level of educational attainment of the labour force. Both formal education and post-school job training were important to the improvement of human resources, but formal education has widely recognised to be more crucial for Taiwan's educational expansion [58]. The impressive improvement in the quality of human resources obtained through increased investment in education has provided general human capital for the economy on the whole. The government substantial investment in human resources led to improving the quality of its workforce. Therefore, the improvement of the human knowledge and skills can be indeed the key to faster economic development. Despite of the Taiwan's very successful experience of development of its human resources, Taiwan suffered from a brain drain problem during the 1960s to the early 1980s. Many Chinese students who finished their advanced studies abroad did not return to Taiwan. Since mid-1980s, however, as Taiwan became a newly industrialised countries with a relatively high standard of living, the situation has been reversed, which many overseas chinese came back to Taiwan, bringing with them the new knowledge and technical and managerial skills [59].

Taiwan's total expenditure on Research and Development activity has increased from 0.48 percent of GNP in 1978, equalling about $ 111 million to about 1.16 percent of GNP in 1987 and reached to 1.65 percent in 1990. It means that R&D spending in Taiwan grew at an average annual rate of 12.1 percent, which has been faster than that of Japan (4.1 percent) but slower than that of South Korea (14.3 percent) [60].The number of researchers also rose by 12.2% per year during the period between 1983-1990, and the annual expenditure per researcher increased from NT $ 0.92 million to NT S 1.65 million, or at an annual rate of 6.8 % [61]. However, Taiwan's R&D expenditure per GNP (1.65%), has been less than that of U.S. (2.69%) and Japan (2.77%) and Korea (1.92%) [62]. The number of patents applied for in Taiwan has also remarkably increased. There were 10,411 patents applied for in 1979, including 3,075 applications for patent device, 5,320 for utilities and 2,016 for new design. The number of patents applied for in 1983, amounting to 19,429, with 4,747 for patent devices, 9,029 for utilities and 5,653 for new design. The number of applications for patent devices per 10,000 people in Taiwan was 2.6 in comparison with 1.6 and 21.3 in South Korea and Japan respectively.

In Taiwan, private sector has generally been weak in technological innovation. More than 50 to 65 % of total R&D expenditure was undertaken by the public sector in the period between 1977 and 1988, and 32 to 47 % by private enterprises. Within private industry, the manufacturing sector had the highest R&D expenditure, which amounted to 95% of sales [63]. The weak capability of private sector in R&D activity however has mainly because of the lack of research capabilities of the prevailing small-and medium-sized manufacturing enterprises. Having considered three factors involved in transferring technology to Taiwan, that is, the government, foreign corporations, and local enterprises, one can say that the government has had the most control over the process of technology transfer. The function of government as a direct producer, however, has become less important in recent years, as private enterprises have shown themselves to be far more efficient in that capacity. Nevertheless, government has remained as a leading player in the provision of public infrastructure which is essential to a dynamic investment climate and continued growth. Another important factor contributing to the Taiwan's successful economic development was the systematic, regular manner in which development policy was implemented. As an example, one can refer to a systematic approach which was taken in targeting industries for development. In the earlier stages of industrial development, emphasis was placed more on the labour-intensive industries producing essential consumer goods. After a firm foundation had been created for these industries, Taiwan gradually shifted emphasis to more capital and technology intensive industries, manufacturing producer goods and consumer durable, and its strategy.

B.5 THE US AND JAPANESE AID

Another factor in Taiwan's successful industrial and technological development can be seen in the US and Japanese aid and investment since early stages of industrialisation of Taiwan. It is believed that the massive US financial aid helped Taiwan to solve its serious twin budget deficit and balance of payments deficit problems during the post-war economic recovery of Taiwan [64]. As it is discussed earlier, the US firms have also been a principal source of foreign investment and technology into Taiwan, and just as Taiwan has changed the focus of its activity away from simple, low-cost labour assembly operations to concentrate on high-technology sectors such as informatics and microelectronics, the

technological nature of American investments has shifted in the same direction. Taiwanese authorities devoted 26 percent of US aid to human resources development including personnel training in management, and 44.3 percent of the US financial aid was allocated to improving infrastructure, such as transportation, communication, electricity [65]. Moreover, the US market has been the traditional target for a large percentage of Taiwan's exports. In spite of the approximately 50 per cent of Taiwan's exports going to countries in the Asia-Pacific region in 1992, the fact remains that many of Taiwan's exports are designed for use in the American market. The US has also been the main training ground for Taiwan's engineers and scientists, a larger percentage of whom returning home after receiving their education at the graduate level in America. Despite of this substantial financial aid to Taiwan in its early years of industrialisation, it is believed that the US aid was not the main factor in explaining Taiwan's miracle [66].

The Japanese has also played a very significant role in the Taiwan's success. As indicated earlier, according to some statistics on both foreign investment and technical co-operation reveal this fact that the Japanese companies have had more than twice as many cases of foreign investments with approximately $ 4.20 billion since 1991 and the number of Japanese technical co-operation agreements with Taiwan (2182) at the end of 1991 reveal another similar fact. Some observers have also believed that Taiwan's success was no more than a by-product of Japan's growth. Taiwanese labour employed Japanese machinery to produce goods for export to the Unites states.

B.6 SUMMARY AND CONCLUSION

In sum, Taiwan has undergone a fundamental change of status in the changeable international political-economic environment. Taiwan climbed from the bottom of the world capitalist system to middle level as a newly industrialising country. Its economic system shifted from a closed system insulated from the external forces to a highly open system deeply involved in the international market. There has also been a major shift from small scale labour intensive technologies to more capital intensive and high technology intensive manufacturing products.

Having compared the experience of Taiwan with that of Korea, one can notice to some

similarities and differences. Taiwan and South Korea demonstrated important common features. Both Korea and Taiwan were under Japanese colonial rule during the specific period of time. There is a limited natural resources in both Korea and Taiwan, but they have a good human resource base. Both Taiwan and Korea followed similar development patterns, for instance, export-oriented policies, heavy and chemical industrialisation drive and liberalisation policies. There has been high level of rapid growth for both South Korea and Taiwan since 1960s. There were a similar tendency for both to move into the same pattern of fluctuations in the 1960s as the domestic economy of each became increasingly directed by the same external markets. There has also been similar shift to the drive for heavy industry in the 1970s. In spite of a slightly decline in their rapid growth in early 80's, both countries have attempted to make the transition to a modern, technically advanced industrialised economy. However, one can refer to some different patterns and differences between these two countries such as the differences in the commodity composition of exports and in their scale in domestic production. Moreover, while S.Korea imposed restricted regulation on the Foreign Direct Investment (FDI), there has been a greater reliance on FDI for Taiwan as a channel of foreign technology acquisition [67]. Having compared the technology transfer modes of Taiwan and S.Korea, one can find out that, unlike S.Korea, where technologies were mostly transferred in the form of an arm's-length relationship with foreign firms and licensing, Taiwan relied more on the foreign investment and subcontracting as a means to acquire technology [68].

Due to the fact that Taiwan reached the take-off stage earlier than did South Korea, South Korea learned from Taiwan's experience before the 1970s and then started to learn more from Japan's experience after that. In other words, one can say that both South Korea and Taiwan have learned from each other. In both countries, the role of state in rapid economic and industrial development has been very significant. The state in S.Korea and Taiwan shares several common features, such as tendency of both countries to be strong, centralised, authoritarian, and deeply involved in their national economies. However, in Taiwan, the role of state has been much more moderate in comparison with that of S.Korea. In other words, while the state does not seem to have intervened in such detail as in Korea, it has none the less exercised the specific controls. Moreover, the government in South Korea has tended to enforce its policies to larger-sized enterprises, Taiwan's government has aimed to create an economic environment conductive to growth, with more emphasise on

the small-sized firms. Economic planning in Taiwan has been somewhat less extreme than in South Korea. The Taiwanese state has also exercised less direct control over private firms and intervenes in the economy through a large number of state-owned enterprises in key industrial sectors. The impact of export-oriented industrialisation policies on the social structure in each country was also different. While South Korea emphasised more the use of abundant labour as the major input factor of export promotion policy, Taiwan attributed to a higher degree of capital intensity in export products. The state in both S.Korea and Taiwan has played an active role in suppressing labour movements through the corporatist control of labour unions. However, the Taiwanese state has been more welfare-oriented, paying greater attention to equity problems than the Korean state. Consequently, greater inequality in income distribution has developed in S.Korea than in Taiwan [69].

As indicated earlier, both S.Korea and Taiwan pursued the heavy and chemical industrialisation drive in 1970s to upgrade their industrial structures. However, while S.Korea viewed it as a supportive for their national exports, Taiwan used it for the strengthening its existing industries. Moreover, while in Korea it was process-type industries like basic materials and petrochemicals in Taiwan it was machinery industries that led the shift of industrial activities toward the Heavy and Chemical Industries derive of 1970s. Taiwan established a substantial technological and managerial basis in machinery and electronics in 1980s. On the other hand, Korea continued to rely on basic materials (especially iron and steel) and petrochemicals as a important base of its industrial development in 1980s [70]. It is also worth noting that while in Korea, the Heavy and Chemical Industrialisation (HCI) program became very large and absorbed more than half of all the industrial investment for several years, the HCI drive in Taiwan was quite limited. Heavy industry in Korea has been twice as capital intensive as heavy industry in Taiwan [71]. In both Korea and Taiwan, the overall objective during the early years of development was a desire to increase economic productivity. However, in Korea, the relative importance of this objective appears to have decreased vis a vis social development and consideration of price and economic stability. In Taiwan, on the other hand, productivity of economic sectors remained the leading consideration in infrastructure decision making until very recently, when social and budgetary considerations began to play more significant roles. Price and economic stability have also been important concerns, but not as important as in Korea. Both countries have recognised the need for liberalisation policies and privatisation

of infrastructure services. However, they have taken different approaches to these needs and have had different experiences of success and failure. In Taiwan, privatisation of infrastructure has been slow in evolving because of the lack of private sector participation in infrastructure services. In Korea, privatisation covers a wide range of services.

In terms of R&D activities, whereas excessive conglomerate power appeared to be an obstacle to innovation in Korea, in Taiwan the cut throat competition among the many small Taiwanese producers made profits so small that little was left over for R&D [72]. While Korea did not lead Taiwan in terms of economic maturity (i.e., in terms of per capita income, Korea has remained about 30 to 40 percent behind Taiwan), it did make the distinction between economic and social development objectives of infrastructure earlier and more clearly than Taiwan did. There were also some differences between two countries in state structure and political history which led to differences in their respective development strategy. The most obvious has been the nominally democratic nature of the Korean political system imposed by the Americans, compared to the one party structure in Taiwan. Having summarised the success factors of S.Korea and Taiwan, it can be seen that while for S.Korea, important factors such as foreign capitals (heavy foreign borrowing), the big business conglomerates, and state interventions have been the most key players in its success, in Taiwan, foreign direct investment, small and medium enterprises and its appropriate development policies are the major factors. As it is mentioned earlier in the case of Korea, Taiwan's model of rapid industrial and economic development can have valuable lessons for other developing countries. However, it seems difficult for other less developed countries to duplicate Taiwan's development strategies, since every country has its own institutional and cultural characteristics and a unique set of factor endowments. Nevertheless while Taiwan's experience is unique, being the result of a number of different factors, its development process does exhibit features that may be applied to other LDCs trying to build up their economies. Thus, it can be said that many of Taiwan's success factors and experiences can be very useful for the other less developed countries. LDCs can learn from the development experience of Taiwan that the government of a country must have long-range and flexible plans which can serve as a blueprint for gradual and evolutionary development in order to make a direct effort to the rapid development and modernisation.

The fact that Taiwan and S.Korea adopted and adapted successfully the Japanese model of

industrialisation shows that the other developing countries can replicate this model to their own countries. Moreover, it should be noted that a number of countries in particular those of East Asian countries (ASEAN) have been able to follow successfully the Taiwanese and Korean model of technological and industrial development. Some policies such as heavy investment on the development of quality and quantities of its human resources, promotion of the export industries, the significant role of state in choosing appropriate policies and strategies and strengthening its technological capability by transferring technology can be among the most important and vital policies which might be relevant to most, if not all, developing countries. Taiwan's experience also showed that, in order to strengthen technical service, specific task forces, independent of R&D organisations and led by strong leaders with solid industrial backgrounds, were desirable. Another lesson which can be learned from Taiwan's development experience is that in the absence of an already established democratic political system, an authoritarian regime, particularly a "soft" authoritarian regime like that of Taiwan, might be useful in ensuring the stable political and social environment necessary for economic development and modernisation. Such a regime should be prepared to use its authority to encourage economic growth. In other words, authority and power should only be the means to economic development and political modernisation, not an end in themselves. Taiwan's experience also suggests that, for establishing national programs of some strategic technologies aiming at commercial applications, an overall development framework to upgrade the infrastructure and general capabilities is needed. In short, the development experiences of the Taiwan have sufficiently showed that, with long-term planning and concerted efforts, a society with limited resources, a dense population, and almost continuous external pressure can still achieve significant results in the industrialisation process.

Another lesson which can be learned from Taiwan is that Less Developed Countries (LDCs) should not rely on policies which only aim at protecting selecting industries, but they should also choose a directed market approach which allows for development to take place in all sectors and leads to substantial productivity and growth rates, technical diffusion, increased employment, and thus to a balanced share of income and to a political and economic stability [73]. Taiwan's experience is thus most directly relevant to countries willing to accept the social and political consequences of growth and willing to allow an economy that, while mixed, is primarily market oriented [74]. The economic miracle of Taiwan as it called by

Clark (1994) "growth with equity" can be explained in the following three broad trends [75]:

- a remarkable ability of flexible and rapid response to changes in the economic environment;
- a virtuous cycle of positive reinforcing impacts between social and economic development; and
- generally balanced and complementary economic roles for the public and private sectors.

Having considered Taiwan's experience of very fast transition to a newly developed country and assuming that the very rapid growth rate of East Asian countries such as Taiwan continues in the future, as Brick (1992) predicted, there likely will be a shift of economic power away from Europe and North America to the western Pacific by the middle of the twenty-first century [76].

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APPENDIX C:

MALAYSIA'S EXPERIENCE IN INDUSTRIAL AND TECHNOLOGICAL DEVELOPMENT

Malaysia is a country in south-east Asia with abundant natural resources and population of approximately 17 million. It has vast forest resources and petroleum and natural gas. In addition, Malaysia is a large producer of natural rubber (nearly 40 per cent of world output), palm oil (60 per cent of world output), and tin (30 per cent). Malaysia is also one of the most open economies of Southeast Asia and can be classified in the second-tier Asian NICs along with Thailand, Indonesia and the Philippines. However, some economic and industrial indicators, such as an annual average growth of GNP (9 %), the share of manufacturing in GDP (31.5%), the share of export-oriented to total manufacturing (50%), and per capita income ($ 2,182) indicate to the fact that Malaysia can be classified in the first-tier NICs [1].

	1970	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993
GDP ($ billion)	4	24.5	31.2	28	32	34.7	37.9	42.7	47.1	58	6
GDP growth rate (%)	4.5	7.4	-1.1	1.2	5.4	8.9	9.2	9.7	8.7	7.8	8.5
Total exports ($ billion)	1.7	12.9	15.4	14	18	21.1	25	29.5	34.4	40.7	47.1
Manufacturing exports	13.4	22.4	32.8	44	45	48.6	53.9	58.8	64.9	68.9	74.3

Table C.1 The Important Economic Indicators of Malaysia during the period between 1970-1993

Source: Department of Statistics, External Trade Summary, December 1993, Bank Negara Malaysia, Annual Report, various years; Bank Negara Malaysia, Quarterly Bulletin, Dec 1993; Ministry of Finance, Economic Report, various years.

Malaysia's GDP has grown at an annual average rate of 6.5 per cent in the 1960s and average rate of 7.9 per cent in the 1970s and average growth rate of 9 per cent during early 1990s. Nearly 40 per cent of this growth was attributed to industrial sector (including mining, manufacturing, construction and transportation). The share of manufacturing sector of GDP has increased from 12 per cent in the 1970 to 22 per cent in 1980 and over 30 percent in mid-1980s, most of which included electrical and electronics, textiles and food,

beverages and tobacco [2]. According to a survey by Kimmura (1986) the highest export-production ratio in 1983 went to electrical machinery (61.2%), followed by textiles (37.6%), machinery (33.2%), and food, tobacco (32.2%) [3].

Malaysia pursued an import-substitution strategy in the post-independence period. Import substitution in Malaysia has generally involved assembly, packaging and final processing of finished goods previously imported from abroad by domestic labour, using machines and material largely imported from abroad. Import substitution has also been invariably associated with a package of policies aimed at protecting the infant industries in Malaysia such as tobacco, furniture, rubber products, wood products, food and beverages. One can generally say that the import-substitution strategy helped Malaysia to diversify the economy, reduced the excessive dependence on imported consumer goods, utilised some domestic natural resources, created employment opportunities, and contributed to country's economic growth. Although the ISI policy contributed to some of the Malaysia's growth, it had led to inequalities in income and employment, distortions in domestic product policies, inefficient, low value added, local products, saturated domestic markets and serious deficits in balances of payments. It is also believed that, under import-substitution programmes local industries failed to develop competitively either because of tariff protection or disguised subsidies in the form of tax relief [4].

Moreover, it is believed that Malaysia's heavy industrialisation which has been a second stage of import substitution and began in 1981 to develop a heavy industry sector, involved massive government barrowings from abroad to invest in almost unprofitable projects requiring heavy protection, imports of capital goods, deepening technological dependence [5]. Because of the limited domestic market, which was saturated, and the introduction of the investment incentives act in 1968, the emphasis of the industrial policy in Malaysia quickly shifted to an export promotion strategy. It should be noted, however, that the adoption of export-promotion did not mean the entire abandonment of import substitution which continued to exist in a parallel fashion. In the Malaysian context, as in the other LDCs, adopting the outward-oriented strategy was accompanied by a deliberate and extensive intention to increase exports.

It can be said that there is a close relationship between growth rates of GNP and exports

particularly in Malaysia. Export expansion seems to be a very significant factor contributing to the country's economic growth. For instance, one can refer to the sharp decline in growth rates of both exports and GNP occurred during the periods 1973-1975, 1975-82 and 1984-86, which coincided with the periods of world economic recessions. Moreover, the export-promotion policy has been an important source of growth for the Malaysian manufacturing sector since the early 1970s. Over the period 1973-85, Malaysia's growth in manufacturing exports to developed countries has exceeded 15 per cent a year. According to a survey by the World Bank, Malaysia ranked seventh out of 43 developing countries in terms of achievement in the share of manufacturing exports. [6]. Malaysia has become the world's largest producer and exporter of room airconditioners; the third largest exporter of semi-conductors, including microprocessors; and a leading producer of audio- visual equipment [7].

Malaysia has emerged as a world major exporter of integrated circuits since the late 1970s. In terms of value of electrical products exported in 1983, Malaysia had the highest rank among other Southeast Asian Countries. There has also been a close relationship between the structure of production and that of exports. The high degree of concentration whether in terms of output, export or export market contributed to the diversification in the Malaysia's industrial products. By the early 1970s, various new steps, notably the establishment of free trade zones, were taken to facilitate and encourage Malaysian manufacturing production for export, mainly using imported equipment and material. Following the Free Trade Zone (FTZ) act of 1971, the companies established themselves in FTZs and Export Processing Zones (EPZs) of Malaysia to export products assembled or produced by the Malaysian low-wage labour. Most of these products were in electrical and electronics machinery and to lesser extent textiles and clothing. There were about 88 plants operating in FTZs in 1983 which mostly involved in the electronics and electrical components and textile manufacturing [8].

By introduction of these FTZs, the exports of manufacturing grew very rapidly. For instance, the export of manufacturing products accounted for almost a quarter of all exports from Malaysia by 1980. There were about 80,000 employment opportunities created by the FTZs, equalling almost one eight of the total manufacturing labour-force during the period from 1972 to 1979 [9]. Another example is the electronic zone in Pehang which is the

world's largest exporter and the third biggest assembler of computer chips. As Warr (1987) stated, "The importance of FTZs in Malaysia ... is unique among the developing countries establishing these zones. No where else is their role as significant, either in absolute terms or as a proportion of overall manufacturing activity". However, as he pointed out " The degree of linkages between FTZs firms and the domestic economy, through the purchase of domestically produced raw material and capital equipment, has been disappointing" [10].

The composition of manufactured exports, as a percentages of total merchandise exports, increased from an average of 4 per cent in 1960-64 to 22 per cent in 1980- 81. There was a significant increase in export of items virtually non-existent in the 1960s such as textiles, clothing, electronics, electronics machinery and appliances [11].There was a need for Malaysia in the second stage of export-promotion policy to shift from labour-intensive manufactures to more capital and technology-intensive products such as heavy machinery, petrochemicals, and generally other resources-based industries in which the country is expected to have comparative advantage. Furthermore, there was also a shift towards greater privatisation and closer co-operation of state and private sectors in Malaysia.

Following violent racial riots in May 1969, the New Economic Policy (NEP) was incorporated within the framework of the second Malaysia plan (1971-1975), aiming at two broad objectives of promoting the national unity through the increasing income and employment levels for all Malaysians and accelerating the process of restructuring the Malaysian economy. The twin objectives of poverty alleviation and restructuring society to eliminate the identification of race with economic function directed a series of state interventions. Under the New Economic Policy, the desire to improve the position of the indigenous community led to increase in state's direct economic role. The government of Malaysia attempted to play a more direct and active role in the country's industrialisation process following the adoption the of new economic policy. The shift toward a more assertive state role in development process was emphasised by NEP as a mechanism to redistribute wealth more broadly within the domestic economy. It also attempted to amend the imbalance in ownership of equity capital and control of enterprises between foreigners and Malaysians. As a result of this shift, the overall involvement of the government in the economy rose from 24% of GNP in the 1966-70 period, to 29% in 1971-75, 31 % in the 1976-80 period and peaked the following year 48% [12].

During the first decade of the NEP, Malaysia enjoyed a period of favourable economic growth and development. GDP increased at an average annual rate of 7.13 % during the first half of decade and 8.6 % between 1975 and 1980 which can be comparable with that other successful countries in the Southeast Asia [13]. It is generally argued that the achievement of the NEP (New Economic Policy) relied more on two factors: continuing public support and the state's ability to efficient utilisation of resources and the fiscal capability of the state during the NEP which has mostly been due to its large oil and gas income during the sharp increases in the oil prices in the 1970s [14].

The Second Malaysia Plan (1971-1975) encouraged the growth of a modern industrial sector in the belief that this sector had relatively favourable rates of labour absorption. There has also been a decentralisation industrial policy during this period which was supported by the Investment Incentives (Amendment) Act of 1973. Enterprises which were located in a "locational incentive area" exempted from tax for a period of five to eight years. Despite measures designed to promote the decentralisation of the manufacturing industry, these locational incentives were relatively ineffective [15]. In 1974, Malaysia's government achieved the Petroleum Development Act (PDA) with the main purpose of controlling over exploitation of petroleum resources in Malaysia. Following (PDA), the PETRONAS, a 100 percent state-oil company, established in 1974, controlled all management decision-making in the oil sector including production, refining, and transportation, which used to be controlled previously by the foreign oil companies. The Malaysian government also obtained a 59 per cent production share of Malaysian oil and gas through production-sharing contracts.

The Industrial Co-ordination Act of 1975 (ICA) was established with the main objective of assisting in the implementation of government industrialisation policies. The Industrial Co-ordination Act (ICA) has also aimed at providing for the co-ordination and orderly development of manufacturing activities in Malaysia. The Industrial Co-ordination Act was also effective in pushing forward the New Economic Policy in the private manufacturing sector [16]. The ICA was also the instrument through which the government hoped to achieve the objectives of the New Economic Policy in the industrial sector. Under the ICA, all firms were also required to submit any agreement signed with any foreign company for

approval. Following the implementation of the Industrial Co-ordination Act of 1975, the technology transfer unit was established within the Ministry of Trade and Industry for the specific purpose of controlling all types of technology agreements. Technical support of technology transfer unit is provided by the Malaysian Industrial Development Authority (MIDA) which also controlled the quality and quantity of foreign technology transferred from abroad. It can also be added that the act provided various means of controlling information about existing industry in Malaysia [17].

It is believed that ICA has had some negative effects on the Malaysian economy. One of the most important impacts of ICA was a significant decline in private and foreign investment. There was a substantial decrease in investment, both real and nominal terms following the introduction of the Industrial Co-ordination Act of 1975. Figures published by MIDA (Malaysian Industrial Development Authority) showed that in 1976, manufacturing investment was well below 40 per cent of the target for the third Malaysia plan [18]. This can be due to number of factors including concern over the security situation in the country which had caused serious worries among local and foreign investors. The ratio of private investment to GDP in 1978 was considerably lower than the 1973-74 level. It is believed that one of the most important reasons for Malaysia's high external debt in the early 1980s has been the lack of adequate private investment. However, private investment increased during the Fifth Plan (1986-1990) at an annual rate of 13 per cent. Much of private investment concentrated in the manufacturing sector which led to an increase in the manufacturing sector value added of 13.9 per cent during the period of Malaysia Fifth Plan.

Overall, Malaysia experienced a period of favourable economic and industrial growth during the 1970s. There was an average annual growth rate of 11 per cent in manufacturing value added during the period between 1971 and 1975, and the share of manufacturing in GDP rose from 12.2 per cent in 1970 to 14.4 per cent in 1975 [19]. Substantial progress was also made in terms of job creation, structural transformation and modernisation, poverty eradication and restructuring of society. In the third Malaysia Plan 1976-1980 manufacturing was again accorded a strategic role for achieving the goals of the NEP. The participation of Malays and other indigenous groups was also made an important adjunct to industrial development. The 1980s saw a decline in Malaysia's economic performance compared with its past performance and the contemporary performance of the NICs. Despite the

implementation of the Fourth Malaysia Plan (1981-85) which aimed at the growth in Malaysia's GDP and continuing the NEP (New Economic Policy) for poverty eradication, the export earnings declined mostly because of falling commodity prices for rubber, tin, palm oil and petroleum during this period [20].

When the new government of Dr Mahatir Mohammed took power in 1982, it became clear that the extreme interventionist role of government could no longer be counted on to sustain growth. Therefore, a privatisation program became an important component of a new strategy, with the main objective of reducing the role of government in direct economic activity. It was also aimed at two simultaneous goals of reducing government expenditure and promoting competition, efficiency and productivity of Malaysian products. In Malaysia, privatisation was first formulated as a national policy in 1983. Since 1983, 22 major projects have been privatised, mainly through the sale of shares to the public. As a result of an extensive privatisation program, there has been a significant reduction in financial and administrative burden on the government in terms of personnel and financial administration. For example, the sale of shares in government controlled industry has reduced government borrowing. In terms of personnel, privatisation managed to reduce the work force in government departments by about 54,000 [21]. However, privatisation has been hampered, not so much by lack of government resources as by private firms difficulties in raising the necessary capital for purchase of government assets.

By the mid-1980s, public enterprises were made more autonomous with decentralised decision making and many were prepared for privatisation. The government replaced local managers with foreign managers in order to increase efficiency [22]. The privatisation process has recently been accelerated by privatising fifteen major public firms, including the largest automobile producer Proton, the telecommunications utility, Telekom Malaysia, and the Malaysian Airlines System during the period between 1989-1992. By 1992, 40 public enterprises had been taken over by the private sector, and 14 projects involving infrastructure and utility construction had been privatised [23].The government also proposed an integrated industrial strategy which emphasised firstly on the expanding of the heavy and chemical industries based on domestic resources and secondly on the further diversification of the Malaysian industrial structure in particular small scale industries. As an example, one can refer to the bicycle industry which showed how it could expand the

domestic market with an intermediate degree of factor-intensity [24].

As indicated earlier, following the implementation of a heavy industrialisation drive in early 1980s, a number of heavy industries, including integrated steel mills, petrochemical complexes and other plants such as a multi-billion project for building car (Proton Saga) based on Japanese technology were established. The Heavy Industries Corporation (HICOM) was established in 1980 and was made responsible for developing more capital-intensive projects. These projects which required a large amount of money led to heavy loan servicing for the country. The Proton plant was supposed to increase annual output gradually from 80,000 units in 1985 to 120,000 by 1988. However, despite heavy subsidies and protection by the government, total car sales for 1987 had declined to about 50,000. It has also been argued that each car sale abroad involved a subsidy of at least $ 5000- 6000, almost half the sale price.

In addition to the Proton car project, other heavy industries projects such as steel plants has had similar positions. For example, the state-owned steel industry, Perwira Trengganu, had a total debt $ 1.35 billion up to March 1988 [25]. Furthermore, these capital-intensive heavy industrial plants provided relatively few jobs in the country. It is also believed that premature focus on heavy industry has resulted in inefficient allocation of resources which affected other resource-based industries [26]. Malaysia's heavy industrialisation policy has been accompanied by changes in the composition of output, as Malaysian industry evolved from the simple assembly of imported components, to the manufacture of labour-intensive, import-substitutes industries and the processing of new materials such as rubber for export. The heavy industries policy was also formulated as a means of achieving two not very compatible goals, those of accelerating the pace of industrial growth and at the same time improving the economic position of Malays relative to those of the other resident communities in Malaysia.

However, as discussed earlier, it can be said that the heavy industrialisation programme has produced some negative impacts on the Malaysian economy. Although originally designed to generate local linkages, Malaysia's newly established heavy industries remained heavily dependent on participation of foreign capital which led to heavy external borrowing. Another problem faced by heavy industries in Malaysia has been the relatively small size of the domestic market. With a population of less than 14 million in 1980 and a relatively small

domestic market, it has not been easy for many heavy industries to operate at a minimum efficient scale of operation [27]. Malaysia's relatively unsuccessful experience with heavy industries can present at least two useful lessons for other LDCs: Firstly, adequate and intensive preparation have to be made, at least with respect to technology and human resource development as well as the modernisation of small industry before developing heavy industry. Heavy industries require a high degree of technical, managerial and marketing experience. Secondly, where government intervention has not proved to be efficiently and effectively pro-active, the implementation of heavy industries should rely more on market forces and private enterprises, rather than on government.

Malaysia adopted "look-east" policy in the early 1980s with the main objective of promoting industrialisation and modernisation of Malaysia through learning, particularly with regard to labour ethics, discipline, and managerial skills from S. Korea and Japan. It has therefore introduced the Japanese and S. Korean model for Malaysia's industrial and technological development. This has been more because Japan and Korea suggested development paths less threatening to traditional Malay culture. Despite the negative impacts of Japanese occupation in wartime, the Malaysian public has generally been positive to Japanese investment, products and culture, because of the demonstrated economic success of post-war Japan. As Dr Mohatir Mohammed noted, Malaysia wants to follow the good values of the Japanese such as their large capacity for hard work and integrity. It is also believed that adoption of an industrial culture which increased productivity, hard work and financial discipline has been a necessary precondition for successful industrialisation in Malaysia [28]. However as Bowie (1994) pointed out, "Malaysia has never closely resembled the development state model often associated with Korea and Taiwan" [29].

The recession of 1985-86 which was accompanied with an outflow of capital and negative growth rate of 1 per cent, led to a government decision in Malaysia to take some new measures to encourage local and foreign investments. As an example, one can refer to some specific measures, such as privatisation of state-owned companies and relaxation of the regulations on the ownership of the foreign subsidiaries up to 100 per cent. Furthermore, the new Promotion of Investment Act (PIA) replaced the previous Investment Act in 1986, which provided tax exemption for companies engaged in manufacturing new products or undertaking modernisation, expansion or diversification of products. Therefore, with the

implementation of these measures, foreign investment increased very sharply by 137 per cent in 1988 and 77 per cent in 1989, and the economy grew from 1.2 per cent in 1986 to 5.4 per cent in 1987, rising to 8.9 per cent in 1988 and 8.8 per cent in 1989. Other measures undertaken after 1985 economic crisis in Malaysia included deregulation, liberalisation and greater provision for development of infrastructure.

Malaysia's government has adopted the Industrial Master Plan (IMP) in 1986 which accompanied with Malaysia's Fifth Plan (1986-1990) with the new long-term objectives, such as increasing indigenous technological capability and competitiveness in international markets in order to reach the advanced level of industrial and technological development. The government under the IMP also emphasised the importance of export-led industrialisation and promoting manufactured exports. In line with the IMP and to further improve the incentives available for the development of the manufacturing sector, the Promotion of Investments Act (PIA) was introduced in 1986. Under the PIA, new export incentives, as well as incentives for development of small-scaled industries were introduced. The IMP has pointed out that due to Malaysia's growth and development record, it has been a relative latecomer to industrialisation. The IMP attributes Malaysia's delayed industrialisation to its success in developing primary exports. The IMP also admits that Malaysian import-substituting industries have been excessively protected. The effective rate of protection for the entire sector rose from 25 % in 1962 to 50 % in 1966 and 70 percent in 1972. The IMP also realised that export-oriented manufacturing has been heavily dominated by two types of industries, namely, "electronics and electrical products" and "textiles and garments", which together accounted for $ 6.4 bn or 65 per cent of the $ 9.8 bn worth of manufactured exports in 1983, of which semiconductor assembly alone accounted for 41 per cent [30].

While the IMP acknowledged the impressive growth of electronics, it has been argued that this sector has had a heavy dependence on production of components, accounting for 80 to 85 per cent of industry's total output. As an example one can refer to a survey of thirty two electronic and electrical products factories, it has been found that only a quarter obtained some simple parts, not requiring any advanced technology from local firms, while the remaining three quarters imported all their requirements. The IMP has also concentrated on development of resource-based industries in which Malaysia has comparative advantage.

Therefore 12 major industrial sectors identified; rubber products, palm oil products, food processing, wood-based, chemicals, non-ferrous metals, non-metallic mineral products, electronic and electrical, machinery, iron and steel, transport equipment, textiles; as leaders in the Malaysia's industrialisation programme in the 1990s. In order to be able to compete in the international market, these industries need to improve their production efficiency through the generating a strong technological and information base along with a good technical supporting services [31].

In order to accelerate manufacture exports, the IMP provided a series of export incentives such as an exemption from tariffs and customs duties. As a result, the export targets set by the IMP have been generally achieved by almost all sectors. Even in some industrial sectors, the actual export exceeded the IMP export targets. For example, export of electrical and electronics industries exceeded the targets by 44.6 per cent in 1986, 62.1 percent in 1987 and 101.6 percent in 1988 for the electronics sub-sector, and by 77 per cent in 1986, 127.1 per cent in 1987 and 215.1 per cent in 1988 for the electrical sub-sector [32]. However the biggest push in Malaysia's export of manufactured products has been from the iron and steel industry. The export of iron and steel products grew rapidly over the three year period of 1986 to 1988, exceeding the IMP's 1986 export target by more than 500 per cent, over 1000 per cent in 1988 [33]. The Industrial Master Plan also suggested several other measures to cope with the bottlenecks in manufacturing sector: firstly, the overall protection of industry has to be reduced to promote industrial efficiency. Secondly, the existing imbalances in the provision of incentives which exist between import-substitution and export industries have to be adjusted in order to attract more export industries. Thirdly, large and medium scale export-oriented industries have to be located together in urban regions, whereas small and light industries which mainly serve the domestic market encouraged to locate themselves in the less developed regions.

The Malaysian state has adopted relatively similar industrial policy such as Korea and Taiwan in order to implement the IMP. Therefore, industrial policy focused more on attempts to promote reinvestment, industrial linkages, exports, and training. It can be seen that like Korea and unlike Taiwan, industrial policy in Malaysia has favoured more large scale industries than small-scale counterparts. It is argued that the main problems faced by small industries has been the poor access to credit institutions, technology, management

training, marketing, sub-contracting opportunities, suitable sites and premises as well as discriminatory government policies and practices [34]. While the IMP accepted the significant contribution of foreign direct investment, it has recognised that the heavy dependence on foreign investment in some important industries may lead to lack of strong indigenous technological capability [35]. The major problems that have affected Malaysian industrialisation stated by IMP can be summarised as following:

1. Technological dependence and lack of indigenous industrial technology capability;
2. Shortages of engineers and technicians;
3. Lack of private sector initiatives;
4. Constraints imposed by NEP (new economic policy) restructuring efforts;
5. Inadequate incentives for technological development.

Following its growth of 5.4 per cent in 1987, the Malaysia's economy has continued to grow at an average rate of 8 per cent in late 1980s. This impressive performance has been more because of a further change in the nature of development policy. It can be said that the emphasis of development for the second half of the 1980s has been more based on growth with stability along with improving efficiency. One can say that the IMP enabled industries in Malaysia to realise their strength and weaknesses. Moreover, the formulation of the IMP has facilitated the preparation of the Technology Action Plan. However there are some criticism against it. Some argued that the IMP has been too much in favour of the foreign investor at the expense of the domestic investor. Others believed that IMP emphasised more on the state intervention model of S. Korea and Japan and ignored the open market oriented model of the west [36].

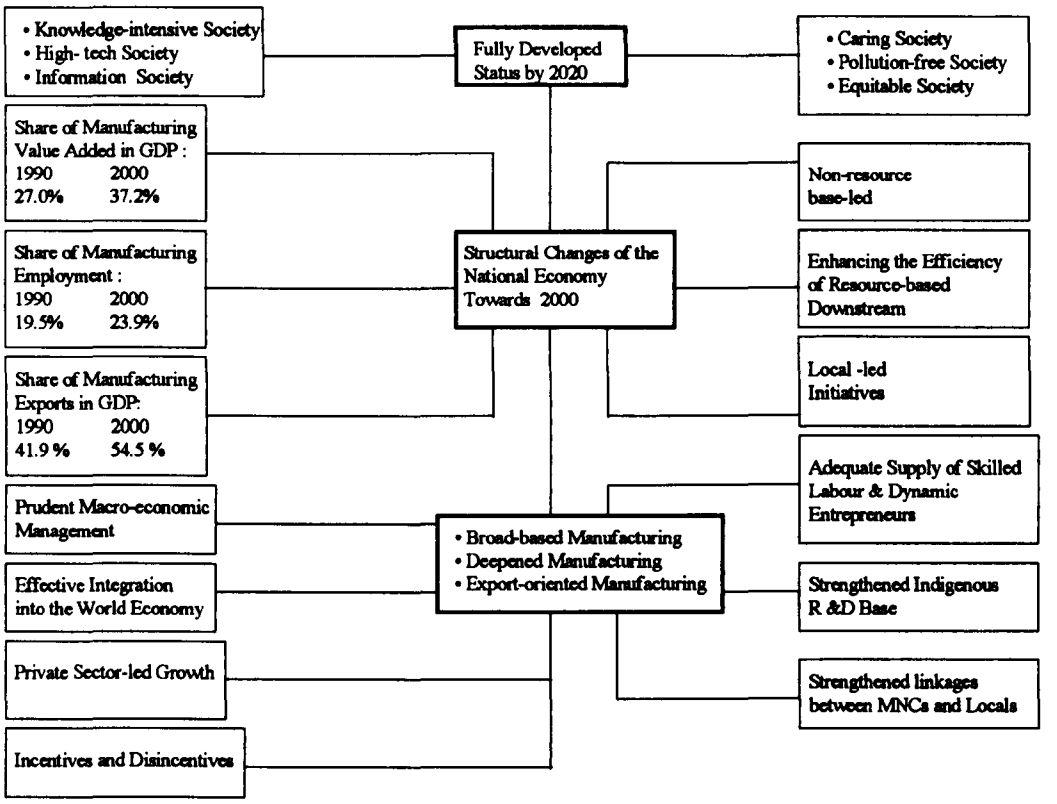
Following the successful implementation of IMP, there has been a significant increase in output of some particular manufacturing sub-sectors in Malaysia. For example, there was annual growth rate of 30 per cent in transport equipment and electrical equipment in 1990 and 1991. There was also an increase in exports of transport equipment by 68 per cent and electrical machinery by 32.1 per cent [37]. However, Malaysia's economy is said by the IMP to be characterised by various imbalances, with the manufacturing sector narrowly based on a few labour-intensive and resource based industries. The New Economic Policy (NEP) whose targets were unlikely to be achieved by 1990 was replaced by the National Development Policy. The NDP main objective emphasised the point that Malaysia should

become a completely developed country by the year 2020. This objective is supposed to be achieved by implementing a number of strategies including an annual average growth rate of 7.5 per cent, continuing the process of privatisation and deregulation, widening the manufacturing base, promoting small and medium-scale industries and attracting more foreign investment by allowing up to 100 per cent foreign equity in export oriented sector. The manufacturing sector is expected to provide the main role for achieving the GDP growth rate of 7.5 per cent. Following the implementation of the Sixth Malaysia Plan (1991-1995), manufacturing sector's share of GDP has increased from 27 per cent in 1990 to 32.4 per cent in 1995.

As Malaysian Prime Minister, Dr Mahatir Mohammed has noted "Malaysia's future depends on improved productivity and the ability to sell more and more goods to the world. He also promised to reduce the role of government in industry and stressed that the main source of economic design [38]. The National Development Policy and the Sixth Five Year Plan has placed more emphasis on accelerating the pace of privatisation of state-owned enterprises, along with improving infrastructure and worker productivity through new training and education programs. This can enable the Malaysian economy to absorb rapid increases in private investment. Furthermore, there has been high priority for the expansion of the transport and communication systems, the upgrading of human resources and the development of science and technology during the Sixth Malaysian Plan.

There has recently been more emphasis on the expansion of private sector. By late 1990, over 30 state-owned enterprises had been privatised, with another 68 firms being either approved or under consideration for privatisation [39]. Furthermore, the government has stressed the need for a collaboration between the public and private sectors through the "Malaysia Incorporated" concept. Under the Sixth Five Year Plan, there has been a strong shift towards emphasis on industries in which Malaysia has the comparative advantage, including natural resource based industries such as wood-based industries, rubber products, automobile tyres and latex products for medical uses and electrical and electronics. There is also a shift from labour-intensive industrial sector towards supporting a more capital-intensive and high-technology based industrial sector. The intense global competition for investment which intensified with the entry of new competitors such as Latin American countries, Vietnam and China, along with the inevitable rising of domestic labour wages are

among major reasons for this shift. Therefore, there has been more priority given to export-oriented, high value added and high technology industries with R&D forming an integral component of industrial sector.



Source : " Structural Change and Industrial Development - The Malaysian Experience", Paper by Professor Choong Yong Ahn, June 1992

Figure C.1 Malaysia's Industrial Development plan towards the year 2000.

One of the most important factor of Malaysia's success is believed to be the overall stability of its socio-political environment. Despite the differences in ethnic, cultural, and religious composition of its population, it has proven to be a model for inter-racial co-operation and harmony for other developing countries [40]. Another important factor that has played a significant role in enabling Malaysia to achieve more rapid economic growth, is the international competitiveness of its labour-intensive industries, in particular the electronics industry.

C.1 THE ROLE OF FDI IN MALAYSIA'S INDUSTRIALISATION

Foreign Direct Investment (FDI) has played a major role in the country's industrial development, not only because of providing product design and industrial technology but

also for its overseas market access. It can be said that foreign investment has been a dominant factor for Malaysia's industrial development during the 1960s and 1970s. For example, in 1970s, foreign investors controlled more than half of the import-substitutes manufacturing sector [41]. Malaysia has been the world's third, fourth and fifth largest receiver of the FDI in the late 1960s, 1970s and 1980s respectively, and it has become the world's fourth largest receiver of FDI in early 1990s after China, Singapore and Mexico. It has received the total amount of $ 13.2 bn during the period between 1988-1992 [42]. Foreign direct investment has contributed to an average annual rate 8 per cent of GDP in Malaysia during the 1980s. Since 1989 this figure has increased to 19 per cent in recent years as a result of more attractive incentives encouraging foreign investors to invest in various industrial sectors of Malaysia. Another estimation provided by the Malaysian Industrial Development Authority (MIDA), FDI contribution to manufacturing investment has increased from around 40 per cent in 1985 to 58.6 per cent in 1988, 73.8 per cent in 1989 and 64.4 per cent in 1990 [43]. During the Sixth Malaysia Plan period (1991-1995), a total amount of M$ 80,000 million have been invested in the manufacturing sector, of which M $33,000 million was FDI [44].

As indicated earlier, most foreign capital and investment have been attracted by the manufacturing sector in Malaysia, of which scientific and measuring industry, the beverage and tobacco industry, and the electrical and electronics industries have had the highest rate in attracting FDI in 1986 [45]. However, it should be noted that FDI inflow, in the long term, moves towards the industries where Malaysia has a comparative advantage such as the electronics and machinery industries. FDI in to Malaysia has been co-ordinated by the Malaysian Industrial Development Authority (MIDA) a governmental organisation that has created incentives necessary to attract new capital, technology and managerial skills into the country [46]. MIDA also provides two major statistical data series on FDI, including an estimation of the expected flow of FDI and the actual stock of FDI. In addition, the industries divisions of Ministry of International Trade and Industry (MITI) provide most information about FDI in industry in the form of manual administrative files containing all correspondents between MITI, the companies and other government agencies [47].

It is argued that the industrial restructuring in Japan and East Asia has led to accelerated inflows of FDI into Malaysian industries. Japan has been the largest investor in Malaysian

1988, with total of M$561 million ($ 215million) in approved investments, followed by Taiwan ($ 147 million),United States ($ 97 million) and Singapore ($66 million). These countries jointly accounted for more than 78.5 per cent of total foreign capital in the approved projects in 1988 [48]. Japanese investment during 1973-4, focused more on light manufacturing and the integrated circuit industry. During the early 1980s, Japanese investment mainly concentrated in the construction of buildings, dams, electric power plants, and highways. The more recent investment by Japanese multinationals has focused more on the electronics and electrical manufacturing. More than twenty-five Japanese semiconductor companies, such as Hitachi, Toshiba, and NEC, have invested directly in Malaysia. The recent Japanese investment in electric and electronics industries of Malaysia can also be best seen in Matushita's air conditioner factory, Sharp's audio equipment and colour TV sets and Hitachi's mainly semiconductor devices [49]. However, the majority of NICs investments has concentrated into Malaysia's traditional export-oriented industries. It can be said that while FDI inflow has contributed to relatively more rapid growth of the manufacturing sector, such inflow has provided substantial opportunities for Japanese industries to increase their exports of intermediate and capital goods to Malaysia.

The Investment Incentives Act of 1968 was basically designed to attract foreign investment by providing total or partial tax relief to companies involved in new manufacturing projects or expanding into new products. More foreign investments were to be found in food, textiles products and electrical and electronic goods, which jointly accounted for 40 per cent of the total FDI in 1983 [50]. With the beginning of new phase of liberalised export-led industrialisation in 1986, the government relaxed the NEP (NEP imposed a requirement of divesting up to 51 per cent of the equity to local Malaysian enterprises) in the interests of boosting industrial investment, exports and employment which have led to the attracting more foreign investment. Moreover, the depreciation of Malaysian currency, structural adjustments, economic liberalisation, and relatively low wage level in Malaysia, have recently led to the new wave of East Asian NICs investment into the country.

As explained earlier, the financial burden of the big projects in heavy industries such as PROTON (Malaysian national car) and problems such as recession and decline of market prices for primary products including oil, rubber, and tin, in the mid-1980s, created financial problems for the Malaysian government, which led to the country's external debt of 21.3

billion ringgits (27.7% of GNP) in 1985 [51]. Therefore, the government relaxed policies on foreign investment in order to attract more FDI. The government allowed 100% foreign ownership to companies that export more than 50 % of their products and employ more than 350 of Malaysian labour force. It should be noted that while there were few wholly-owned and turnkey operations, the majority of the foreign investment in Malaysia has been in the form of equity joint ventures. However, there has recently been a tendency towards FDI in the form of licensing and franchising agreements and management contracts. Malaysia's policy towards foreign investment has been tied to the overall objective of diversification and modernisation of the economy.

Foreign investment in Malaysia has presented a certain pattern, particularly in terms of market orientation and ownership structure. It is argued that foreign investment in Malaysia has been heavily oriented to exports which improved country's balance of payments in the late 1980s [52]. It is believed that a heavy reliance on foreign investment in Malaysia has led to the heavy imports of capital and intermediate goods. It is also observed that despite creating employment opportunities, the types of industries which came into Malaysia did not generate high value-added in the overall economy of the Malaysia [53].

C.2 THE ROLE OF HUMAN RESOURCE DEVELOPMENT

The role of human resource development in Malaysia's development should also be noted. It is obvious that investment in human resources and education has played a significant role in facilitating an upgrading process to achieve higher productivity and remain competitive in international markets. For instance, it can generally be seen that Japan's large pool of scientists and engineers has been more important to success in numerous Japanese industries than the low wages of Japanese production workers [54]. Overall, the strategy of human resource development in Malaysia has been a vision of a more efficient and effective labour market with better and effective allocation of labour resources to sectors which need labour and skills, and allowed mobility of labour between regions. Education was a primary concern of the early Malaysian plans. In the 1960s, it was the third largest item in the development budget, after land development and transport. Nearly 20 per cent of total expenditures has been allocated on education program in 1960s. Development expenditure on education rose from 9.4 per cent of the total in the second Malaysia Plan to 16.1 percent in the Fifth Malaysian Plan, before dropping to 15.1 per cent in the 6th Malaysia development plan [55].

The Fifth Malaysian Plan (1986-1990) also emphasised more on human resource development through the training and education of the labour force to increase their productivity. Furthermore, rapid growth and the pressure for the adoption of more capital-intensive technologies has been another incentive for Malaysia for expanding its education and training programmes. Education standards also continue to be a major advantage for Malaysia in attracting, and keeping, foreign investors like the electronic chip makers in recent years. Some electrical and electronics firms began introducing systematic human resource development programmes which not only provided some training and retraining programmes for their workers but also motivated workers sufficiently to retain them [56].

Having compared the educational factors of Malaysia with other less developed countries, one can see that the educational attainment in Malaysia has been in a high position. For instance, the literacy rate was 60 per cent in 1987, the primary and secondary school enrolment has been 60 per cent and 56 per cent respectively [57]. However, despite a relatively high rate of expenditure on education, Malaysia has got less out of it. It is believed that Malaysian educational system has concentrated more on humanities rather than technical and engineering science, and technical education has been neglected [58]. Moreover, despite of a relatively good stocks of educated labour in Malaysia, it is believed that the amount professionals, particularly engineers, skilled technicians and managers, has been inadequate for sustaining rapid industrialisation in Malaysia. Malaysia's existing six universities and other institutes of higher education have produced only about 500 engineers and 1,500 diploma- level technicians every year. This problem has intensified with increasing rate of emigration of its qualified and experienced professionals to more advanced countries (brain drain). For instance, as a result of recession over the period between 1984-1986, many middle-level managers and professionals emigrated to countries such as Australia, New Zealand and Singapore [59]. Hence, the shortage of highly qualified technicians and engineers has been a source of complaints from foreign investors, and has remained a barrier for more effective technological transfer. Moreover. the weakness of the education system as well as lack of adequate training for Malaysian industrial labour have led to the low level in technology absorption capacity of domestic industries.

Having compared the educational level of Malaysia with that of Korea, Taiwan, China and

Thailand, as Lall (1990) indicated, Malaysia's overall educational level has been some way below S.Korea, Taiwan and China but slightly greater than Thailand [60]. According to a survey by the World Bank (1989) in Malaysia only one in ten applications for vocational training has been accepted, compared to one in three applicants for higher education [61]. Another survey by World Bank on the impact of recession in the Malaysian economy indicates to the existence of a mismatch between the skills available and that needed by industries. This dissimilarity has increased by the reduction in public sector expenditure and the freeze in public sector employment. As a result, the Malaysian economy has suffered from increasing unemployment which led to a certain extent to the weakness of the Malaysian educational and training system. Furthermore, the poor linkages between various academic institutions and local firms has been another problem for Malaysian industrial sector.

C. 3 THE ROLE OF TECHNOLOGY IN INDUSTRIALISATION OF MALAYSIA

Technology transfer to Malaysia has been another important factor of Malaysia's industrial development. There were a total of 1,579 agreements, approved by the Ministry of International Trade and Industry (MITI), during the period between 1957-1989. The averaged number of these agreements per year has increased from less than 60 a year before 1980 to a peak of 198 agreements in 1989. Japan has transferred highest proportion of technology to Malaysia (35%) followed by UK (13.5 %) and US (11.1%) during this period (1975-1989) [62]. The Japanese share as a major supplier of foreign technology in Malaysia can be attributed to Malaysia's Look East Policy as well as the increasing international role of Japan as industrial technology exporter particularly in 1980s. Malaysian firms have obtained Japanese technologies more through imports of capital equipment or machinery. For example Japan provided almost 34-40 per cent of Malaysia's machinery needs between a period between 1978 and 1983. However it should be noted that capital equipment or machinery alone does not constitute technology, it represents only part of technology embodied in hardware, while the remainder included software can only acquired through indigenous technological effort.

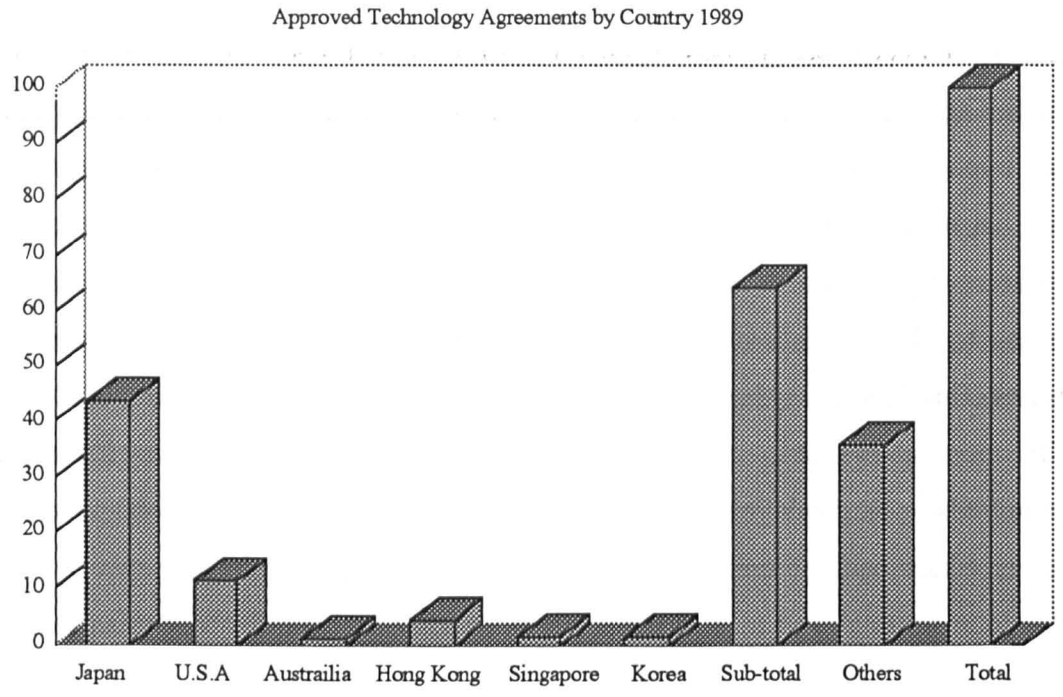


Figure C.2 Approved Technology Agreements by country 1989

As is shown in the following table, the number of technological agreements has increased since 1980. It can also be seen that technical assistance and know-how agreements with about 52.6 per cent of all technological agreements approved during the period between 1980-87, has been the major mechanism for acquiring foreign technology. Management services and joint ventures with about 22.2 per cent of total technological agreements have been another main source for importing foreign technology in Malaysia during this period. Turnkey engineering agreements, where technology suppliers are responsible for all technical decisions, has accounted for a much smaller proportion of the total (1.7 %) [63]. This indicates that there has been a shift from the packaged to unpackaged type of foreign capital investments in relations to technology transfer process in Malaysia. The former refers to an arrangement whereby technology is purchased as an important component of an investment package to be complemented by management, marketing services and equality participation.

Types of agreements	1980	1981	1982	1983	1984	1985	1986	1987	Total	%
Technical assistance	57	64	48	61	71	51	50	53	455	52.7
Management contracts	13	6	10	13	10	6	10	5	73	10.1
Joint Venture	14	22	14	14	17	9	19	11	120	12.2
Service	6	7	2	7	2	1	1	1	27	5.9
Trademarks & patents	4	8	8	7	1	19	33	30	110	9.9
Turnkey	5	5	4	4	6	-	1	-	25	1.7
Others	15	19	8	25	12	10	9	10	108	7.5
Total	114	131	94	131	119	96	123	110	949	100.0

Table C.2 Types Of Technology Transfer Agreement, 1980-87

However, it should be noted that most technologies have been transferred to Malaysia in the past (before the 1980s) through importation of machinery and equipment, complete plants or turnkey projects, and transfer of knowledge through the movement of people. In Malaysia, the largest proportion of technology transfer payments made by firms involves payments for new machinery and equipment. More recently, it appears to be more profitable for Malaysian enterprises to obtain their required technologies by entering into a joint venture or licensing agreement with foreign partners. Most of these technology agreements were in the electronics and electrical industries (17.7 %), fabricated metal industries (10.8 %), chemical industries (12.3 %), and transport equipment (10.6 %), which accounted for more than 50 % of all technology agreements signed, indicating more emphasis on Malaysia's technology transfer policies towards these relatively technology-intensive and heavy industries. As in most other developing countries, technology transfer regulations in Malaysia have not been utilised to search for more appropriate technologies, partly because technology transfer is processed by administrators lacking the necessary technology background [64].

It can be said that lack of indigenous technological capability within domestic industries has been a major hindrance in achieving a higher level of industrialisation in Malaysia. Because of direct and easy access of Malaysia to foreign technologies through foreign direct

investment and joint ventures, little attention was paid to the creation of the minimum levels of indigenous technology which was necessary to absorb foreign technology. It is believed that due to some factors such as small domestic market and partly its inability to internalise foreign technologies, Malaysia has also lacked legislation and government control on technology transfer. Moreover, low productivity in some of the Malaysia's industry sector including small industry, transportation, which is believed to be because of the institutional and structural constraints, has prevented the application of more efficient or appropriate technologies. Furthermore, there have been other reasons including the absence of incentives and infra structural support for small industries, and lack of know-how in some of its industries. Therefore, Malaysia needs to identify the foreign technologies which can be more contributed to the strengthening of its domestic technological capability through better adaptation and assimilation of those technologies to its local conditions.

In the 1970s and the early 1980s, multinational investment was concentrated in capital-intensive and high levels of direct foreign investment, contributing little to domestic technological capability. Due to change in MNCs strategy in order to improve productivity for the competitive international markets, they started to transfer skills and know-how along with the machinery and train local engineers and workers. The government in Malaysia has encouraged technology transfer from multinationals in order to accelerate the growth rate of economic and industrial development. The technology transfer unit in the Ministry of Trade and Industry was set up to ensure the assimilation and absorption of foreign technology. It can generally be said that due to some factors particularly, heavy dependence on foreign companies, lack of linkages with local producers, and limited R&D activities, Malaysian firms did not have adequate opportunities to transfer foreign technologies through learning by doing. These factors also led to the lack of adaptation of imported technology and heavy dependence on imported technology in Malaysia. One can also add that most MNCs (multinationals) in Malaysia have involved in simple assembling of imported components rather than actual manufacturing, therefore there has been less real transfer of technology in Malaysia.

However, there is some evidence of successful technology transfer between Malaysian firms and their foreign counterparts. As an example, one can refer to a Malaysian- Singapore joint venture agreement in transferring textile mills into the country. There has been considerable

transfer of textile technology appears to have occurred, such as acquiring various skills in different aspects of textile manufacturing and also maintenance and operation of highly sophisticated machinery and equipment by Malaysian workers. Another example of successful technology transfer was a Malaysian-Taiwanese joint venture in producing copper and aluminium power cables, telephone cables, and underground cables. It can be said that Malaysian workers not only adopted the know-how of the wire and cable technology and operated advanced machinery and equipment but also they could diversify the products by undertaking R&D activities [65].

These success examples of technology transfer can refer to the point that Malaysia has been able to adapt, assimilate and absorb technologies which were transferred by other NICs in East Asia rather than multinationals in other developed countries. This is partly because of the cost consideration. While MNCs in developed countries invest heavily in R&D to innovate technology, NICs generally copy technology from advanced countries and transfer older technology to the other LDCs (including Malaysia) which they acquired from industrialised countries at much less cost. The most recent shift to strengthening high-technology manufacturing in Malaysia has led to the establishment of comprehensive infrastructure and support services. These include new technology parks and science parks which offer investors and companies access to ready-built, specialised research and development facilities. These technology parks also provide the infrastructure for R&D activities to support the operations of high technology industries, for example, Technology Park Malaysia which has been established in Malaysia since 1986 to support the growth of high-technology industries and industrial entrepreneurship. It has also provided a critical link between industry, the government, research institutions and universities [66].

Determined to be a major part of the technology revolution that has taken place in manufacturing around the world, Malaysia is building a strong technological competence, particularly in areas where it has a natural advantage, such as resourced-based industries. The Malaysian government has recently identified six strategic industrial sector in this area, to be given priority for R&D support. These include advanced materials, automated manufacturing, biotechnology, microelectronics and laser technology, information technology and energy-related technology. In Malaysia, the process of technology transfer has generally taken the following forms:

1. Introduction and purchase of technology from outside,
2. Maintenance and modification and
3. International development and production.

It can be said that among the technological power factors in Malaysia, maintenance is evaluated at the highest level of 4.4 and modification at 3.8, followed by manufacturing at 3.2, and designing at 3.0. The maintenance level of 4.4 can be equalised with that of other NICs such as Hong Kong and Singapore [67]. According to a survey of the situation of technology transfer in the firms locating in the FTZs in 1980s, it can be seen that while there has been less technology transfer in textile firms, it can be said that the greatest transfer of technology has been taken place in the communications and semiconductor firms. In the case of the semiconductor firms in the Malaysia, however, technology development has been limited to the machinery. A survey by MIDA of the effects of technology transfer on the Malaysian domestic enterprises in 1989 has pointed out that local engineers have on several occasions developed automated machines and exported them all over the world. One such a product was a semi-automated die-attach machine, which was previously subcontracted to a local firms [68]. Moreover, it can be said that there has generally been a high degree of transfer of technology in the electric industry in Malaysia, which contrasts with the automobile industry's low rates of transfer for most technology types.

As indicated earlier, in order to be able to compete more in the international technology market, Malaysia needs to upgrade and promote its technological capability. It is argued that one of the major obstacles in the development of technological capability in Malaysia, has been its relatively weak scientific and technological infrastructure in manufacturing industries. Therefore, the recent technology policy in Malaysia has emphasised more financial support of R&D activities particularly in areas in which the country has a comparative advantage. Priority has also been given to the expanding and strengthening of human resource development to increase the availability of the high-level industrial workers required to adapt and assimilate imported high-technologies. It is also needed for Malaysia to link the science and technology activities between academic institutes and universities by establishing an effective co-ordinating ministry or organisation. It is also argued that technological capability can be improved by emphasising more the adaptation and acquisition of imported technologies rather than generating new technology, although the

latter skill remains the final objective.

C. 4 THE ROLE OF RESEARCH AND DEVELOPMENT (R&D) ACTIVITIES

It is obvious that R&D activities can enhance the country's capability to absorb and assimilate foreign technologies and also improve indigenous technological capability. The national R&D expenditure was estimated to be 0.66 % of GNP in 1984. The government has allocated M$ 400 million for R&D for public research institutes (59%) and universities (32%) [69]. It must be noted that there was a significant increase in university research after 1987, indicating the government emphasis on developing the research capabilities of universities. There were about 20 government institutions for R&D activities in early 1980s, such as SIRIM (Standards and Industrial Research Institute Malaysia), IMR (Institute of Medical Research), Tun Ismail Atomic Research centre. As an example of R&D activities in Malaysia, one can refer to the R&D activities in rubber products which has been one the major items of Malaysia's exports. While Malaysia has owned 36% of the world's natural rubber, its share in the world's rubber output was 0.4% in 1983. This is mostly due to the fact that only 20% of Malaysian rubber manufactures have involved in R&D activities [70].

However, all of Malaysia's major universities have recently established research and development centres and operations. For example, University Pertanian Malaysia (UPM) had 1,300 research projects during the period 1991-1993 covering production of food through biotechnology, environmental conservation through the sustained use of natural resources and automation and electronics in industry. Meanwhile, University Malaya has been very active in research in the some areas such as industrial products, timber preservatives and crop protection; lasers and opto-electronics for industrial and medical applications; plasma research; and solid and biomass as alternative sources of energy. As indicated earlier, there has been a lack of systematic linkages between scientific and technological infrastructure existing in Malaysia. All the components of that infrastructure remain basically unconnected and act almost independently of one another. It seems that there has been a gap separating the industrial sector from the educational and research sector in Malaysia. Therefore, the Malaysian government has attempted to fill this gap by establishing science parks for the exchange of ideas between technologies and academicians.

Total R&D expenditure in Malaysia has increased to an average of 0.8 per cent of GNP in

1989, comparing to 1.4 per cent in Taiwan and 2.1 per cent in Korea. The share of public sector investment in R&D activity has accounted for over 80 per cent of the total R&D expenditure in Malaysia. In 1989, of the total of 13600 personnel engaged in R&D activities, only 13 percent were employed in the private sector. However, there has been an increase in private investment in R& D during the Sixth Malaysian Plan. There has recently been a tendency for foreign companies to establish R&D centres in Malaysia. For instance, Sharp Co-operation of Japan has set up a $ 20 million R&D centre in Johor with facilities for research in areas such as electronic and mechanical design, product planning and engineering analysis [71]. Furthermore, the government has decided to increase R&D expenditure per GNP to 2 per cent by the year 2000, as R&D and the ability to innovate are the key factors to promote Malaysia's competitiveness in international market.

C. 5 SUMMARY AND CONCLUSIONS

As indicated earlier in detail, Malaysian rapid economic and industrial development during the period between 1970-1990 can be attributed to the achieving of some specific industrial policies and plans in this period. These policies and programmes included early import substitution industrialisation policy for building industrial infrastructure which was accompanied with the New Economic Policy (NEP) announcement of 1971 and was intensified by the Industrial Co-ordination Act (ICA) of 1975, followed by a successful shift towards export promotion industrialisation policy as well as significant effort to attract labour-intensive export activities particularly in electronic components and textiles in 1970s, and a state-led heavy industrialisation policy of early 1980s along with a series of reforms (managerial improvement and privatisation of public enterprises, new investment incentives for attracting more foreign investment) that began in 1983 and intensified in response to the recession of 1985-86, the Industrial Master Plan (1986-1995) which aimed at the utilisation of the country's abundant natural resources and accelerating the growth of the resource based industries, and the recent National Development Policy which replaced the NEP in 1991.

Therefore, these programmes and policies have played a critical role in the Malaysia's experience of industrialisation. It should also be noted that to succeed to the higher stage of industrialisation which has envisioned by Dr Mahatir Mohammed as a new vision for

Malaysia to become a fully industrialised country in 2020, Malaysia must acquire much greater technological capability. This required the state to provide several forms of support for science and technology development. As indicated earlier, Malaysia can promote its technological capabilities through number of supportive policies including more financial support for R&D activities, support policies for human resource development and programmes to promote the diffusion and assimilation of foreign technologies.

It can generally be argued that the Malaysian industrialisation has been conducted under government guidance within the framework of the successive national development plans and as part of NEP (New Economic Policy), IMP (Industrial Master Plan) and NDP (National Development Policy). Therefore, it can be concluded that despite the open nature of the Malaysian economy, the state has played a critical role in creating the required infrastructure for industrial development, providing facilities for private firms, and utilising the country's vast natural resources. As in other Southeast Asia NICs such as Korea and Taiwan, the government has had an important role in the achievement of a strong and efficient manufacturing sector in Malaysia. While government in Malaysia has not been authoritarian as in some of the Asian NICs, it has also not been weak and uncertain, as in some less developed countries.

In sum, one can generally refer to several reasons for industrial development in Malaysia. First, as the experiences of industrialised countries and newly industrialised countries such as Korea and Taiwan shows, industrial development can make significant contribution to employment creation particularly from that of labour intensive industries. Therefore, the poor labour absorption by the agricultural sector in Malaysia relative to the high population growth rate necessitated rapid development of the industrial sector to avoid high unemployment. Secondly, rapid growth rate of the industry sector, particularly manufacturing, has shown that Malaysia can achieve higher economic growth as a result of industrial development. Moreover, Malaysia would be able to compete in international market by its rapid technological development and adequate provision of physical facilities and a well balanced industrial policy [72]. One can also refer to the Malaysia's major natural comparative advantage for rapid industrialisation which consists of:

1. an adequate infrastructure,
2. extensive natural resources,

3. a moderate industrial base which concentrate mainly in electronics and textiles, and
4. the existence of some general engineering capability.

Moreover, the success factors of the Malaysian economic and industrial development during the past three decades can also be included with some other reasons such as its rich endowment of natural resources, relative political and social stability, the existence of infrastructure and industrial facilities, relatively high amount of foreign investment, and the role of government in industrial development. It can also be added that with substantial revenue generation capacity from its natural resources, particularly from petroleum and natural gas, Malaysia could choose to industrialise through the "leap-frogging" approach by adapting the latest industrial technologies

However, there are some general points which one should note in Malaysia's experience of industrialisation. Firstly, there has been an imbalance in the rate of investment across various industries which are concentrated only in some particular industries. There has been high investment in electrical and textile industries while there has been little investment in certain other industries. This has led to an imbalanced structure in employment and manufactured exports. Secondly, there has been limited use of the country's natural resources in the exporting industrial process. Malaysia still exports a large amount of raw materials such as palm oil, tin and timber to advanced countries to be processed into higher value added products. For example, the Malaysian sawn timber is used in large scale production of plywood and fabricated furniture in Korea and Japan while its natural rubber is exported to United States, European countries and Japan for the production of tyres and surgical protective devices. Therefore, one can say that the past industrial policies have not been very satisfactory in promoting a stable and balanced manufacturing structure.

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APPENDIX D:

THAILAND EXPERIENCE OF INDUSTRIALISATION

Thailand is the only country in south east Asia that has never experienced colonial rule. It covers almost 200,000 square miles of the Indochinese Peninsula and has four main geographical regions, each with somewhat different natural resources and economic development. Thailand's highly fertile central plain is one of the richest sources of food in Asia. There is a substantial amount of rice are grown throughout the region which has made Thailand the world's leading exporter of rice. Thailand has also been the world's second and third largest producer of tungsten and tin which accounts for 12 per cent of GDP and 65 per cent of its labour force. The Thai people consists of about 85 percent of Thai ethnic origin and another 12 percent of Chinese descent. The remaining 3 percent are Malays, concentrated in southern Thailand along the Malaysian border, and hill people, who are found along the borders of Burma and Laos.

Thailand has also one of the fastest growth rate within developing countries with an averaged real growth rate of 7 per cent over the past 30 years. Thailand was an agricultural economy with the annual average growth rate of 8 per cent in the 1960s. The agriculture sector was as a provider of resources for industrial investment. The manufacturing sector in 1960, was predominantly concentrated in food and beverages, tobacco, textiles, and a few consumer non-durables [1]. Furthermore, Thailand had a more open trade system than most countries at similar levels of economic development, with relatively low tariffs and few quantitative import restrictions. The openness of the Thai economy was reflected in the high share of foreign trade in GDP. In the period between 1960-73, export and import share averaged 18% and 21%, respectively [2].

The industrialisation began in the 1960s with the usual pattern of import substitution including tariff and import controls and investment incentives, aimed at creating an industrial sector producing for the domestic market. Thailand's protection level of domestic industries has been moderate and relatively stable, thus not encouraging huge inefficiencies. The protective system has been inclined against the agro-based industries and towards the manufacturing sector. The main incentive for industrial growth in the 1960s came from

industries producing for the domestic market, but even at this early stage of industrialisation, the rich natural resource base of the country provided a competitive advantage for some export industrial activity [3]. Thailand's national development plans in the 1960s were mostly concentrated on the economic and social development at the national level. Thailand's First National Plan (1961-66) was formulated in 1961 which emphasised import substitution industrialisation policy and giving priority to a number of infrastructure projects, including transportation and communication. The government in Thailand with the assistance of US foreign aid during the Vietnam War period invested extensively in infrastructure such as roads, power generation and irrigation projects. Moreover, during the first plan (1961-1966), the government also emphasised promoting private industrial investment through incentives and protective measures against competing imports.

The second National Plan (1967-1972) emphasised increasing the income level and living standard of the people and also increasing the productivity by utilisation of resources. The manufacturing sector grew at an average rate of 11.4 percent during this period [4]. The leading industries in the earlier phase of industrialisation were textile and food processing industries. During the late 1960s the domestic consumer market, particularly for textiles and locally assembled vehicles, was at near saturation point. The manufacturing sector achieved an average annual growth rate of 10.8 during the period between 1966-1972. According to a World Bank survey, 64% per cent of the expansion in manufacturing was due to an expansion of the domestic market, 29 % was to replace import and 7 % for export [5]. As a result of import substitution policies pursued by the Thai Government, some industries such as motor cycle and agriculture machinery industries have expanded.

It is generally argued that the import substitution policies of the early 1960s favoured large enterprises, which were found to be more capital intensive and import dependent and therefore caused an increase in income inequalities. Import substituting industries relied heavily on imported materials and capital equipment, causing industries to locate plants near the big cities such as the capital Bangkok [6]. Therefore, most manufacturing industries of Thailand concentrated near big cities especially in Bangkok and the suburb areas. It is believed that the lack of adequate infrastructure outside Bangkok and the central provinces excluded a large share of the rural population from participation in modernisation until the second half of the 1970s [7].

By the late 1960s, there was a tendency to shift the industrialisation policy in Thailand towards export-led growth. It should also be added that by the 1970s, the Thai economy reached the stage where component parts and other intermediate capital goods could be produced locally .The 1970s also witnessed a gradual, but clear, evolution in Thai industrial policies as a partial response to declining commodity prices and the oil price shocks. The Thai government's emphasis changed from one of import-substitution, favouring the development of domestic manufactures over imported goods, to one of export promotion associated with a greater opening of the economy to trade and foreign investment [8]. However, despite the shift towards export promotion policies, Thailand continued import substitution in the area of consumer durables and intermediate goods mostly due to its large domestic market. Several incentives was given to the local producers by government in Thailand for encouraging exports and at the same time, a high protection for domestic industries was also given. Export promotion measures have been applied in the area of labour intensive goods, while in the area of heavy chemicals protective measures have been taken in order to promote import substitution, thus resulting in the striking differences in trade policies among industries [9].

It is believed that the shift of industrial promotion policy towards exports was started with the passage of the Investment Promotion Act of 1972 [10]. Moreover, a variety of export incentives were introduced by government including the tax exemptions, electricity rebates, low interest loans, and establishing the export processing zones. Thailand experienced an export commodity boom from 1972 to 1974 which was mainly due to the increase in the price of rice. Thailand has been one of the most successful agricultural exporters in the world during the 1970s because it has successfully adapted to and diversified into new and rapidly changing markets for agricultural products. The volume of sugar exports doubled between 1974 and 1976 and the volume of rice export, which was the major agricultural export commodity increased by an annual average of 11 per cent during the 1970s [11]. Moreover, the export of labour intensive industries including rubber products and non-ferrous metals and also food, textiles, leather products, plastic products increased very rapidly during this period. Exports of the machinery and electronics industries in Thailand have also increased since 1970s. In the electronic and electrical appliances industry, there have been about twenty large companies producing television sets, radios, refrigerators, air

conditioners, and integrated circuits. The manufactured exports increased from 10 per cent of total exports in 1971 to 66 per cent of total merchandise exports in 1988.The value of exports of processed goods increased from 23 billion baht in 1973 to 67 billion baht in 1978 [12].

The export promotion act was formulated in 1972 which provided a full tax exemption on imported inputs used in export activities, a refund of all taxes on the production process, a discount facility on short term loan from the Bank of Thailand and an exemption of business tax on the product exported. However, the rise in oil prices in 1973 and 1979 along with the reduction of the American economic aid slowed Thai growth from around 9 per cent to around 6 per cent and led to a decline in country's industrial outputs in the early 1980s. The Third Plan (1972-1976) placed more emphasis on economic restructuring through the accelerating of growth of industrial development while maintaining the high economic growth rate. It also emphasised the promotion of manufactured exports as an industrial development strategy. There were extensive efforts to promote exports. Revising the Export Promotion Act and the Investment Promotion Act in 1972, implementing tax refund program by the Ministry of Finance, and providing a rediscount facility for exporters were the most important measures which taken for the expansion of the exports during the period of Third Plan.

One can point to two broad factors for Thailand's success in rapid expansion of its exports. Firstly, the internal factors such as the state economic policy. As explain earlier, the government in Thailand adopted export oriented policies in the early stage of industrialisation. These export expansion policies accelerated the industrial development of Thailand in various ways, in particular through stable financial policies, low levels of taxation and the maintenance of strong currency, which have all helped to promote domestic savings and foreign investment. The second looks to external factors, such as American aid during the Vietnam War, the impact of Japanese economic growth and the growth of the NICs in providing not only export markets and a source of foreign capital investment but also models of export-led growth, and changes in world currency movements [13]. Furthermore, it is believed that one of the main reasons for Thailand's success in exports has been the international economic restructuring from the success of the NICs in Asia and Japan, and the revaluation of the yen. Thailand favourable policies, along with its adequate

infrastructure and low cost of labour attracted a huge inflow of foreign investment which largely accelerated export-led growth [14].

The Fourth Plan (1977-81) intended to stabilise the economy from the world economic recession through accelerating the rate of export expansion. A significant elements of Thailand's strong industrialisation lay in the export drive, which exports grew from only 14.3 billion baht in 1970, to 60.4 billion baht in 1976, to 150 billion baht in 1981 and 616 billion baht in 1990. Moreover, there was more emphasis placed on the role of government in export marketing and on the establishment of export processing zones in the Fourth Development Plan as a long term strategy. In 1979, the Industrial Estate Authority of Thailand (IEAT) was created to promote industrial development through establishment of industrial estates and Zones. There were three export processing zones in operation by 1988 in Thailand which were designated for export manufacturing industries. Firms located in an EPZ were exempt from import duties and business taxes on machinery, and equipment. Additional incentives were proposed for project development in theses zones, which include reduction of business tax on the sales of products, reduction of corporate income tax, and corporate income tax deductions for expenditures [15].

A crucial part of the export promotion shift in the 1970s was the increasingly state-sponsored, preferential treatment given to investors and producers in industrial export activities. The Thai Board of Investment (BOI) which was established in 1960 following a World Bank mission, was particularly important in attracting the labour-intensive parts of the production processes of export-oriented transnational corporations [16]. The Board of Investment also attempted to promote certain exports since the early 1970s. The BOI also acted as the central council for controlling the implementation of new policies vis-a-vis foreign capital. The 1977 Investment Promotion Act authorized the Board to engage in a number of export-promoting activities, including the granting of tax privileges and the establishment of Investment Promotion Zones and enterprises [17]. The BOI also provided investment for exporting firms, but the firms were required to export around 80-100 per cent of their total production. The promotions allowed exporting firms to acquire imported machinery and intermediate goods at world market prices by providing exemption from import tariffs.

By the mid 1970s there was increasing pressure for a further shift in emphasis towards export oriented industrialisation policy. This was coming from the international agencies, particularly the World Bank: the need to increase exports to reduce the balance of payments deficit and domestic capital interests. These influences were strongly reflected in the fourth plan, 1977-81, under which EOI was given a central role [18]. The deterioration of Thailand's balance of payments in the second half of the 1970s can be mostly attributed to increase in industrial protection. For example between 1974 and 1978, tariffs were raised on 53 industrial categories and reduced on only 19 categories. The average levels of nominal protection of import substituting activities were also increased during this period from 34.6% to 50.8% for products with low import competition [19].

Towards the end of 1970s, two major policy shifts marked a new phase of industrialisation. First, a large scale industrial development plan, the Eastern Seaboard Development Program (ESDP) was initiated. Secondly, while export promotion continued, protection was granted to heavy industries producing intermediate and capital goods. From 1979 to 1983 the current account deficit averaged about 7 percent of GDP, and the public sector deficit rose to around 5 percent of GDP for an even longer period. Long term debt rose from $ 2.7 billion in 1978 to $ 13.2 billion in 1985. Manufacturing growth was only 4.1 per cent, less than half the 10 per cent annual real growth experienced in the 1970s. It should be noted that unlike some of the NICs, Thailand has never enjoyed a large current account surplus. Moreover, because of some factors mainly a decline in the price of the Thai products in world markets such as rice, coconut oil, tapioca, tin, sugar, and rubber, and the world recession in early 1980s, the growth rate of Thailand slowed to an average of 4.2 percent in the first half of 1980s and to 3.2 percent by 1985 [20]. However, since 1983 the contribution of manufacturing to the GDP has exceeded that of agricultural sector. The growth of manufacturing production increased from 7.2 per cent in 1982 to 12.6 per cent in 1987 and 15 per cent in 1989. This continuous rate of growth in manufacturing production was due to the favourable conditions in domestic and foreign markets, including the government's policy of promoting production and exports together with the relatively stable prices of oil, interest rates and exchange rates.

In 1983 the Board of Investment declared a new set of policies that sought to encourage the development of labour intensive export industries through the controlling of fiscal policy and

encouragement of foreign direct investment. Under the new guidelines, the BOI acted as referee and created a competition environment among foreign investors [21]. Thai economic growth during the later half of 1980s was remarkable. In comparison with other countries in South east Asia (ASEAN) which grew an average of 4.2 per cent between 1983-1987, Thailand growth rate was an average 5.2 per cent in this period. The 1980s also marked a new approach to Thai industrialisation. The role of the private sector was appreciated and development policies of this decade called for greater participation of the private sector in the development effort, particularly in spreading economic benefits to other parts of the country. As a result of the rapid growth in manufactured exports, the share of manufactured exports increased from 36 per cent in 1981 to 66 per cent in 1988. While world trade grew at an average annual rate of 13 per cent between 1986-1989, Thai manufactured exports grew at an average of 40 per cent per year during this period. Growth of manufactured exports has been concentrated in clothing precious stones and integrated circuits. The share of clothing and textiles in total exports increased from 4.8 per cent of total merchandise exports in 1983 to 14.5 per cent in 1988. It should be noted that despite of increase in Thai exports, as a study by World Bank indicated, Thai exports constituted only 1 per cent of industrial countries imports from developing countries, compared with 3-4 per cent for Malaysia and Singapore, and 14 per cent for Taiwan and Korea in mid-1980s [22].

During the Fifth Plan (1982-86), the government continued to promote private investment, both domestic and foreign, in the production and sale of industrial products while the main objective of industrial development policies was to contribute towards stable economic growth, and to help solve the basic problems of the country, such as trade deficit, unemployment, uneven distribution of income, and poverty. The fifth development plan also emphasised industrial adjustment, improving efficiency and strengthening competitiveness in both domestic and international markets. The basic industrial development policies were achieved for these purposes, including policies to promote manufactured exports, to restructure the existing industries to be more efficient, to promote small-scale industries, to promote rural industries, to promote industrial employment and to set up a system to promote and monitor foreign investment [23].

Thailand's export performance in 1987 ranked the best among LDCs. Total export earnings increased from 146,472 million baht in 1983 to 298,099 million baht in 1987. In 1988,

Thailand exported nearly $2.3 billion worth of textiles and garments, about $ 500 million worth of integrated circuits, some $ 400 million worth of footwear, around $ 200 million worth of steel pipes, and about $ 200 million worth of wooden furniture, out of $ 16 billion in total exports. It can be said that this exceptionally fast growth in manufactured exports which accounted for 58 per cent of Thailand's total exports in 1988, was comparable with 72 percent in the case of Singapore, and Taiwan and S. Korea's 93 per cent in the same year. This again indicates that Thailand can join the four NICs of Asia [24].

It can be said that Thailand has emerged from the latter half of the 1980s as the most promising developing country in the world. The two digit growth rates of 13 per cent and 11 percent in 1988 and 1989, respectively, were the highest rate of growth in the world for these two years, generating a widespread feeling that the economy had finally reached a take-off stage and Thailand was about to join the ranks of the Asian NICs. Some important factors such as, export, tourism industry, and foreign investment, are said to be the main engines of growth for Thailand. This fast growth pattern is accompanied by rapid structural changes in three dimensions. Firstly, there has been a clear internationalisation of the Thai economy. The share of exports to GDP rose from 19.2 percent in 1982 to as high as 26.5 percent in 1988. There was also a remarkable change in the structure of exports which the value of industrial exports surpassed that of agricultural exports in mid 1980s. Secondly, massive relocation of export industries from Japan and NICs in Asia, led to the increasing integration of Thailand. It is believed that Thailand comparative advantage during this period has been its low wages. Moreover, Thai labour can be described as literate, trainable, disciplined and hard working. According to a survey by World Bank, comparing industrial earnings and output for selected Asian Countries, the rise in labour productivity in manufacturing in Thailand during the first half of the 1980s has been (66%) greater than in any other country [25].

During the period from 1988-90, the annual growth rate exceeded 10 percent. This solid growth rate was due mainly to an increase in exports and a large amount of foreign investment in Thailand. Although Thailand has traditionally had an agrarian-based economy, its manufacturing and service sectors have grown tremendously in both size and significance. In 1990, the share of manufacturing exports, which reached 49.5%, exceeded that of agricultural exports (37.9 %) and by 1991 exports of manufactured products accounted for

more than three-quarters of the country's total exports. Textiles and garments were the most important industry, accounting for 29.2 per cent of principle exports between 1986 and 1988, while canned food accounted for 12.7 per cent in 1988.The nominal value of textile and jewellery exports grew an average of 25% annually during the last years of the 1980s. The Thai export of food processing such as fruits (especially pineapple), various canned and frozen vegetables and tuna have also increased very rapidly during this period [26].

Thailand has adopted the Sixth National Economic and Social Development Plan (1987-1991) which aimed at strengthening the scientific and technological capability through human recourse development and promoting of R&D activities, and providing of incentives to the private sector and state enterprises for the extensive use of science and technology .The plan particularly emphasised the development of technological capability in the areas of bio-technology, material, electronic and information industries. As indicated earlier, the Thai economy has experienced a very significant growth rate of an average 10.5 per year during the implementation of sixth National Plan, which was twice the plan target. It is believed that this high growth has mostly been because of a considerable expansion of Thai manufacturing exports as well as foreign investment and tourism during this period. World economic conditions, in particular the lower oil prices and lower interest rates, brought further benefits during this period. The rapid and unexpected growth during the period (1987-1991) changed the structure of the Thai economy. A much more diverse industrial structure, with growing technological sophistication, has been accompanied by huge investments in infrastructure during this period.

The value of exports increased from $ 10 billion in 1987 which was the same value attained by S. Korea 10 years earlier, and increased to $ 20 billion in 1989 and almost $ 30 billion in 1991 [27]. However, because of high dependency on the imports of machinery, capital and intermediate goods, Thailand faced deficit in its overall current account during the period between 1987-1990. The high import intensity of export led growth reflect the missing link in the country's industrial structure, failing to supply adequate intermediate and capital goods. Therefore, one of the strategic approaches to industrial development in 1990s is aimed at developing basic industries as well as supporting industries in order to strengthen inter-industry linkages and thereby reduce the high degree of import dependence of industrial production [28].

It can be said that Thailand had most of criteria which was necessary to join the ranks of the NICs in around 1988. Some indicators such as its share of industrial sector per GDP, and the share of manufactured output accounted for 32 and 76 per cent respectively. Moreover the manufacture exports accounted to about 44 per cent of total exports of goods and services. However, there are some major constraints to Thailand's becoming a fully NICs, such as high dependency on foreign technology in particular from Japan, the shortage of adequate scientists and engineers, inadequate research and development activity, inadequate upgrading of skills through training and continuing education, a relatively low level of GDP per capita, inadequate domestic savings and capital formation and unbalanced income distribution. One can say that while Korea and Taiwan have undergone four significant stages in their industrial development, namely the simple assembly, fabrication, design improvement and engineering design within the past two decades to become a NIC, Thailand, which took off at the same time, has just entered the second stage. Moreover, despite the Thai economy having met the basic common features of NICs, however, in order to become the fifth tiger, other elements, in particular social indicators such as enrolment in education, and infrastructure status need to be developed. Therefore, Thailand still has some ground to cover to catch up with the newly industrialising countries. For instance, per capita GNP is $ 1400 per year, less than a third of S. Korea's and 13 per cent of Singapore's.

The export component of the manufacturing products continued to be dynamic in 1991. This dynamism has been attributed to the recent growth in export-oriented direct investment, the price competitiveness of Thai products, and government policies which encourage exports. Industries in which production has increased rapidly include computers and electronics, garments and footwear, furniture and wood products, canned foods, gems and jewellery, toys, and plastic products. Production for the domestic market was also important to continued strong output during 1991. High growth industries include construction materials, foods and beverages, and electronic appliances. Growth in the automotive industry in 1991 was affected somewhat by the substantial reduction in import duties on cars and components in July 1991. In 1991, the Board of Investment in Thailand issued promotion certificates for 534 investment projects; 304 of these projects planned to export 80-100 % of their output and a further 30 projects planned to export 30-79%. These projects include investment by

Thai and foreign firms, but it is observed that particularly the foreign investment projects are export oriented. It is estimated that the foreign firms accounted for at least 25% of manufactured exports by the end of the 1970s and that share, by 1990 had risen to 30- 40% [29].

Thailand's Seventh National Plan (1992-1996) has formulated with the main development objectives of maintaining economic growth rates at an appropriate levels, redistributing income in particular to the rural areas and accelerating the development of human resources. The Thai government has decided to achieve these objectives through restructuring the economic and industrial policies. These policies include liberalisation of the economic system in order to increase efficiency, expanding private sector role, increasing production efficiency by enhancing technological capability and diversifying and expanding economic base to the regions and new economic zones. The Seventh National Plan has also set an average annual growth target of 9.4 per cent for industrial production. The plan has identified six strategic industrial sectors in which Thailand could gain a competitive advantage. These include agro-industry and food processing, textiles and garments, electronics, metal-based industries, petrochemicals and iron and steel. The Thai government has taken supportive measures for developing these industries, including removal of barriers protecting local car assembly and short term protection for iron and steel industries. Thailand is currently not only competing with the other ASEAN countries for foreign investment and aid but is also confronting the economic pressures from Eastern Europe and China as they become competitive in the jewellery, textiles, and electrical appliances sectors [30].

In order to be more competitive in international market, the Thai government has attempted to diversify manufactured exports towards products of greater technological sophistication. Therefore, it has emphasised more on support for those industries which include all industries support the activities of major manufacturing companies by providing essential materials, component and services. Thailand adopted the Japanese and Taiwanese system of industrial production for improving its competitiveness. Unlike S. Korea which neglected the development of an efficient local supply base of parts and components and suffered from high dependency on foreign parts and components, The Japanese and Taiwanese model of industrial production which has relied more on subcontracting and supporting industries, and

they initially established a powerful domestic parts and components industry. Moreover, like Taiwan, the size distribution of firms in Thailand has shifted towards small and medium sized industries which accounted for 98 per cent of enterprises in mid-1980s [31].

D.1 THE ROLE OF FOREIGN DIRECT INVESTMENT AND TECHNOLOGY TRANSFER IN INDUSTRIAL DEVELOPMENT OF THAILAND

Foreign Direct Investment (FDI) in Thailand has been growing steadily since the industrialisation began in early 1960s. Foreign investment accounted for only 12 per cent of net capital inflows into Thailand in 1970s which accounted an annual average of 1900 million baht in this period [32] Until the early 1980s, Thailand, along with the S. Korea, had the lowest level of foreign investment among the Southeast Asian countries. Foreign Direct Investment began flowing into Thailand mostly after 1987, boosting GDP growth to beyond 8 per cent a year. Like other countries in Southeast Asia, Thai authorities offered a wide range of incentives for foreign investors especially those from Japan and the Asian NICs.

In order to attract more export-oriented manufacturing investments, Thai government has recently allowed even 100 per cent foreign ownership in export oriented projects. Therefore the number and value of foreign investment approved by the board of investment reached to nearly 600 billion baht in the 1987-89 period [33]. One can also say that some factors such as the availability of a vast pool of low-wage, unskilled, trainable labour, sufficient infrastructure for industry, a sharp appreciation of Japanese yen and Taiwanese dollar (yuan) against the Thai baht in the latter half of 1980s and the presence of a relatively stable government with an favourable policies toward foreign investment, are among major factors which made Thailand an attractive base for foreign investors particularly in the last years of 1980s. For several years Japan has been Thailand's number one foreign investor. In 1985, Japan accounted for 26.7 per cent of all foreign investment in Thailand with nearly 90 per cent of it investing in the manufacturing sector. In 1987, Japanese firms invested in 200 approved ventures totalling $ 1 billion; in 1988 nearly 300 investments totalling almost $3 billion were registered, and the Japanese investment increased to $ 3,537 million in 1989, which was about 6 times more than the U.S. investment ($ 551 million). Most Japanese investment flew to those Thai industrial sectors which American and European firms did not have a strong intention to transfer their manufacturing systems, including the motorcycle,

automobile, and electrical appliances.

Furthermore, most Japanese investment took the form of joint ventures with local equity participation. However, as a result of the shift toward export oriented production, recent Japanese investors have shown a preference for wholly owned subsidiaries over joint ventures. It can be generally said that as the experience of Thailand in transferring technology indicated, Thailand could attract more investment and technology through joint venture agreements with foreign partners. Despite the large amount of investment from Japanese firms in Thailand, they have been criticised as not really willing to transfer technology and managerial skills to Thailand. It is pointed out that Japanese firms transferred mostly out of date technologies that lacked the potential to generate enough productivity to gain competitiveness in international markets. It can also be added that Japanese firms did not care to complete handbook manuals for operation and management, which has made the understanding of know-how and principles of production and management difficult for Thai people to obtain [34]. The following diagram distinguished the Japanese technological catch-up pattern from the conventional patterns that we can see in most developing Asia countries such as Thailand.

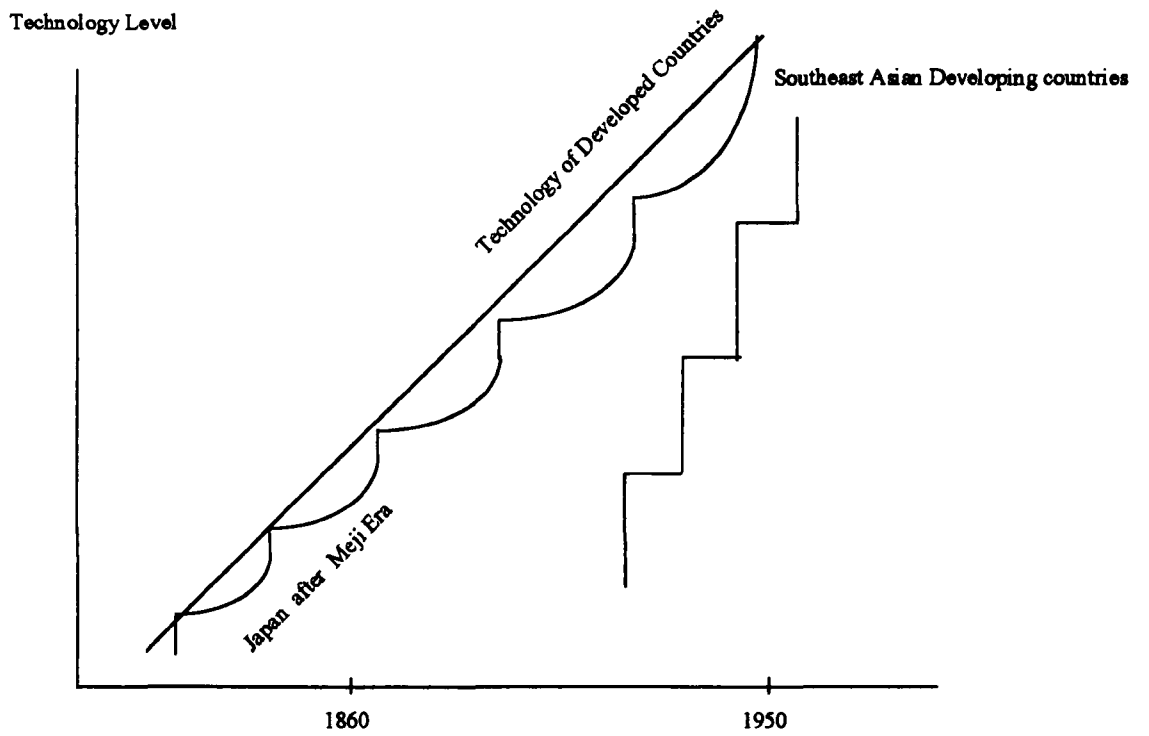


Figure D.1 Technology Catch-up Patterns of Japan and Southeast Asian Developing Countries as Compared to Developed Countries

Source: Institute of Developing Economy, Tokyo, 1985, P:22.

The second most active foreign investor has been Taiwan, at $ 1 billion in 1988. The United States, with a hundred approved projects in 1988 valued at about $ 700 million, is in distant third place [35]. Thailand has been an attractive location for Taiwanese enterprises mostly in labour intensive industries such as footwear, electrical appliances, ceramics, food processing, textiles and toys, due to Thailand's cheap labour, as well as similar cultural background and the existence of a large Chinese community. In 1988, Taiwan investors proposed 400 projects accounted 28.6 per cent of total foreign investment to Thailand which exceeded that of Japan with 389 cases in the same year. Among the approved Taiwanese projects in 1988, 29 % were wholly owned by Taiwanese firms, comparing to 25% of Japanese projects, while 90 per cent of the investment of both countries were export oriented [36]. Thailand has also attracted investments by other Southeast Asian countries, including Hong Kong, Singapore, Malaysia, the Philippines and S. Korea.

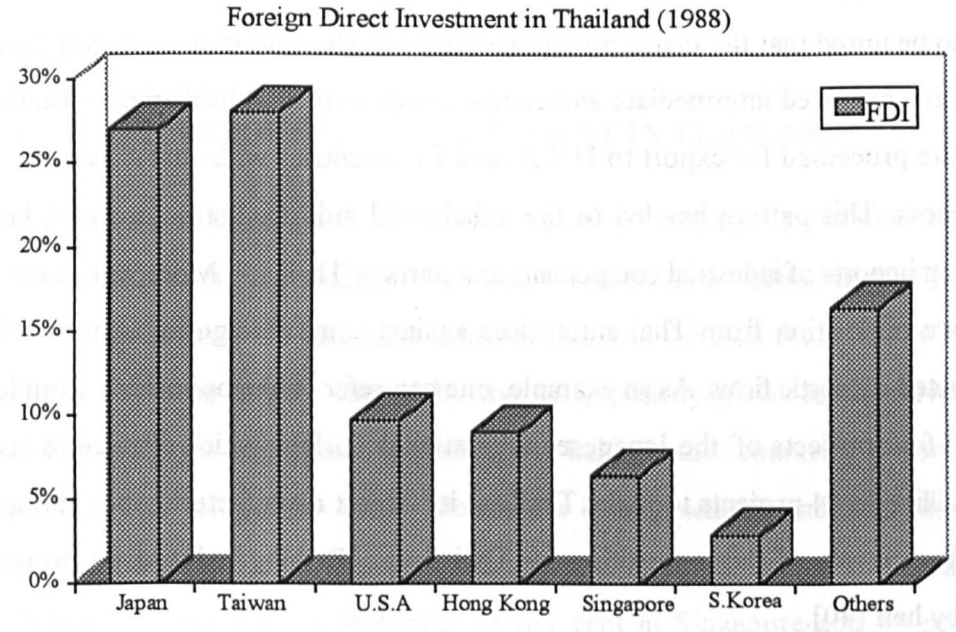


Figure D.2 Foreign Direct Investment (FDI) in Thailand in 1988.

Source: UNIDO (United Nations Industrial Development Organisation), 1992.

A survey by Lee (1990) indicated that while Taiwan has invested more in Thailand and Malaysia, Korea investors has invested more in Indonesia. Taiwanese investment in Thailand

has been more concentrated in construction as well as manufacturing, and there has been more investment in electronics in Malaysia by Taiwanese investors [37]. There is no doubt that foreign investment has played a vital role in industrial development and transferring the technology and managerial skills to Thailand. However, some believe that foreign investment during early stage of Thailand industrialisation has been concentrated mostly in production for a protected domestic market, with heavy dependence on imported machinery which led to the negative balance of payment. Furthermore, there has been little transfer of know-how and skills through past experiences of Thailand in attracting foreign investment in the country. As Satikarn (1982) noted more technology transfer in Thailand occurred through the purchase of technology and other channels rather than through foreign direct investment [38]. There have also been some cases in which foreign investors have brought to the country second-hand machines and semi-obsolete "labour intensive" technology which led to high costs for maintenance and repairing those machines [39]. It can also be added that Foreign investment in Thailand in some cases has led to an increase in import demand, resulted to current account deficit and increasing external debt.

It should also be noted that the major foreign investors in Thailand such as Japan, Taiwan and Korea have exported intermediate and capital goods to their subsidiaries in Thailand, where they are processed for export to U.S.A. and EC countries with cost advantage and competitiveness. This pattern has led to the unbalanced industrial structure with heavy dependency on imports of industrial components and parts in Thailand. Moreover, there has been effective opposition from Thai enterprises against some foreign investment which mostly competed domestic firms. As an example, one can refer to the opposition from local producers to four projects of the Japanese multinational Toshiba which planned to invest over $ 400 million in 14 projects to make Thailand its largest manufacturing based outside of Japan. As a result of this opposition by Thai firms, Toshiba reduced its proposed investment by half [40].

One can also add that the past foreign investment in Thailand did not create adequate employment for Thailand's huge labour force. It is believed that most of foreign business activities in Thailand did not have sufficient beneficial effects on employment creation. It seems that Thailand could gain more benefits from foreign investment if the government would take measures to increase market competition and to continue insisting upon more

participation of local workers in the investment projects. Thus, Thai's authorities have recently attempted to take some effective measures in order to attract more foreign investment which bring about transfer of technological know-how and know-why to local personnel, through ongoing training programs, using foreign and local experts to involve more in R&D activities.

As pointed out earlier, more technology in the past has been transferred by other channels than FDI. Until 1975, 256 technology contracts were submitted to the Bank of Thailand, which 115 were technical assistance agreements, 23 engineering agreement, 1 management agreement, and 33 contracts were combinations of the above agreements. However, it should be noted that this classification was based more on the actual title of each contract. For example, due to lack of patent laws in Thailand, there has been no indication or specification of the relevant patents in most of the licensing agreements. Therefore, it was impossible to separate patented from unpatented products or processes. Most technology agreements with Japanese technology suppliers have been in the form of joint venture agreements in relatively simple industries, such as textiles, electrical appliances, and vehicle assembly [41].

D. 3 HUMAN RESOURCE DEVELOPMENT IN THAILAND

As it pointed out earlier, technical human resource development is seen as a key factor underlying the economic success of the newly industrialised economies of East Asia. It is widely recognised that the successful industrialisation of the East Asian newly industrialising countries has been largely caused by the early priority given to the development and upgrading of human resources. Thailand lagged behind other countries in Southeast Asia in science and technology education. The number of high school graduates has been only 30 per cent of the population in Thailand, compared with 94 per cent in S. Korea, 91 per cent in Taiwan, 53 per cent in Malaysia, 71 per cent in Singapore and 68 per cent in the Philippines [42]. This was mostly because of structure of economy, with most people engaged in traditional agriculture. As it is pointed out, there has been a close link between the share of employment in agriculture and the transition rate from primary to secondary education [43].

According to a report by Thailand Development Research Institute, the number of potential

scientists and engineers in Thailand is lower than that of Indonesia, the Philippines, Singapore, and Korea. The ratio of total science and technology human resources per 10,000 population in Thailand (4.8) is the lowest among all Asian countries, which is 49.6 for Japan, 24.4 for Korea, and 7.3 for Indonesia. Another indicator shows that the number of scientists and technicians per 10,000 of the population was 524 for Korea, 256 for Singapore, 78 for Indonesia, and 14 for Thailand. As estimated, there has been only 15% of Thai university students graduate in scientific and technological disciplines, compared with Korea's near 40 per cent. By the year 2000, Thailand's shortfall of engineers will range between 10,000 and 30,000 [44]. The total number of Thai scientists and engineers engaged in R&D in the entire country has been only about 2,700, comparing with that of 330,000 for Japan, and 30,000 for Korea. Thailand has also allocated an average of 0.1 per cent of its GDP for research and development activity, while other Asian countries like Taiwan and Korea have spent an average of 1-2 per cent of their GDP for R&D activities [45]. According to another statistics, Thailand produces only a total of 2,500 science and technology graduates each year. This figures indicates to lack of qualified human resources at all levels as the one of the major constraint on development of technological capability in Thailand [46]. Another figure shows that the number of scientists and engineers in Korea in 1981 was almost double that of Thailand in 1984 and the number of Korean technicians was larger by more than 700 per cent [47].

In 1990, 83 per cent of Thai workers had completed only primary school or less. The secondary enrolment ratio has been the lowest of all ASEAN countries, and well below that of S. Korea a decade ago. It was estimated that the enrolment ratios for lower and upper secondary in 1986 were 41 per cent of those aged 14-16 and 28 per cent of those aged 17-18. This indicates that more than half of the Thai children in the age group 14-18 were not attending school. This can be a major hindrance in the production of a skilled and adaptable labour force, not to mention the creation of scientists, engineers and technicians to promote Thailand's technological capability. One can generally say that science and technology capabilities in Thailand has been in lower level in comparison with that of Asian NICs. Thailand has emphasised more on the basic physical infrastructure for industrial development. As an example, in 1987, total R&D expenditures accounted for only 0.22 per cent of GDP, which is very low in comparison with approximately 2 per cent in S. Korea, which only about 3 per cent of total R&D activities has been carried out by private sector,

compared to about 80 per cent in S. Korea. It is believed that the low rate of R&D activities in Thailand had mostly been due to its heavy reliance on imported technology.

As pointed out earlier, it seems that Thailand has to shift toward producing more high-tech products with a greater degree of sophistication, in order to continue the substantial growth rate in the late 1980s and to become more competitive in international market, particularly with the emergence of countries such as China and Vietnam as serious competitors in the markets for labour intensive manufactured products, due to their lower wage rate in comparison with Thailand. This can be achieved through strengthening of its technological capability. One has to take account some factors which are necessary for enhancing technological capability, such as the development of country's science and technology infrastructure base, more R&D expenditure per GNP, development of human resources and the country's comparative advantages, which can be helpful to find out the most appropriate strategic industries and technologies for the country.

However, there are some general problems in development of Thailand's technological capability. One of the most important problem has been inadequacy of its technical human resources. As explained earlier, there has been shortage of S&T personnel in all of Thailand's industry. This inadequacy in technical human resources has also affected the adaptive, and absorptive capacities to assimilate foreign technologies. Another problem in enhancing Thailand's technological capabilities has been the lack of sufficient technical information services. It is believed that there has been high dependency of domestic enterprises to foreign technical services in order to assimilate those technologies. The limited capability in the acquisition and transfer of technology has been another problem in upgrading Thailand technological capability. This has mostly been due to inadequate source of data and information on technology, as well as lack of bargaining power and appropriate financial support for the Thai's small and medium-sized enterprises which have been involved in technology transfer. Another important factor which has played a part in delaying the application of modern technology to increase industrial productivity has been the high level of protection that the government had given to the industrial sectors, such as import tariff barriers.

Furthermore, research and development activities and basic facilities and support services for development of science and technology are still not strong enough to readily absorb

foreign technology, or to have sufficient degree of self-reliance for indigenous technological development. Most of R&D activities are conducted by the public rather than private sector, which mostly due to the lack of positive measures and incentives from the government to encourage them to invest in research and development. Thai authorities have determined to increase R&D expenditure to 0.75 per cent of GDP by 1996. According to a recent survey undertaken by Thailand Development Research Institute (TDRI) which have analysed the overall technological capabilities of 119 Thai firms, average capability levels were found to be highest in agriculture, bio-technology based industries and lowest in the electronic industries. It is also noted that operative capabilities including maintenance, professional management, technical training tended to be in favourable level while innovative capabilities such as R&D activities, major product and process modifications and development of new products were found to be in low level [48]. The Thai government has also taken some effective measures through the Seventh National Plan (1992-1996) to promote application of appropriate technology, enhance productivity, increase international competitiveness, strengthen technological capability, assimilate foreign technologies, and particularly develop its human resources.

D. 4 SUMMARY AND CONCLUSIONS

In sum, like most developing countries, Thailand chose to follow the import-substitution industrialisation in 1960s. Subsequently, the first two plans, covering 1960-66 and 1967-71, introduced mechanism to induce domestic production to substitute for imports, particularly the consumer non-durable goods. Attention was paid to export promotion in Third Plan (1972-1976) and the trend toward export promotional drive was intensified again in the next two plans. One can refer to two broad reasons for Thailand's successful transition to become an exporter of manufacture products. Firstly, as mentioned earlier, because of its rich natural resources, Thailand has a natural advantage in the processing of its primary commodities for exports such as leather and wood products, and food processing industries. Secondly, Thailand's relatively large size of domestic market has encouraged local firms to not only become efficient in providing import substituting industries but also to compete in international market [49].

Having compared some aspects of Thai experience with that of neighbouring Malaysia, it can be said that the role of state in the economy has been larger than in Thailand. The ratio

of government expenditure to GDP in 1984 was 18 per cent in Thailand, 30 per cent in Malaysia. Furthermore, foreign direct investment has played more critical role in industrial development and technology transfer to Malaysia than in Thailand. As an example, the stock of FDI in 1974 was $ 1350 million in Malaysia, while FDI inflow accounted only $ 550 million in Thailand [50]. Moreover, there has been some important structural differences in the early phase of industrial experiences of Thailand and Malaysia. For instance, while Thailand's major traditional exports were indigenous products, Malaysia concentrated upon modern export products such as rubber, palm oil, and tin. In both cases, export production was supported by commercial and processing activities supplied by industrial sector [51]. Furthermore, unlike the Malaysia which implemented a heavy industrialisation drive in 1980s, heavy industries has been relatively underdeveloped in Thailand. Thai industrial sector in 1980s had a higher proportion of light industries, particularly of food processing, beverages, leather and rubber products and of textiles. However, Thailand's heavy industry has increased from 18 per cent of manufacturing value added in 1960 to 32 per cent in 1988.

As in other South east Asian countries, the Thai state has played a vital role in directing the economy towards rapid industrial progress. The Thai state traditionally played an active role to promote domestic capital through diverse state institutions and sought ways to utilise foreign capital. The government's major contribution to economic growth has been to provide economic and social services, most notably to build infrastructure such as highways, power stations, as well as to provide various incentives and financial assistance to promote private investments. The Thai Government has also controlled a substantial portion of the economy, including the postal service, telephone, telegraph, radio, and television communications, the railroads, ports, and an airline. Despite the recent privatisation program in order to privatise as much as state owned firms, the government is still interested in participating in some Manufacturing industries such as glass, rubber, canned fish products, automobile batteries, petroleum, and petroleum refining.

There are also other fields which controlled either by the government through direct participation or special arrangement (including concessions to private operators and licensing), such as the mining and exploitation of minerals, the production and distribution of electricity, the water supply, passenger transport (other than the government-owned railroad), banking, and insurance. Therefore, there is no doubt that the state has played a

central role in Thai economic progress, and the dynamic relationship between the state and private sector is considered to be one of the important factors of success. Having compared the state role in industrial development of the South East Asian countries, one can say that there has been less direct intervention in Thailand than Korea and Taiwan. The state has played a more passive role in industrialisation of Thailand than in Taiwan and Korea. The Thai state has legal control over natural resources and it uses its power to determine how natural resources are to be exploited. Thai government has also been effective mainly in creating favourable conditions for attracting foreign investment. Despite of relatively unstable politics in Thailand, the relationship between state and private sectors has been very stable and institutionalised [52].

Having identified the specific factors contributing to Thai success one can refer to three broad factors. Firstly, the dynamic growth of its agriculture which along with other natural resources, provided a supportive base for the development of processing export oriented industries. The second important factor is the political development in Thailand, which led to the assimilation of the capitalist class of Chinese origin into an indigenous economic and political power elite with similar views on development policies. Moreover, Thailand also benefited from long periods of relatively political stability. Despite some coups and changes of governments during the past three decades, the changes in government hardly affected the basic development philosophy or development strategy of the country. A third factor contributing to Thai success is the location in a dynamic region of the world economy and the longstanding and close relations with the main industrial force in the region, Japan [53].

Furthermore, the gradual shift towards export promotion policies through various incentives for exports from the 1970s, and Thailand's stable macroeconomic conditions which enhanced the confidence of local and foreign investors, are among other factors which have also contributed to the success experience of Thailand. Compared to the negative growth rate of some developing countries during the post second oil shock period, it is clear that the maintenance of macroeconomic stability was a crucial factor that enabled the occurrence of the rapid growth experiences in the late 1980s. A constant and stable Thai baht against dollar and yen during the last 30 years as well as a low inflation rate have been the most important aspects of Thai macroeconomic stability. As pointed out earlier, Thailand's relatively political stability, its social openness and tolerance, its freedom of

markets, and its good record in social development may also be considered as other success factors.

Thai authorities and economic planners have recently faced a major decision: whether to encourage a NIC's (Newly Industrialised Country) type of strategy based on manufacturing exports from the urbanised central region, which will probably require increasing dependence on foreign investment and technology, especially from Japan, or follow a NAIC's (Newly Agro-Industrialised Country) type of strategy based on agro-industry exports, which will mean less overall rapid growth but an improvement in rural conditions as well as more independence through internal sources. Choosing either a NIC's or NAIC's strategy alone is not probably desirable for Thailand, since both approaches have different advantages. It seems that in the long term, Thailand needs to develop more its manufacturing industries in addition to agro-industries. One can say that although NAICs approach may solve to some extent Thailand's problem of rural poverty and emigration of labour force into urban areas, it does not appear to be the final solution for Thailand since agriculture productivity has not reached a sufficient level yet. On the other hand, adopting only the NICs approach will require an extensive infrastructure investment and can not provide employment for the majority of Thailand's population who are mainly in rural areas. Although Thailand may not have enough financial and technological resources to pursue both strategies, a mixture of both strategies therefore seems to be an appropriate choice for the Thai authorities.

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APPENDIX E

INDUSTRY AND TECHNOLOGY DEVELOPMENT IN INDONESIA

Indonesia is another ASEAN member located in Southeast Asia with more than 13,000 islands and a total population of about 190 million along with 2000 ethno-cultural groups. Indonesia was a Dutch colony for a period of three and a half centuries which influenced the building of its institutional indicators particularly the educational system. Therefore, one can say that the Indonesian school system has been more oriented to the general pattern of the "Nederlandsch Indie" educational system [1]. Indonesia is also rich in natural resources of every type, of which oil is certainly the most important, with a capacity to produce 1.7 million barrels a day. The reserves are equal to 2 per cent of the world oil reserves [2]. After the second world war and its independence on 17 August 1945, Indonesia has given top priority to the agricultural sector to exploit and develop its abundant natural resources. The Indonesian government tried to develop indigenous small scale industries located in rural and semi rural areas during the first five year plan (1956-61). Indonesia also pursued an import-substitution industrialisation policy which was carried out by public enterprises under a highly centralised administrative system. The infant industries were heavily protected and promoted by high tariffs, import quotas, local content requirement and various subsidies [3].

Due to the existence of many microeconomic distortions and huge macroeconomic imbalances prior to 1966, the new order government of president Soeharto adopted stabilisation policies which aimed at economy recovery through devaluation of national currency and encouraging private and foreign investment. As a result of the stabilisation policies, the annual average growth rate reached 8.2 per cent compared to the average rate of 1.2 per cent in the preceding five years [4]. One can say that Indonesia's rapid growth rate during this period was partly due to the increase in its productive capacity, both through higher investment and faster technological progress. The manufacturing sector grew very quickly at an annual rate of 12.5 per cent during the period between 1965-1991.This indicates a doubling of real output about every six years, or a ninefold increase over the 25 years.

According to another figure, the rate of growth in manufacture during the period between 1967-81 increased 14 fold, which was mainly concentrated in construction, transport and communications industries [5]. The manufacture value added (at a constant prices of 1973) increased at an average annual rate of 15 per cent during the period between 1971 and 1980. The contribution of the manufacturing sector to GDP also increased from 8.4 per cent in 1971 to 11.6 per cent in 1980 [6]. One can refer to some overall factors contributing to the rapid growth of manufacturing sector in Indonesia, such as increasing rate of foreign investment, in particular in capital intensive industries, and high tariff systems which created an extremely high effective level of protection. It can be generally said that the relatively successful experience of import substitution in Indonesia during the 1970s has mostly been because of the massive inflow of oil revenues and foreign investment. Consequently, the emerging modern manufacturing sector was highly capital intensive, and the labour intensive, traditional manufacturing sector dominated by indigenous private capital suffered a rapid decline [7]. The process of import substituting industrialisation was closely controlled by the state through direct participation in manufacturing.

With the ending of the easy phase of import substitution industrialisation, there was a shift from production of consumer goods towards intermediate and capital goods and this along with state protection, subsidy and public and private investment, provided more for further development. Consumer goods dropped from 80.8 per cent of total value of manufacturing in 1971 to 47.6 per cent in 1980, whilst intermediate goods grew from 13.1 to 33.5 per cent and capital goods from 6.1 to 16.9 per cent in the same period. However, due to low tariffs on intermediate and capital goods, intermediate-goods industries were limited to state enterprises producing cement, steel, paper, fertiliser and petrochemical [8].

The Indonesian economy grew at an average rate of 7.9 per cent per annum during the period between 1973-81.The high growth rate during 1970s was accompanied with an import substituting path and rapidly expanding investments in infrastructure and directly productive capacity reflecting the dominant role of the government sector in the growth process. The strong performance of the Indonesian economy during 1970s was also associated with rapid increases in private and public consumption, overall investment, domestic savings and foreign exchange earnings. In particular, the oil sector contributed to substantial increases in government revenues and foreign exchange earnings. The share of

oil and gas in total exports increased from 39 per cent in 1971 to 75 per cent in 1980. Therefore, rapid industrial growth tended to be oriented to the domestic market and was relatively capital intensive during 1970s [9]. Moreover, trade and industrial policies during the 1970s were directed at influencing the pattern of industrialisation through protection of domestic industries. The protectionist regime that developed was characterised by import controls through tariff and non-tariff barriers, high and variable levels of effective protection which are inclined against exports, proliferation of administrative procedures and allocation processes, and excessive government intervention in the direction of industrialisation [10]. According to Pangestu and Boediono (1986) the average effective rate of protection in import competing industries was 108.6 per cent in 1975 with a range from 35 to 4315 per cent across all industries [11].

The development of manufactured exports during the 1970s went through two distinct phases. The decline of manufactured exports in the first half of the decade was attributed mainly to the increased importance of oil exports in this period. Furthermore, the strong emphasis on the development of import substitution industries has been another reason for the decrease in manufacture exports during the early 1970s. The other reason, as Paauw (1981) indicated, has been the overvaluation of the Indonesian rupiah which associated with a high rate of domestic inflation [12]. The second half of the 1970s, however, saw an increase in both the share of manufactures in total exports as well as the share of manufactured exports in output of the manufacturing sector. During the period between 1975 to 1980 the value of manufactured exports in constant prices increased by an average annual rate of 28 per cent. The major incentive to the growth of manufactured exports is considered to be the 33 per cent devaluation of rupiah in 1978 [13].

Because of a serious depression in oil market and the general world recession of the early 1980s, the average annual growth rate of GDP declined to 4.2 per cent during the period between 1980 to 1984. Faced with lower oil prices in the early 1980's and the need to create more than two million jobs annually, the government of Indonesia in 1983 launched "deregulation and de-bureaucratization" programs. The main goals were to give more emphasis to the private sector and reduce dependence on petroleum as a source of export earnings and tax revenues. The deregulation program indicated both a reduced role of government intervention and wider and more creative participation by the public. Moreover,

the deregulation policy has been considered as a necessary component of the broader task of structural adjustment directed at a more efficient allocation of resources. Therefore, another aim of deregulation program during the late 1980s has been improved economic performance through a more efficient allocation of resources, and the most immediate measure of its success was the growth in non-oil exports. The strong drive for non-oil exports seem to have encouraged a tendency toward new regulation or re-regulation either by restricting or totally banning the export of a range of products, primarily unprocessed or semi-processed goods [14].

The program began with a loosening of controls on the financial sector. In the initial phase of the deregulation and adjustment period (1983-1985), there has been a sharp reduction in imports in order to adjust the balance of payments. Several factors contributed to this reduction. Firstly, public sector imports of capital goods were reduced sharply by a reconsidering of large projects in March 1983 and by reduction of real capital spending in subsequent years. Secondly, by redefining priorities, the government diverted its expenditures from sectors with a relatively high import-intensiveness (mining and industry) to those that were less import-intensive (agriculture, education, and transport). Thirdly, the large depreciation of the real exchange rate raised the price of imports relative to domestic goods, causing the private sector demand to shift from imports to domestic substitutes. Fourthly, a strong public investment effort during the oil boom increased import-substitution activities in some important commodities such as rice, sugar, processed food, cement, and fertiliser. Fifthly, the proliferation of non-tariff barriers in the form of import licenses after the early 1980s also led to the reduction of imports [15]. In 1986, it was estimated that the approved importers system restricted 28 per cent of the total number of items imported, 26 percent of the total import value, and 31 percent of the value added [16].

The Indonesian government also decided to take further effective measures for economic recovery from the negative effects of recession in early 1980s. The major measures included reducing public expenditure and subsidies, devaluation of the rupiah by 28 per cent against the US dollar in March 1983 and September 1986, a number of tax reforms to raise government revenues, liberalized conditions for foreign and domestic investment, reduced tariffs and import-licensing restrictions, and eased export requirements. As a result of these measures, the balance of payments improved considerably and non-oil exports increased

very rapidly. Moreover, the widespread deregulation of the economy had favourable effects on economic efficiency. According to a World Bank study in 1989, the rate of return on investment rose from 13 per cent in 1982-85 to almost 22 per cent in 1986-88 and that of total factor productivity a more comprehensive measure of efficiency gains also improved during this period [17].

It is generally argued that most of the deregulation policies in the mid-1980s concentrated in the simplifying procedures, allowing the exporters special facilities, and removing the anti-export bias. However, the current deregulations go beyond simplifying procedures, making regulations more obvious, and removing distortions for exports and re-examining the objectives behind the regulations [18]. The continuing of deregulation policies has also strengthened the private market for technology development through the trade and investment incentives which allowed greater flows of foreign investment and technical expertise into Indonesia. Moreover, the Indonesian government intended to encourage exports in the non-oil sector from 1982. Therefore, the government formulated some policies such as reconsideration of disincentives to exporters under import substitution, provision of services to the export sector in the fields of finance, sale, quality control, and inspection, and reduction of transportation costs such as those of shipping. As a result of these policies the non-oil exports rose from 18 per cent of total exports in 1982 to 27 per cent in 1984 and to 41 percent in 1989. Moreover, the value of manufactured exports increased from $ 2.5 billion to $ 19.6 billion and in relative terms from 11 % of total exports to 57.7% of total exports between 1982 and 1992. This growth has been particularly evident since 1986, when the sector's export revenues still amounted to only $ 4.5 billion or about 30 per cent of total export earnings. (the real annual average growth of exports increased to 30 per cent during the 1980s). Moreover, the economic growth increased from an average rate of 4 per cent in mid-1980s to about 7 per cent during 1988-91. It should also be noted that the major force driving economic recovery was the private sector which played an important role in the success of deregulation policies. The private sector contributed over 70 per cent of total GDP growth during 1983-1991 [19].

One can generally say that from mid-1980s onwards, the previous import substitution policies replaced with an export oriented policy aimed at promoting non-oil exports and private sector. Despite significant growth of manufacturing exports in Indonesia during the

late 1980s, there have been some problems in promoting manufactured exports. Due to the low level of labour productivity and the increasing pressure of its competitors in the international market, Indonesia does not offer a particularly favourable environment for export-oriented manufacturing investment [20]. Manufacturing contributed only 15 per cent of Indonesia's GDP in 1983, in comparison with 21 per cent of Thailand and 18 per cent of Malaysia [21]. Moreover there have been some overall problems such as the cultural influences of the colonial period along with political instability and sometimes inconsistent industrialisation policies particularly in the 1960s and 1970s. Another major obstacle in promoting manufactured exports has been Indonesia's high cost of industrial products. While the reduction in tariff protection has encouraged the export of manufacture products, the use of non-tariff protection such as import licensing arrangements has created high prices for industrial inputs, leading in turn to uncompetitive exports. The other important problem in enhancing the manufactured exports is the fact that most foreign investment in Indonesia has been import-substitution oriented which emphasised more producing for the domestic market. As an example, a survey of 113 Japanese enterprises in Indonesia indicated that 105 of Japanese firms were import substitution oriented, while only 3 were export oriented, and the other 5 were both import substitution and export oriented [22].

The Indonesian fourth national development plan (1984-1989) formulated during the mid-1980s aimed at raising the standards of living, intellectual abilities and general welfare of the people, and laying strong foundations for subsequent stages of the nation development. The priorities of this plan were given to self-sufficiency in food and machinery industries [23]. One can generally refer to several points regarding Indonesian's very rapid growth rate of the manufacturing sector. Firstly, while some of the manufactured products in the 1960s were almost regarded as non-tradable and mostly included traditional and small-scaled industries, there has been a dramatic increase in both quantity and quality of manufacture products through the massive public and private investment in the manufacturing sector. It should also be noted that a very rapid increase in oil prices in 1973 provided a substantial amount of foreign exchange for the Indonesian government in order to develop the manufacturing sector. Secondly, Indonesia has imported an enormous amount of new technologies from foreign countries since mid the 1960s. It can be said that despite highly regulated and self reliant industrial policies, Indonesia has relied heavily on imported technology. The import-substitution industrialisation strategy of the 1960s and 1970s has

led to a flood of new technologies into Indonesia, many of which replaced older technologies and some of which made new goods available. Generally, with the increase in oil income revenue in 1970s, Indonesia was able to improve both general education and infrastructure, which facilitated the acquisition of new technologies. In addition to rapid modernisation of its labour- intensive technologies, the Indonesian government also developed the large-scale capital intensive industries during the 1970s and 1980s.

This indicates the importance of modern technologies for the Indonesian authorities. As one of the Indonesian Ministers (Research and Technology Minister) has stated, development should not only be regarded as increasing the national income but the physical appearance of the economy which can result from the heavy use and diffusion of high technologies may also have a significant impact to development of the economy and national income. He concluded that the capacity to develop and produce technology is essential for successful industrialisation [24]. His four part dream for Indonesia include acquiring advanced technology by assembling foreign designed aircraft under license, integrating this knowledge into high-tech joint ventures, developing indigenous technical skills through technical institutes, and finally providing competence in basic science and technology at the same level with the advanced industrial nation [25].

He has established two major technology ventures in shipbuilding (PAL) and aircraft manufacturing (Nartanio). While Nurtanio has produced aircraft (the CN 235) under license to the Spanish company (CASA), PAL has manufactured various types of ships, from tankers to patrol boats and hydrofoils. [26]. Moreover in aircraft manufacturing, since the establishment of Indonesia Nusantra Aircraft Industry (IPTN) in 1976, Indonesia has designed and manufactured five seater helicopters (NBO- 105) under licence from MBB-Germany, 19 to 28 seater fixed-wing aircraft (NC-212) under licence from CAS-Spain, PUMA NAS-300 and super PUMA NAS-332, 19 to 24 seater helicopters under licence from Aerospatiale France, and the recent collaborative programme with US companies with the purpose of assisting IPTN to be one of the subcontractors for Boeing products [27]. Both the ship and aircraft industries are examples of the government's continuing involvement to intervene in the marketplace through regulation and direct investment, in order to create a domestic industrial network in the face of market forces. The Indonesian government established the Agency for the Assessment and Application of Technology

(BPPT) in 1978 in order to strengthen its industrial technology capability through the selection, assessment and application of appropriate science and technologies. The agency was also responsible to formulate general policies for the assessment and application of technology requisite for national development. In order to achieve these objectives, BPPT employed 2,305 scientists and researchers involved in a wide range of research and development activities. Eight industries, namely, aeronautics and aerospace, maritime and shipbuilding, land transportation, telecommunications, energy, engineering, agricultural equipment, and defence industries have been selected for intensive research and development.

The flow of industrial technology from foreign sources including MNCs to Indonesia has mainly taken place been by the private firms rather than through state-owned enterprises. Most of industrial technology has been transferred into Indonesia through foreign direct investment (which in Indonesia can also take place through joint ventures) or through technical licensing agreements. In a survey of technology transfer through MNCs in twelve manufacturing companies in Indonesia, the primary concern was to examine to what extent this technology transfer has contributed to the development of indigenous (local) technological capability through the application of technological effort. The studies indicated that the degree of local technological effort for achieving indigenous technological capability in Indonesia has been greater in the case of national companies which have purchased technology through licensing agreements than in the case of joint ventures between MNCs and Indonesian private or state-owned companies [28].

There are five general stages in the process of technology transfer to LDCs such as Indonesia, including, learning how to operate machines, establishing maintenance skills, acquisition of repairing skills, establishing basic technology to make independent design possible, and establishing independent development in full-scale technology. As an example, the aeronautics and aerospace industry in Indonesia has reached the stage of design and manufacture of the CN-235/2 engine 38 passenger short take-off and landing aircraft [29]. Despite this significant development in some technology-intensive industries, it should be noted that Indonesia still lacks a strong scientific, engineering and managerial base along with skilled workers on which to build high value added industries. Moreover, it is believed that the development of these targeted high-technology industries supported by direct

public investment or subsidies and high levels of protection are costly and ineffective and inconsistent with Indonesia's strategy of broad-based growth and creating enough employment for its growing labour force.

Broadly, the government in Indonesia have used two strategies to accelerate the development of technological capability. The first is to promote private market mechanisms for technology development through functional interventions, for example maintaining competitive and open product markets, allowing unrestricted imports of machinery, technology and services; providing incentives for private investment in technology research and development, developing human resources, helping establish industrial standards and technology services and providing extension and information services. The second strategy has been to invest in technological development through selective strategic interventions, such as selective targeting of technology-intensive industries through import protection, direct public investment or subsidies to encourage private investment in such industries and the targeted development of highly trained manpower for such industries.[30]. It appears that Indonesia has currently used both functional and selective interventions in pursuing technology development with being more successful in the first (functional) than the second (selective strategic interventions).

Having compared the experiences of most East Asian countries including Indonesia in development of their technological capability, one can refer to some of the main common policies in which these countries have adopted in order to develop their technological capability such as a huge investment in development of their infrastructure in particular the manufacture sector, developing of their human resources through massive investment in education sector, the acquiring of foreign technologies through selective appropriate channels and through limited, well-designed government intervention and encouraging private sector through various incentives in order to help private companies to be able to compete in international technology markets. It should also be noted that as the experience of several East Asian countries has indicated, import substituting industrialisation strategies are not conductive to the absorption and diffusion of industrial technologies that are appropriate to labour-intensive economies [31].

The third feature of Indonesia's manufacture growth has been the rapid transition from

production of consumer goods and resource processing industries towards more intermediate and capital goods and heavy industries. For example, the manufacture value added in some consumer goods such as beverages and tobacco and rubber industries decreased from 60 per cent in 1963 to 12 per cent in 1986. The share of intermediate and capital goods in manufacturing value added increased from 13.1 and 6.1 per cent in 1971, to 35.5 and 16.9 per cent in 1980 respectively [32]. The increase in the capital goods industries were mainly due to the expansion of production in the engineering sector (such as electrical machinery, transport equipment and metal products), which was one of the fastest growing sectors during the 1970s. There was an annual growth rate of about 9 per cent in labour productivity among large and medium firms during the period between 1975 and 1986 [33].

Another important issue in the assessment of industrial development is the considerable growth in the manufacturing employment which grew at an annual rate of about 5.6 per cent for large and medium firms from 1975 to 1986. According to another figure, employment in manufacturing grew from 3.1 million in 1971 to 4.7 million in 1980, and the rate of growth in manufacturing employment increased substantially from about 4.5 per cent per annum in 1980-85 to 7 per cent per annum in 1985-90 [34]. Related to growth rates of manufacturing employment to value added gives the employment value added elasticity of about 0.30 in the period between 1971 and 1980. However, in comparison with the other South east Asian countries especially Thailand, Malaysia and Singapore, the manufacture sector made a much more important contribution to employment creation in these countries than in Indonesia with the employment elasticities of 0.56, 0.66 and 0.78, respectively during the 1970s [35].

The next important characteristic is an increase in the manufactured exports after 1985. Indonesia's manufactured exports during 1970s never surpassed $ 500 million which constituted less than 3 per cent of total exports. This weak performance of manufactured exports in 1970s can be mostly attributed to the Indonesia's import substitution and protectionist policies and reliance on export of its mineral resources, in particular oil and gas sector. Due to the shift towards an export promotion industrialisation policy, a sharp decline in oil export prices in mid 1980s, and a major devaluation of national currency in 1978 and 1984, manufacturing exports rose fourfold in the period between 1980-85, and nearly

doubled again in 1985-89, and increased a further 50 per cent in 1989-91. During the whole period (1980-91), real exports grew at an annual rate of 30 per cent [36]. By 1987 the value of the manufactured exports exceeded that of the agriculture commodities, and by 1991 manufactures constituted over half of all merchandise exports. Non-oil exports increased more than doubled from $ 6.7 billion in 1986-87 to an estimated $ 14.3 billion in 1989-90, an average annual increase of about 29 per cent. Much of this growth was believed to have come from a diversifying base of manufacturing goods [37].

It should be noted that due to weak domestic economic conditions related to the oil price decline that began in 1986, there was excess production capacity. Thus manufactured export output could be increased in response to a more favourable policy environment without increasing investment. As the decline in the role of oil revenue in GDP is continuing in the 1990s, it seems crucial for Indonesia to keep a non-oil manufacturing growth rate of around 10 per cent per year for the 1990s. At this rate, the share of non-oil manufacturing in GDP could increase from about current rate of 16 per cent to 23 per cent by the year 2000. Therefore, the importance of promoting efficiency and productivity of manufacture products becomes more vital for Indonesia in order to be able to compete in international export market. Most of early growth in manufacturing export has been in some natural resource based processed products such as plywood, clothing and textiles which accounted for about 40-50 per cent of total exports. Indonesia has been the largest supplier of plywood in the world since 1984. A range of other resource-based products including cement, fertiliser, paper, footwear, garments, furniture, jewellery and glass products also became significant in the late 1980s [38]. The share of heavy (engineering and assembly) industry which consisted of more capital intensive processing activities such as iron, steel, chemicals, and engineering and assembly activities rose substantially to over 40 per cent by mid 1980s [39]. The transition to resource-based manufacture exports has been based on Indonesia's comparative advantage, which would allow maximal foreign, productivity and employment benefits.

Moreover, a major dimension of Indonesia's industrial transformation lies in its rapid diversification. For example, the share of food, beverages, tobacco and rubber products fell extremely sharply, from 70 % in 1963, to 53% and just 33% in 1975 and 1986 respectively. On the other hand, the share of other newly emerging engineering and metal goods

industries, rising from 6 per cent in 1963 to 13 per cent in 1985, and heavy processing industries rose from 9 per cent to 25 per cent over the same period [40]. However, in comparison with most of its neighbours in South east Asia, the share of industrial products in Indonesia has been lower than those of neighbouring countries except for the wood and chemical products. Another feature of the industrial sector in Indonesia is its pattern of industrial ownership. Three main ownership categories dominate Indonesian non-oil manufacturing: (domestic) private firms, private foreign joint ventures, and joint ventures involving government, private and foreign interests. The large state enterprise sector reflects the government's strategically important role to guide the pattern of industrialisation. The state particularly controlled some strategic and capital intensive industries such as oil refining, sugar refining, cement, fertiliser, aircraft, spinning and weaving. In 1983, state owned firms contributed 55 per cent of total manufacturing output, and a further 21 per cent in joint ventures with foreign firms. In 1985, there were about 589 large and medium sized state enterprises. Data on 215 firms owned and operated by Indonesian government at the end of March 1986 provided further information. By sector, the total included 38 in manufacturing, 19 in public works, 17 in transportation, and 8 in mining and energy [41]. Some Indonesian authorities believed expanding large state enterprises is essential for Indonesia to catch up with modern technology and compete internationally. However, as the examples of garments and footwear industries indicated, one can say that the success of the non-oil exports drive has mostly depended on small enterprises rather than large firms [42].

However, despite relatively large state involvement in the manufacturing sector, private firms have been the major factor in Indonesian non-oil manufacturing. They provided over two-thirds of the jobs compared with 12 per cent government groups and just 6 per cent for foreign firms. Private firms dominate much of manufacturing mostly in consumer goods and labour intensive industries, including food products, plywood, textiles, garments, rubber products, and most non-metallic minerals industries [43]. The share of private firm's output has been increasing over time and they contributed over half of value- added in sixteen of the 28 main industrial groups. Another important point in the growth of manufacturing exports during the 1980s has been the direct role of government intervention in stimulating non-oil exports. As an example, one can refer to the ban on log exports which facilitated the very substantial growth of plywood, controls on the export of a range of timber products,

and the export of relatively capital intensive products supported by heavy public sector investment. Export developments in 1991 suggest a return to the earlier trends of rapid growth and diversification. Thus the experience of 1989 and 1990 can be viewed as unusual, and brought about by strong growth in domestic demand and a crowding out of certain export activities, particularly machine goods and metals. Rapid export growth in 1991 has been attributed partly to the jump in domestic and foreign investment directed towards exports in the previous two years, especially in textiles, footwear and wood products [44].

The Indonesian economy continued to shift from reliance on the oil and gas income to the broader base in particular manufacturing exports. In 1992, manufacturing has continued to be one of the most rapidly growing of Indonesia's major economic sectors and accounted for 21.7% of GDP. The increased importance of the manufacturing sector has resulted in manufacturing products becoming Indonesia's major export item in 1992, overtaking the value of exports of oil and gas for the first time. Manufactured goods produced export revenues of $14.0 billion and accounted for 41.1% of total exports in 1992. Exports of oil and gas, historically Indonesia's largest export item, moved into second place with export revenues of $10.7 billion which accounted for 31.4% of total exports. Non-oil manufacturing accounted for 17.5 percent of gross domestic product (GDP), oil and gas production and refining for 13.0 percent, agriculture for 16.7 percent, and trading, hotels and restaurants for 16.6 percent in 1992. Real growth in GDP averaged 6.7 percent from 1987-92, and slowed down to around 6.5 per cent in 1993. The principal manufactured goods produced in Indonesia included textiles, processed foods, motor vehicles and electronic equipment in the consumer goods sector and plywood, cement, fertilizers, metals and glass products in the intermediate goods sector.

Indonesia's prescription for its economy in 1993 places a high importance on mobilising financial resources to help the country develop its infrastructure and professional training. In order to make industry and trade more internationally competitive, Indonesia sharply reduced non-tariff barriers in July 1992, and deregulated key industries to allow free importation of essential manufacturing inputs. There have been 227 new manufacturing projects, at a combined value of over $ 2.5 billion in February 1993 including 18 chemical plants and 28 metal plants which are capable of generating approximate foreign exchange earnings of $ 1.1 billion and saving an estimated $ 1.4 billion annually in imports [45]. In

1993 manufactured exports reached US$22, 944 million or an increase of 17.0% compared to that of 1992 which amounted to US$19, 613 million and 247.7% compared to that of 1988 which amounted to US$9, 262 million. The increase in exports value has in fact lifted the role of manufactured exports on the whole of the national export from 50.4% in 1988 to 62.3% in 1993. While the role of manufactured exports on the whole of non-oil and non-gas exports increased from 82.1% to 84.7%.

E. 1 HUMAN RESOURCE DEVELOPMENT POLICIES IN INDONESIA

Human recourse development has received strong emphasis in the government's development strategy, both as a means of raising living standards and increasing the capacities for growth. It can be said that one of the most significant achievements of the New Order government has been a dramatic expansion in educational enrolments at all levels. The share of education in GDP increased from about 2 per cent in 1969 to 3.5 per cent in 1976-77 and again to 4.5 per cent in 1985-86. Moreover, in the early 1980s the literacy level grew very rapidly and reached to 80.9 per cent in 1985 and 86.4 per cent in 1990, compared with 71.1 per cent in 1980. It should be noted that the development of education have been remarkable at all levels, particularly at the primary and secondary levels. In terms of growth rates, upper secondary school graduates grew fastest at over 11 per cent per year over the period between 1971-1985 [46].

Moreover, in 1993/94, the number of new students in the senior high schools and vocational and technical schools (not including the Islamic senior high schools where the education is non-technical) reached 1.34 million. This amount shows a slight increase compared to the 1.33 million of the previous academic year which was in accordance with the increase of the junior high school graduates from 1.61 million to 1.63 million. Thus, the ratio of the number of newly admitted students in the senior high school against that of the junior high school graduates has increased from 82.1% to 82.3%. This amount shows a sharp increase comparing to that in 1968 which was only 35.3%. It is estimated that the real rates of return to improved basic education in rural areas have been about 27 per cent and in secondary education about 11-16 percent [47]. The few available studies on rates of return to education in Indonesia have indicated the highest returns at primary level and lowest for higher education. As Byron and Takashi (1989) estimated, general returns to education in Indonesia has been 15-17 per cent for each additional year of schooling [48].

In 1990, there were 49 public institutions for higher education in Indonesia, 10 of which are authorised to grant master's and doctoral degrees. Furthermore, there were 872 private institutions of higher learning [49]. In 1993, the government's plans for expansion of educational facilities at the university level included the introduction of new areas of study such as marine science, bio-chemistry, bio-technology, computer technology and micro-electronics. According to another figure, the student enrolments in tertiary education, both public and private, has increased from 8.5 per cent of the population aged 19-24 years (1.65 million) in 1989 to 11 per cent (2.5 million) [50]. Furthermore, there were 88,700 higher education academics in 1994 with a ratio of one academic for every 23 university students in academic year 1993/94. These numbers are higher than those of the previous academic year which are 59,500 academics and a ratio of 1:28. Research activities have also increased and there were 1,500 research titles funded by the Government during 1993-94 [51].

However, one can say that despite the quantitative growth in the Indonesian educational system, the quality of the educational system has not developed to the same level. The Indonesian authorities have recently tried to find a selective development strategy in which the highest returns for good quality in higher education are achievable. This human resource development strategy aimed at a re-evaluation and promoting of study programs to give significant stress on the development of the basic sciences, technology, economics, business and commerce. This should include new policies to enable professional colleges to increase their capabilities in training for industry. The strategy also encourages the academic staff to become more involved in research and development activities in order to improve self-confidence and academic standing. Moreover, Indonesian officials required foreign suppliers of technology to provide facilities for the training of Indonesian workers. This training generally aimed at promoting the capability of Indonesian workers to assimilate and develop imported technologies and also the replacement of foreign staff by Indonesians. Therefore, it appears that in order to meet the demands of continued industrialisation, the Indonesian authorities continue to make worker training and vocational education a top priority in the current development strategy.

Having compared the educational development in the Southeast Asia, between the period 1970-1985 adult literacy rose from 54 to 74 per cent in Indonesia, 60 to 74 per cent in Malaysia, and 69 to 86 per cent in Singapore. In the Philippines and Thailand literacy rate

were, respectively, 86 per cent and 91 per cent in 1985. Gross enrolment ratios at the secondary level in 1985 ranged from 30 per cent in Thailand to 71 per cent in Singapore, with Indonesia having made the most dramatic progress from 16 per cent in 1970 to 42 per cent in 1985. In terms of the share of educational expenditure per GDP, while Indonesia allocated about 4.5 per cent of its GDP in education, this figure have been 6 per cent and 1.8 per cent for Malaysia and the Philippines respectively in mid 1980s [52].

E.2 THE ROLE OF FOREIGN DIRECT INVESTMENT IN TECHNOLOGY TRANSFER TO INDONESIA

The inflow of foreign direct investment has been an important factor in Indonesian industrial development since 1967, when the Foreign Investment Law was passed. During the first year of its enactment, more than twenty large MNCs applied to invest in Indonesia. Between 1967 and 1992, more than 1,590 manufacturing projects involving $ 37.7 billion in foreign investment were approved by Indonesia's Investment Coordinating Board (BKPM), which represented 60 per cent of the value of total foreign investment commitment approved outside of the petroleum and financial service sectors [53]. Following the anti-Japanese riot of 1974, the New Order state undertook an Indonesianisation policy by amending the foreign investment law. The maximum limit of foreign share of ownership in all existing and new investments was fixed at 49 per cent. Furthermore, the main requirements of any joint ventures constituted the capital value including the local contribution of not less than $ 500,000, the local share-holding of not less than 20 per cent which should be increased to 51 per cent within 10 years [54]. Moreover, foreign investors were required to train local personnel to replace foreign personnel within 3 to 5 years [55].

This restrictive policy towards foreign investment, however, turned out to be in line with a general thrust toward more government intervention and government regulation of the economy which became increasingly evident after the mid-1970s. Since implementation of restrictive policies towards foreign investment in 1973, the amount of foreign investment declined sharply, causing increased concern by the Indonesian government. In order to attract more foreign investor, the government issued new regulations in mid 1980s, liberalising the restriction of the 51 per cent Indonesian ownership for joint venture agreements [56].

Moreover, the Indonesian government also authorised foreign investors to enter the service sectors and other activities previously reserved for Indonesian nationals if there was a lack of local entrepreneurs in that business area. Japan has invested more than any other country in Indonesia's manufacturing industries. Following the Foreign Investment Law of 1967, the flow of Japanese investment into Indonesia increased rapidly, which was mostly in the form of joint ventures with majority ownership in the early 1970s [57].

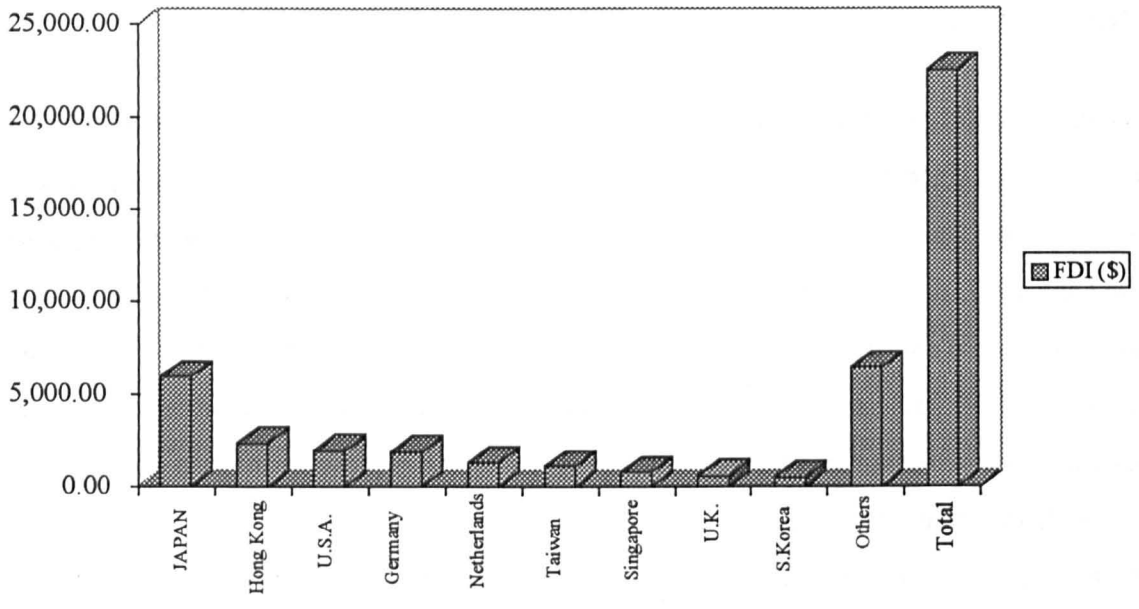


Figure E.1 Foreign Direct Investment (FDI) in Indonesia during the period between (1967-1988)

However, more than 50 per cent of foreign investment in Indonesian manufacturing was implemented through imports of goods [58]. According to a figure published by the Japanese Ministry of Finance, the cumulative total of Japanese investment in Indonesia registered to the end of March 1984 amounted to $ 7, 641 million, which made Indonesia the second largest recipient of Japanese investment after the United States, during the period between 1951-83 [59]. Another figure indicated that the total approved Japanese investment in Indonesia was estimated to be $ 5.9 billion in 244 projects, which accounted for around 26 per cent of the total investment in Indonesian manufacturing industries, for the period 1967-1988. It can be said that almost all Japanese manufacturing affiliates in Indonesia have been import substitution oriented, having been set up to produce goods for the domestic

market. According to a study of technology transfer by Japanese companies in Indonesia showed that almost half of the inputs of Indonesian subsidiaries of Japanese companies were imported from the parent company in 1974, a substantially higher figure than for either the Philippines or Thailand. This indicated to high import intensity of foreign investment in particular Japanese investors [60].

In addition to be an attractive place for foreign investors, mainly because of rich natural resources, cheap labour and large market size, the government in Indonesia also introduced some other incentives such as tax exemptions and establishing export-processing zones in order to attract more foreign investment. More recently, the Government of Indonesia eased restrictions transferring majority ownership to nationals. Under these rules, foreign investors are limited to 80 percent equity in a limited liability company, which must be reduced to 49 percent within 20 years of commencement of commercial production. As a result of these policies and due to emergence of favourable international conditions, the flow of FDI reached $ 1.5 billion in 1987, $ 4.5 billion in 1988, $ 4.8 billion in 1989, $ 8.8 billion both in 1990 and 1991, and $ 10.3 billion in 1992 before decreasing in 1993 to $ 8.0 billion, which mostly concentrated in export-oriented manufacturing industries [61].

Year	No. of Projects (New	Amount ($ U.S. million)
1980	20	1,074.4
1981	24	706.5
1982	31	2,416.9
1983	46	2,470.8
1984	23	1,096.9
1985	45	853.2
1986	93	847.6
1987	130	1,520.3
1988	145	4,481.6
1989	294	4,718.8
1990	432	8,751.0
1991	376	8,778.2
1992	305	10,313.2
1993 (Jan-	99	3,973.2

Table E. 1: Approved FDI in Indonesia during the period between 1980- May 1993.

Source: Capital Investment Coordinating Board: Statistics on Investment, Monthly Investment Report, Jakarta, May 1993.

The slight decline in the amount of FDI in 1993 can be partly attributed to a massive slowdown in Japanese investment. It should be noted that, FDI approved on condition that 65 per cent or more of its production should be allocated for export, which increased to 70-80 per cent during late 1980s. Much of FDI to Indonesia was attracted by manufacturing industries in particular, chemicals and rubber industries, the processed metals and metal products, paper and paper products, and textile and leather industry. Therefore, the bulk of foreign investment since the late 1980s, apart from the oil related industries, have been directed towards export activities, particularly in labour intensive and resource based manufacturing industries, where Indonesia has a comparative advantage.

Having compared the foreign investment in Indonesia with other ASEAN countries, as a survey conducted by Japanese Committee for Economic Development in early 1987 indicated, Indonesia's investment climate was perceived by many Japanese enterprises to be less favourable than those of the other Southeast Asian countries, with the exception of the Philippines [62]. However, one can say that in comparison with some ASEAN countries such as Thailand and the Philippines which suffered from relatively inadequate infrastructure and shortage of skilled managerial and technical workers, Indonesia appeared to be more appropriate as a base for attracting foreign investment. Although Indonesia has not established Export Processing Zones (EPZ) as much as its neighbours, there was a small EPZ operating for many years in Jakarta and more recently the government has established the "Golden Triangle" in Batam-Singapore-Johor in co-operation with the governments of Singapore and Malaysia in order to attract more foreign investment [63]. Batam is a small island which belongs to Indonesia's Riau province and in about 20 Km. away from Singapore. The Indonesian government planned Batam to be a free trade zone to compete with Singapore. In order to attract more investment, the 100 per cent foreign ownership was allowed in the Batam Economic Zone. The first official statement of the concept of Golden Triangle comprising the state of Johor in Malaysia, Singapore, and the Riau province (Batam and Riau islands of Indonesia) was announced in December 1989.The main objectives of the establishing Golden Triangle included simplification of product distribution, payment and delivery product, joint tourism promotion and development, co-operation in water supply and transportation in Singapore, co-operation in development and maintenance of infrastructure for joint development projects and co-operation in industrial and technological development in the Riau province of Indonesia. By the end of 1990, Batam

attracted a total amount of $ U.S. 2.8 billion, with 79 per cent of private investment and 21 per cent of public investment [64].

In addition to taking advantage of Singapore's financial and commercial status with its efficient facilities for communication, transportation and other services, Batam can also be used as a link between the Indonesian domestic economy and the world economy. Batam can process Indonesian raw materials for export to Asia, America and Australia. It can also manufacture goods from components from foreign countries (or the domestic components) for the Indonesian market. There has been foreign investment from other countries into Indonesia in particular from NICs in Southeast Asia, which of the 432 foreign investment projects in the non-oil and gas sectors approved during 1990, about 58 per cent of the total were initiated by investors from these four countries [65]. It is believed that increasing labour costs, higher land prices, heightened concern about the environment and appreciation of their currencies have led these countries to relocate labour intensive and resource-based industries off-shore and to concentrate on high-tech and knowledge-based activities which produce high value added products [66]. While Taiwanese and Korean investment is more concentrated in the Indonesian manufacturing sector due to their greater degree of a technological capability, whereas Hong Kong and Singaporean investment have been more diversified in other sectors. Korean investment in the manufacturing sector was heavily concentrated in the chemicals industry, which accounts for 58 per cent of Korean investment in Indonesian manufacturing, and the wood and wood products industry (34 percent). Taiwanese investment on the other hand, was concentrated more on the paper and paper products industry which included 86 per cent of its total investment in Indonesia. Hong Kong investment in Indonesia ranked second after Japan with an invested amount of $ 2,308.2 million which represented 10.3 per cent of all foreign investment in Indonesia during the period between 1967-1988. Most of Hong Kong investment in Indonesia concentrated in the textiles and garments, iron and steel, chemicals and pharmaceutical, and paper products.

Most of the NICs investment in Indonesia has been export oriented in nature and in fields in which Indonesia has a strong comparative advantage, such as labour and resource-intensive activities. Furthermore, many NICs tended to invest in small-scale manufacturing in Indonesia. However, with the growing of technological capability and comparative

advantage of the NICs, there has recently been a shift towards investing in more capital and technology intensive industries by Korea and Taiwan, such as electrical and machinery industries. A case in point is the electronics industry, where Japanese and Korean manufacturing firms, such as Sony, Matsushita, and Samsung electronics, set up new plants in 1992 which are equipped with the most modern capital equipment to produce consumer electronics products, such as audio and video equipment, almost all of which is being exported. Apart from Korea the presence of a large Chinese business community in Indonesia facilitated the establishment of trade and investment links between the Chinese NICs and Indonesia.

It is believed that FDI has two main types of benefit for Indonesian manufacturing sector. The first benefit has been increases in real income reflected in increased wages, reduced prices to consumer, or higher government revenues. The second and indirect benefits such as introduction of new techniques and managerial expertise into Indonesia. It appears that Indonesia has gained in both ways during the past decades [67]. One can generally say that the recent flow of foreign investment into Indonesia has been effective in promoting Indonesia's technological and industrial capacities. The majority of this investment has taken place in industries in which Indonesia has a strong comparative advantage, in particular those producing labour-intensive, and utilising relatively simple product and process technologies. It should also be noted that despite an important contribution of foreign investment in transferring technology and managerial expertise in the Indonesian manufacturing sector, however as the experience of Korea in achieving technological capability through other channel of technology transfer such as licensing agreement indicated; foreign investment has not been considered the only way of gaining access to more advanced products and processed technologies and marketing expertise for Indonesia.

E.3 SUMMARY AND CONCLUSIONS

Indonesia's industrialisation started much later than other Southeast Asian countries, because it took a long time for the country to achieve a political stability as well as economic reformation and stabilisation after the end of second world war. Between 1965 and 1975 Indonesia followed a strategy of Import Substitution Industrialisation financed largely by foreign aid and loans and in which private investment, both foreign and domestic, was to

play an important role. Serious efforts to establish import substituting industries in manufacture of final consumer goods were initiated only after 1967. From 1973 to 1981, the oil boom overshadowed industrial development. However the main industrial strategy during the 1970s and early 1980s was still import substituting, which expanded further to include intermediate and capital goods. The rapid decline of oil prices in the mid-1980s eventually forced Indonesia to change to a policy of promoting non-oil exports, particularly manufactured products, with an effective currency devaluation.

This shift in strategy has been the incentive for the economic and trade reform packages that have been introduced on an almost annual basis since the late 1980s. The Indonesian government has introduced a series of policy measures including, devaluation, privatization, and deregulation and Export Promotion policies to promote non-oil exports especially manufactured exports. Due to these new government policy initiatives substantial progress has been made in many sectors of the economy in particular non-oil exports. Indeed, since 1987, non-oil exports have become major source of income for Indonesia. However as a latecomer to production of manufactured exports, Indonesia still produces largely resource-base and labour-intensive light industrial goods. The Government also has encouraged domestic and foreign private investment and continues to seek an important contribution from the private sector towards the establishment of a broader and more balanced base for economic development. The Indonesian government also views foreign investment as a way of attracting high technology and managerial expertise to Indonesia. Various measures have been introduced to encourage both domestic and foreign private investment. More recently, in an important development of this policy, during late 1993 and early 1994, the government announced a privatization programme in which several state-owned companies' shares are being sold on the domestic and foreign capital markets.

Having compared the Indonesian manufacturing sector with some other countries, it appears that despite rapid growth in the manufacturing sector during the last two decades, the Indonesian manufacturing sector is relatively smaller than that of South Korea and India (and Mexico), and little larger than that of Thailand. However, Indonesian's pattern of industrialisation has had common features with its East Asian neighbours in the its recent export promotion policies, with Mexico and Nigeria and other oil exporter countries as a "petroleum economy", and with India in its large domestic market. The Indonesian

government's strategy for the future development of the manufacturing sector is essentially twofold: to continue promoting the development of labour intensive industries to create more jobs and raise the nation's living standards; and to promote value-added industries in order to strengthen Indonesia's trade position and global competitiveness.

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APPENDIX F

MEXICO'S EXPERIENCE OF INDUSTRIAL AND TECHNOLOGICAL DEVELOPMENT

Mexico is a middle-income economy, characterized by a low- productivity primary sector and, at the same time, by relatively well-developed manufacturing and service sectors. Manufacturing and the construction sector generate 23% and 5%, respectively, of total output, but absorb just 18% of the labour force. The main manufacturing products are vehicles, machinery, chemicals and textiles. Oil extraction and processing constitute another important part of the secondary sector. Services contribute about 60% to GDP and provide employment for more than half of the population. Commerce, restaurants and hotels comprise the most important part of the service sector, contributing 26% to GDP, followed by financial services, insurance and real estate, which together accounted for 11% of GDP [1]. Prior to the 1980s, Mexico stood out as one of the Third World miracle economies: a successful, though occasionally troubled, example of import substitution industrialisation. It had achieved annual average growth rates of 6 per cent a year from 1950 to 1970. Manufacturing grew by an annual average of 7.6 per cent from 1960 to 1980, with heavy industries growing more than 10 percent [2].

Import substitution policies and restrictions on foreign investment were a major part of the postwar development strategy in Mexico. During the 1950s, import substitution was still in the first stage in Mexico and the country lagged Brazil by almost one decade. As its name suggests, the goal of ISI was to develop a strong industrial base by encouraging the domestic production of previously imported goods. Moreover, the import substitution policy promoted and protected an industrial sector that was generally inefficient and therefore unable to compete in international markets. In the first stage of Import Substitution during the 1960s most non-durable consumer goods produced in Mexico substituted to the imports of intermediate goods. The government has directly participated in the industrialisation process by coordinating manufacturing corporations, either by itself or in conjunction with private investors. The manufacturing growth rate accelerated at 9 per cent through 1960s compared with 6.1 per cent in the 1950s. Non-durable consumer goods continued to grow by 6.3 per cent annually, but intermediates accelerated at 8.4 per cent while capital and

durable consumer goods grew faster than the manufacturing average (by 12 and 12.8 per cent, respectively) [3].

In Mexico, ISI was also associated with agricultural development programs that assured increasing in basic food supplies for most of the population. Import substituting industrialisation also succeeded in its initial goals of reducing imports and promoting domestic manufacturing. As a result of adopting the ISI strategy, imports fell rapidly as a proportion of total Mexican demand. The growth model based upon import substitution has enabled Mexico to move ahead in the development process. Mexico was also a model for other countries that employed the ISI strategy [4]. King (1970) summarises the major reasons for adopting an import substitution policy in Mexico in early stage of its industrialisation to the following four points [5]:

1. Mexico has frequently been dependent on a single country or even on one firm for her imports. Import substitution reduced this economic dependence.
2. Import substituting industries gave employment to a growing labour force.
3. Such industries helped the transfer of people employed in agriculture into non-agricultural sectors, thus reducing pressure on agricultural resources and so raising agricultural incomes.
4. Import substitution strengthened Mexico's balance of payments in face of her slow growth of commodity exports.

It can be said that even though there is a general agreement about import substitution as a necessary prerequisite for industrial development, particularly in a large country like Mexico, this strategy resulted in a deficit of trade in manufactured goods. The IS strategy increased the demand for the import of non-competitive raw materials and investment goods and reduced the export of manufactures [6]. However, import substitution policies are considered to be not efficient enough for leading the country in economic and industrial development. This can be summarised in the following points:

1. The ISI was not able to resolve the shortage of foreign currency. Import substitution was itself import promoting. The second stage of import substitution required more importation of materials and capital goods.
2. Due to neglecting the efficiency and quality of the import substituting industries, they were not competitive in international market.

3. The import substituting industries were created less employment opportunities than expected.
4. The income distribution was not improved by the ISI policies.

While IS and protection policies did help to expand industrialisation in Mexico, and industrialisation has been a key element in raising incomes, diversifying and increasing exports, and modernising Mexican society. One can say that there could be more manufacturing outputs by pursuing less protection policy in Mexico. Indiscriminate protection has also been a major obstacle to manufactured exports. Such protection not only increased the costs of intermediate inputs but in many case resulted in lowering their quality. The import substitution policy promoted and protected an industrial sector that was generally inefficient and therefore unable to compete in international markets. Labour productivity in the Mexican manufacturing sector grew by only 3 per cent annually, comparing with 9.8 per cent for Korea between 1963 and 1973 [7].

As discussed earlier, since early in the 1970s it has become evident that the import-substitution pattern of industrialisation in Mexico, which relied heavily on the use of imported technology has led to a worsening of the trade balance. This was mainly because of a rapid increase in imports of the intermediate and capital goods. The lags in manufacturing goods exports and the stagnation of traditional primary exports were also responsible for the size of deficit. Hence, ISI policies only altered the nature and composition of the dependency and failed to reduce the country's general dependence on imports from the industrialised countries. In 1972, the Mexican government adopted a strategy of state intervention greater than ever before. As a result of this policy GDP grew in 1972 and 1973 causing a recovery process which extended to the rest of the economy. However, this recovery was short lived. The shortages in the production of basic industrial inputs and the stagnation of agriculture production caused the Mexican economy to encounter another recession in the mid-1970s. Import-substitution as a development strategy began to stagnate and the import share of manufactured goods rapidly rose during this period. Protectionism allowed an industrial sector to develop, but after three decades of doing business with government subsidies and protective tariffs, Mexican industries grew inefficient and uncompetitive.

The national development plan (1976-82) which emphasised more the expansion of petroleum sector, along with rise in oil prices in 1979, resulted in an extraordinary boom in

the Mexican economy and led to the accelerated GDP growth of over eight per cent during this period. Although exports increased from 3.6 to 9.4 per cent of GDP between 1975 and 1980, due to growth in oil exports which expanded to $16 billion by 1982. Non- oil manufactured exports increased only slightly as a percentage of GDP from 1.1 per cent to 1.4 per cent between 1975 and 1980 [8]. According to a government report, from 1975 to 1981 the production of crude oil increased 3.2 times; natural and refined oil products by 2 times; basic petrochemicals by 2.5 times; fertilizers by 2.3 times; steel and cement by 1.5 times; automobiles by 2 times; and electricity by 1.7 times [9]. In spite of some important results such as high GDP growth rates (of averaged 8.4 per cent) and expansion in the manufacturing, construction and oil and electric power sectors, some serious problems such as low labour productivity and lack of competitiveness distressed the Mexican economy during the short lived petroleum-led economic boom of the late 1970s.

F.1 TRADE LIBERALIZATION AND PRIVATIZATION

Following the debt crisis in 1982, Mexico changed its previous inward-looking strategy of protection and state regulation to the outward-oriented, private sector-led development strategy. Import substitution policies and reliance on oil exports for foreign exchange earnings were replaced with policies aimed at attracting foreign investment, lowering trade barriers, and generally making the country more competitive in non-oil exports. Mexico began to rely more on market forces in order to allocate resources more efficiently. One of the main objectives of adopting the new strategy was to encourage domestic industry to greater efficiency and international competitiveness. It is also argued that trade liberalisation, by expanding output of labour-intensive industries in Mexico, led to increased employment of wage earners, and therefore, to a more even distribution of income. Whiting (1991) has pointed out five overall reasons for a transition toward more open and liberalised economy after the Mexico's 1982 crisis [10]. Firstly, the economy had become excessively dependent upon oil. Secondly, the growth of the state-owned sector was accompanied by increasing indebtness. Thirdly, import substitution industrialisation, even when accomplished through foreign direct investment, was highly inefficient. (Mexico's import substitution industries were high cost and low quality). Fourth, Mexico had failed to develop an autonomous technological capacity, one of the stated goals of industrial policy. Fifth, Mexico's manufacturing productions were not able to compete in the international markets.

Mexico's trade liberalisation program can be divided into three stages running between 1983 and 1989. The first stage was from 1983 to June 1985, the second stage from July 1985 to December 1988; and the third since 1989 under the Salinas administration. During the first stage of the trade liberalisation (1983-1985) some of the import tariff schedule were reduced and import-licensing requirements for intermediate and capital goods were eliminated. For example, the proportion of imports exempted from tariffs increased from 21 percent in 1982 to 42 percent in 1983 [11]. Some of the previous restrictions on the Foreign Direct Investment (FDI) were also simplified. The second phase of trade liberalisation consisted of removing licenses and import permits and replacing them with tariffs. One of the most important results of the trade liberalisation policies was the government decision to join the General Agreement on Tariffs and Trade (GATT) in late 1985. It is believed that this decision has been a shift in balance of power from small and medium sized firms towards the large private industrial concerns, which have had extensive and profitable links with multinational corporations for many years [12].

In addition to obtaining the advantages of GATT membership, the agreement was viewed by the Mexican administration as a means of strengthening private sector's confidence in the government's long term commitment to trade liberalization. The stabilization caused the Mexican economy to contract by almost 5 per cent between 1982 and 1983, and cut the average rate of Mexican GDP growth to the only 0.8 per cent between 1982 and 1988. According to Ramirez (1994), the most important components of the economic stabilization and adjustment program were [13]:

1. a systematic policy of devaluing the real exchange rate by devaluing the peso along with stabilisation of inflation rate via a reduction in public sector deficit.
2. The reduction by more than 40 percent of the number of public enterprises as part of the government's so-called strategy of disincorporation.

The growth rate of total non-oil exports particularly manufactured exports have been significantly increased since 1983 as a result of trade liberalisation policies. For example, manufactured exports rose at an average annual rate of about 22.4 percent between 1983 and 1988. In 1988, for example, total merchandise exports reached 20.7 billion dollars, with manufactured exports accounting for most of the expansion. Manufactured exports, on the

other hand, accounted for 82.4 percent of non-oil exports in 1988, and their share of total merchandise exports rose to 56.5 percent that year (compared to only 20.6 percent in 1983) [14]. The Mexican government turned to export promotion when it found problems in the balance of payments. As a means to promote an export-oriented industrial sector, Mexico's state employed various forms of subsidies to exporters, preventing the use of imported inputs in export production only when domestic substitutes were available.

It is generally believed that there are two general reasons for adopting export-led industrialisation policies in Mexico. The first reason is that, adopting an export-oriented strategy through relaxing the foreign investment rules, may attract Multinational Companies (MNCs) into the country, which would be more likely to bring modern technology and techniques with them. Mexico's need to create as many as jobs as possible can be seen as another reason for the change of its policy to an export oriented industrialisation [15]. Since 1985, a number of initiatives have been taken to promote non-petroleum exports, including the greater access of credit for exporters, easing the requirements for admission of imported intermediate inputs and further devaluation of exchange rate. Consequently, non-oil exports grew from $7 billion in 1985 to $14 billion in 1988 and $ 16 billion in 1990 [16]. It should be noted that Mexico's significant performance of non-oil exports has mainly been due to manufacturing exports and in particular those of the maquiladoras. *(Maquiladora is the term applied to companies that assemble or process foreign-made components in Mexico and then export the resulting products. The term "maquiladora" originally referred to millers who collected tolls in kind as a service charge called "maquila" for processing wheat into flour).*

For example, Mexico changed from being a net importer of motor vehicles to being a net exporter, in the 1980s. In 1988 Mexico produced 512,776 vehicles and, the following year, generated $ 1,600 millions from overseas sales and a further $ 2,200, from overseas sales of parts. One can say that a competitive exchange rate and trade liberalization can be contributed to this improvement in export performance [17]. Moreover, the main reason that Mexican exports gained additional world market shares was its exports of machines and transport equipment [18]. It is noteworthy that much of Mexico's success in exporting manufactured products has been the result of the government's promotion of labour-intensive firms known as maquiladoras along the country's 2000 mile border with the United States. Maquiladoras can be concluded a Mexican version of a Free Trade Zone (FTZ). It

is believed that some of the leading U.S. multinational enterprises which had faced the price competition in their home market from European and Asian producers, established maquiladoras to perform labour intensive assembly operation in order to take advantage of the cheap labour costs in Mexico[19].

Following some incentives introduced by the Mexican government, such as allowing sale of up to 40 percent of their products locally, the number of these firms increased in some other regions of the country and away of American border. One of the prime objectives of the maquiladora operations has been the earning of foreign currency through exporting their products. The maquiladora exports was the second largest foreign-currency earner after petroleum exports in the 1980s [20]. However, in spite of some advantages such as providing more than 160,000 jobs in 1985, these firms had some disadvantages such as dependency on the U.S. market for both their imports and exports, lack of linkages with domestic suppliers and markets and inadequate physical infrastructure of the maquiladora industry which led to the pollution of environment and prevented for their further expansion. It is believed that the maquiladoras had very weak linkages with the rest of the Mexican economy, with much of their contribution decreased, for all intents and purposes, to the payment of salaries and the expenditures related to the installation and operation of the plants [21]. Moreover most of maquiladora activity involved assembly and was not truly high technology. Most of the parts and materials were shipped to the Mexican border mainly for the labour-intensive phases of the productive process and then merely shipped back. Over 75 per cent of the production workers in maquiladoras were women. It can also be said that maquiladoras operated as self-contained units and they contributed little to the development of indigenous industrial activity. In 1975-80, Mexico's share of total materials and supplies utilised by maquiladoras varied around 1.5 per cent [22].

Some of the other reasons criticizing the maquiladoras are as follows:

1. It is believed that they paid low wages, transferred few skills, and generate few backward linkages or local content.
2. In addition, it was argued they seem to be unstable since plants involved little capital investment and could be easily shut down.
3. It was also argued that they did not provide the basis for viable long-term industrialisation of Mexico.

4. Some have criticised the maquila program for putting upward pressure on skilled labour wages, which could cause inflation.

However, as mentioned earlier, the maquildora production was an important part of growth of manufactured exports. There were about 2000 maquilas in Mexico by 1992, employing almost half a million workers. Annual maquila export earnings are in the region of US $ 2-3 billion. Two-thirds of the plants are owned by United States citizens, nearly 25% by Mexican, and 3% by Japanese. As Sklair (1989) pointed out, the maquila industry has certainly been responsible for the upgrading and encouragement of profession skill all along the border. Sklair (1989) also argues that maquiladoras have largely failed to establish links to local business via transferring technology or improving the conditions of labour. Although he accepts the maquiladoras' ability to generate foreign exchange, he points out the gap in the cross-border spending of maquiladoras workers and contradictory effects of devaluation on domestic value added in the maquila industry [23]. As an effect of the maquiladora, one can refer to the increased effort to train and educate employees to fill the growing demand for skilled labour. A comparison of labour intensive border maquiladoras with maquilas in the interior shows that high-tech U.S. firms have started combining some of the most automated manufacturing technologies and the latest management techniques with some of the world's lowest-paid workers [24].

In recent years, the maquiladora program has attracted more sophisticated forms of production in automobile-related manufacturing and advanced electronics assembly. This "second wave" of maquiladora plants has made substantial investment in complex technology. In the most part of these maquiladors industries, high and sophisticated technology is contained in the components which are assembled in a highly standardised and simplified technique by low-paid maqila workers doing the same things hundreds of thousands of time every day. This forms of technology transfer to Mexico which can be called production sharing means that in some major industries, particularly those that are based on electronic control systems, the high technology processes transfer in the form of components to low wage areas for further processing. Thus, the technology has been relocated, not kept in production processes within low wage areas where the further processing is taking place. High quality exports can be produced in Mexican plants using advanced production technologies [25].

The 1985-87 was extremely a difficult period for the Mexican economy, beginning with the sharp fall in oil prices in the second half of 1985, and followed by the devastating earthquakes that hit Mexico City in late September of that year, and the Mexican stock market crash of 1987, sent the economy into a downturn as severe as the one experienced in 1982-3. While the early stages of Mexico's stabilization and liberalization policies accelerated the process of internationalisation, the later stages have speeded up Mexico's integration into international economy. This indicates a reshaping of production processes, including the assimilation of new technologies and new organization of the labour process, which involves more automation and fewer worker in production [26]. Since 1988, the additional liberalization measures, combined with an appreciating real peso, have had a stronger impact on increasing imports. Merchandise imports during 1988 estimated almost $ 19 billion, up from $ 12 billion in 1987. The growth in imports has been dominated by capital goods and has resulted in a sharp reduction of the trade surplus to a mere $ 1.8 billion in 1988 [27]. By 1989 the Mexican economy had turned around according to most economic indicators. After a long period of negative economic growth (1983-1988), the Mexican economy enjoyed three years of positive per capita growth. For labour productivity, in manufacturing in the aggregate, growth after 1985 was no more than modest. For 1985-1989, it averages 1.9% annually compared with around 1% in 1981-85, and around 3% in 1975-80 [28].

As explained earlier, one can say that trade liberalization policies facilitated transforming of an inward-looking economy characterised by high tariffs and heavy reliance on import controls into an outward-looking economy which identified by greater reliance on market forces and less government interventions. Mexican firms have also improved their productivity under the liberalization policies and more generally the liberalization measures have contributed to the establishment of a predictable and logical incentive structure for the private sector in Mexico. Moreover, the elimination of subsidies, quotas, as well as deregulation and privatization of state enterprises along with fiscal and financial incentives for export promotion, have played a critical role in the restructuring of Mexican industry. For instance, private firms were allowed to import petrochemical materials since 1986 which previously had been permitted only for state enterprises [29].

After the election of president Salinas de Gortari as a Mexico's president in December 1988, the National Council of Concert and the National Plan of Development (1989-1994) were

established in 1989. Additionally, the deregulation and privatisation of state enterprises was accelerated, and the number of state enterprises declined from 1,155 in 1982 to 386 in 1991. Following the accomplishment of a solidarity pact (Pacto de Solidaridad Economico) in 1987 by de la Madrid administration and renaming to the pact for stability and growth (PECE) by the Salinas government in 1989, the inflation rate was brought down from 159.2 per cent in 1987 to 18.8 percent in 1991, and estimated 11.9 percent in 1992 [30]. The economy grew strongly, expanding 3.3 per cent (real GDP) in 1989, and 4.4 per cent in 1990. Concerning privatisation, by February 1990, 891 enterprises had been privatised or closed, from a total of 1,155 in 1982 [31].

Following the foundation of North American Free Trade Agreement (NAFTA) with the United States and Canada in 1992, Mexico has decided to modernise its industrial infrastructure, especially in the area of international competitiveness. As a result, four modernization programs were launched: the national program of science and technology modernization, 1990-94; the national program for industrial modernization and foreign trade, 1990-94; the national program for modernization of education, 1989-94; and the program for modernization and development of micro, small, and medium industries, 1991-94. In Mexico, the integration of a free trade area Mexico-US- Canada, is seen by many as the logical outcome of the neo-liberal model and the ongoing trends between the Mexican and the U.S, economy, also called the "silent integration". However, there is some argument about the probable disadvantages of NAFTA for small and medium firms as well as for small farmers. It is believed that a treaty based on the exploitation of cheap Mexican labour, cheap energy and raw material, technological dependency and a weak protection of the environment are the wrong assumption for economic integration.

Some of the most important effects of the NAFTA in the Mexico's economy can be summarised to the following points:

1. It is believed that NAFTA may affect Mexican agriculture products (particularly grain production) because of the high production costs and low productivity level of Mexican agriculture compared to those of United States.
2. NAFTA has accelerated the industrial restructuring of Mexico due to transition of the American and Canadian factories to Mexico to utilize low cost of labour in Mexico.

3. It is believed that small-scale enterprises in Mexico have been harmed by low-price import products resulted from NAFTA, since they have limited managerial, technological, financial, and marketing resources.
4. It seems that after the NAFTA, the future growth of Mexico will depend more on foreign investment than on export performance. The future performance of the economy is thus rather fragile, since most of capital inflow has gone to the stock exchange rather than direct investment.

However, in short term, the most important benefits of NAFTA for Mexico is the capital inflow. Moreover, the prospect of a Free Trade Agreement with Canada and U.S. has provided an excellent chance to advertise to the world the business opportunities available in Mexico. In the medium term, there would be an increase in Mexico's efficiency and productivity levels due to removal of trade barriers resulting from anticipation of the benefits of NAFTA [32]. Furthermore, a free trade agreement with the United States, by encouraging Mexico's reforms, would increase investors' confidence in Mexico [33]. NAFTA can be characterised as an expanded free trade area. Some surveys of the effects of NAFTA on the Mexico's economy shows that if NAFTA allowed Mexico to increase its level of specialization in manufacturing and permitted the import of specialised inputs, then output per worker in manufacturing could rise by some 1.6 percent a year. This is beyond the growth that would exist without NAFTA.

It is also believed that a trade agreement with the U.S. enhances the flexibility of the strategy to future Mexican political changes. Furthermore, the pursuit of a Free Trade Agreement (FTA) with a partner so much more powerful also has been shown to include some risks. Firstly, the United States' capacity to put pressure on Mexico is far greater than the converse. Mexico accounts only for about 6 per cent of U.S. total trade, but depends on the U.S. market for almost 75 per cent of its exports and imports. In addition, about 63 per cent of total foreign direct investment in Mexico comes from the United States. Secondly, Mexico's internal matters have been and will continue to be under close investigation [34]. The Mexican authorities in particular expect that Mexico's widespread access to the North American market will open new opportunities for Mexican companies help generate employment in Mexico, and increase wages. Also, the NAFTA is expected to improve Mexico's position in the current international competition for capital. Furthermore, greater

access to goods from Canada and United States would give Mexicans a wide choice of products at lower prices. On the other hand, NAFTA can be seen as a first step toward a wider trading region encompassing other Latin American countries [35]. High quality and productivity combined with low wages present a vital attraction for new investment, Moreover, NAFTA minimizes or eliminates one of the major barriers to investment today, the perception of political risk.

It is believed that NAFTA means the beginning of the end of the maquiladora program. With the advent of free trade in north America maquiladoras are no longer able to receive duty drawbacks on third- country components included in exports to the United States and Canada. Maquiladoras should be free to sell their products within Mexico, upon payment of appropriate duties [36]. It is generally accepted that a NAFTA accompanied by continued policy liberalization will cause Mexican exports of goods and non-factor services to grow at a faster rate than would otherwise have occurred. However, some of the industrial unions in the U.S. opposed to the agreement because of fear of runaway industries that would take advantage of low Mexican wages.

F.2 FOREIGN DIRECT INVESTMENT IN MEXICO

Foreign Direct Investment has long been a part of Mexico's industrialisation. The changes in Mexico's policies toward foreign direct investment and intellectual property are among the most notable aspects of that country's liberalisation of foreign economic policy. Throughout the 1960s and 1970s, foreign investment grew primarily in import-substituting industries such as automobile electronics, chemicals, and processed foods. During the 1970s, about 75 per cent of foreign investment was concentrated in the manufacturing sector. In contrast to three of the four Asian NICs (Korea, Taiwan, Hong Kong) FDI played an important role in early phases of development in Mexico. Mexico has been among the developing countries that have received the most foreign investment. Net FDI, including the reinvestment of profits, reached almost $ 13.5 billion from 1955 to 1982, the period when Mexico's manufacturing industry grew the fastest. From 1971 through 1981, the year before the crisis, the flow of FDI was growing at an average rate of 18 per cent [37]. In 1981, of the $ 9.9 billion of FDI in manufacturing, 64.3 per cent came from U.S.A, compared to 9.9

per cent from Germany, 5.4 per cent from U.K., 5 per cent from Switzerland, 2.8 per cent from Canada and 2.7 per cent from Japan. U.S investment was dominant in all sector of production in 1981, except for wood products and non-metallic mineral products, Swiss investments in foodstuffs, beverages and tobacco (16.7 per cent) and in non-metallic mineral products (23.4 per cent), Japanese investments in basic metallic industries (17.9 per cent) and those of U.K. in non-metalic mineral products (36.4 per cent) [38].

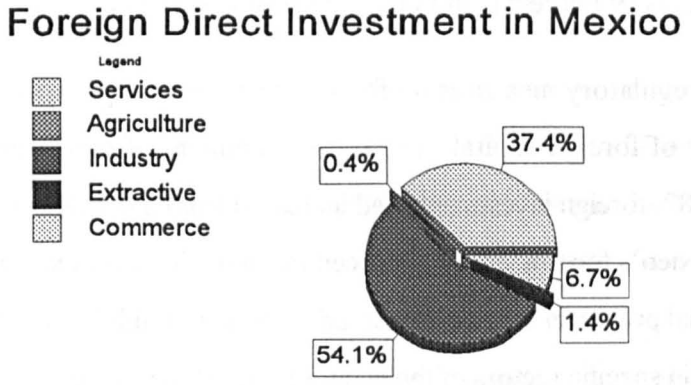


Figure F. 1. Foreign Direct Investment (FDI) in Mexico

Source: Banamex, Review of the Economic Situation of Mexico, July 1991

Since the 1970s there were a number of laws and regulations aiming at promoting foreign investment and technology, particularly in the manufacturing sector. The " Law to Promote Mexican Investment and Regulate Foreign Investments" in 1973 was passed to combine all previous related laws and regulations and to establish the sectors in the conditions under which foreign capital could be invested in the country. The 1973 law also introduced a maximum of 49% for foreign participation. However, the National Commission of Foreign Investment established by this law was responsible for implementing the law and on occasion authorised increase or decrease of foreign capital participation. In the period since implementation of the law until April 1976, there were about 345 enterprises which foreign participation of 338 of these did not exceed 49 percent [39]. Between 1973 and 1980, 1,724

proposals for foreign direct investments were approved by the National Commission on Foreign Investment. Of these 171 wholly foreign-owned subsidiaries were allowed, since their production was entirely for exports. Apart from these, majority foreign holdings were permitted in only forty-four cases. Throughout the 1970s and early 1980s, foreign investments have continued to concentrate on a relatively few, mostly technologically advanced industry accounted for about half of the total foreign investments. These included the manufacture of chemicals (18.5 percent), transport equipment (14.5 percent), electrical and electronics products (9 percent), and non-electrical machinery (7.4 percent) [40].

The introduction of regulatory measures on foreign investments appears to have had little impact on the inflow of foreign capital. From the enactment of regulatory legislation in 1973 to the end of 1982, foreign investments had increased from $ 4 billion to $ 10.7 billion. It can be said that Mexico's foreign laws and procedures have been a mixture of nationalism and deliberate industrial policy. In 1984, Mexico adopted new guidelines for the promotion of foreign investment in specific sectors of the economy which was able to generate positive foreign exchange balance and create employment. Comparing the amounts of FDI authorised or directly registered for 1982 and 1987 ($10.8 billion and $ 20.9 billion respectively), it appears that FDI stock nearly doubled in just five years. Automobile and electronic industries have received a large share of FDI in the major industrial projects undertaken by foreign enterprises from 1985 to 1987. Moreover, foreign firms played an important role in the growth of non-oil exports increasing their share from 22 percent in 1983 to 53 per cent in 1987. In the same period, their share in total exports from the private sector rose from 34 per cent to 65 percent. The wholly foreign-owned firms and those with less than 49 per cent foreign equity were in automobiles, synthetic fibers, glass, cement and paper products, while the state-owned enterprises were in iron and steel, petrochemicals and sugar. The wholly nationally-owned private firms were to be found in the production of beer, iron and steel, petrochemicals and artificial fibers, metal products and car parts.

In may 1989, the "Regulations of the Law to promote Mexican Investment and Regulate Foreign Investment" were designed to increase the inflow of investment capital by providing legal certainty and by clarifying investment rules. According to these regulations, foreign investors were allowed to own 100 per cent of enterprises valued up to $ 100 million without need of approval from the National Foreign Investment commission, provided that

certain conditions were met. Since the introduction of the economic stabilization and trade liberalization programs in 1985, the stock of foreign direct investment in Mexico has more than doubled, to a level of $ 33 billion at the end of 1991, with about 63 per cent of US and 6 percent for both UK and Germany. Mexico's strong growth performance in 1989-1990 and its perspective membership in a NAFTA seem to have encouraged new investors [41].

Mexico has also attracted much indirect or speculative foreign investment. An increasing share of Mexico's foreign investment has been channelled into stock market. However, it should be noted that since portfolio investment is highly unstable, it could leave Mexico just as quickly as it entered. Therefore, although it helped Mexico's balance of payments, it has been less valuable as a base for economic development. It is estimated that the most European and Japanese investments have concentrated in manufacturing within the automobile, electronics and petrochemical industries. Volkswagen and Nissan have been key participants in the automobile industry; Thompson, Phillips and every single major Japanese electronics producer have manufacturing plants in Mexico as well; and European firms such as ICI, Hoescht and BASF have involved in the petrochemical industry. Within the service sector, telecommunications became quite important in the early 1990s following the privatisation of the government telephone monopoly. TELEMEX, with extensive participation of France Telecom in a joint venture with Mexican and US capital [42].

Generally speaking, Mexico seem to have taken advantage of the potential that derived from the restructuring of industry worldwide, although it is not possible to determine whether or not more radical changes in FDI policy would have had a more favourable impact on the trade balance and investment flows. With the beginning of the debt crisis, foreign investment was greatly reduced. The value of foreign investment flowing into Mexico dropped from an annual average of $ 2.5 billion in 1980-81 to $ 0.4 billion during 1983-85. Flows rose again to $ 2.9 billion per year on average during 1987-90, before rise to historic high of over $ 4 billion in 1991. Most foreign investment has been in manufacturing, tourism and computer services [43].

It has been argued that after 1982 foreign investment had become a necessary precondition for growth rather than simply its by-product, as it had been in the past. As a method of strengthening the balance of payments, foreign investment has been something of a two-

edged weapon, particularly where there were no exchange controls. In the past, foreign direct investment has been desirable not merely for its effects on reserves of foreign exchange but for its contribution to the total capital stock. During the period of import substitution, foreign investment flew to Mexico to control the most dynamic and profitable sectors of domestic market. More recently, foreign investment in manufacturing has flowed predominantly into Mexico's export oriented production. It can be said that one of the most important factors for high FDI in Mexico has been the increased access that products from Mexico had in the markets for the U.S and Canada. As foreign investment rules were relaxed, foreign companies started investing in Mexico as part of their global strategy and with a view to exporting to the United States in particular. Basically, Mexico has been a more attractive host for FDI not because of changes in its domestic economy, but mainly because of its position as a springboard for supplying the U.S. [44].

However there is another belief that the level of new U.S. foreign direct investment in Mexico has relied less on Mexican regulations than on the growth prospects of the Mexican economy, since the main objective of most foreign companies has been to expand their internal market in Maxic. Mexico has also experienced a strong increase in foreign direct and portfolio investment during the past few years, which accounts for its strongly positive capital account. These favourable developments are mainly the result of high real interest rates, but also prove the increasing confidence of foreign and domestic investors in Mexico's economic future. In 1993, foreign direct investment rose by 11% to $ 4.9 billion, mostly due to the prospects of NAFTA, while portfolio investment more than doubled to $ 10.7 billion. The huge capital inflows since 1990 have allowed a significant increase in Mexico's foreign exchange reserves - amounting to$ 25.3 billion at the end of 1993, which is equivalent to 6 months of imports- and have reduced Mexico's reliance on external borrowing by public authorities.

F.3 TECHNOLOGY TRANSFER IN MEXICO

Technology transfer has been identified as a key factor in the industrialisation through foreign direct investment which Mexico had been pursuing. Mexico's total expenditures on technology including the payment of royalties on technology transfer as well as

independent consultants fees for short term technical services, increased from $ 80.3 million to $ 208.9 million between 1970 and 1978 [46]. Until the introduction of legislation on foreign technology in 1972, technology transfer agreements between foreign technology suppliers and recipient Mexican enterprises has been formalised generally by contracts and there was little governmental control over technology fees and payments to parent companies and other technology licensors. The major objectives of the legislation were to promote national technological development and therefore to provide greater technological support to Mexico's industrialisation program. In Mexico, international technology transfer has taken place by various methods: contractual agreements, payments for the use of patents, licenses and technical assistance, as well as those originating in foreign direct investment. Each of these major mechanisms was used according to its importance to a particular sector and the nature of ownership of the enterprises involved (domestic or foreign).

In a survey of technological elements in the technology transfer contracts of four industrial groups in Mexico in 1979, it has been discovered that the elements of most frequently transferred were non-patented know-how and technical aid. It was also found that while trademarks appeared in about half of the contracts, patent licences appeared in only 20 percent and engineering services 10 percent of the contracts. According to the Ministry of Trade and Industrial Development, from 1983 to 1987, the United States continued to be the principal supplier of technology (based on the number of contracts signed with foreigners involving some form of payment: 1989 contracts out of 2,652). Of the total of transfer contracts registered from 1983 to 1987, more than 53 per cent went to the manufacturing industry, mainly in the sectors of chemical substances, oil by-products and rubber, and metal products, machinery and equipment. Foreign firms accounted for 20 per cent of transfer contracts during this period. The import of technology to Mexico has played an important role in development of Mexico's domestic industrial infrastructure, since R&D activities did not have much to offer for local technological capability.

The Law on the Transfer of Technology and the use and exploitation of patents and trademarks was passed by the Mexican congress on December 28, 1972. This law identified as an first major attempt in Mexico to regulate technology, patents, and trademarks imported from outside Mexico. The law on technology transfer was designed primarily to

provide a mechanism for monitoring the flow of technology and to reduce its cost. A national registry for the transfer of technology was established following the 1972 technology transfer law, to review and approve, after negotiation if necessary, all contracts with foreign companies. The law also provided a means whereby the state could not only collect information on the technology transfer process as reflected in contracts with foreign firms but also could propose itself as a third bargaining agent between the supplier of technology and the acquiring firm [47].

A new law on technology transfer was passed at the end of December 1981, replacing the law passed in 1972. The purpose of the 1982 law moved from mere registration and negotiation of terms of technology transfer to the development of existing technologies. The 1982 law also represented an important step towards the formulation of a policy of technology development in Mexico, the idea of which is to combine a selective transfer of foreign technology with local efforts of assimilation and innovation. As an effect for the law of 1982, foreign supplier of technology could transfer technology easier if they could argue that their practices benefited the nation. The National Council of Science and Technology (CONACYT) founded in December 1970 was the central Mexican government agency responsible for coordinating and supervising the National Plan for Science and Technology. There were several other activities assigned to CONACYT such as a consultancy service for the government concerning all aspects of research and development as well as financial support of scientific programs, commercialising innovation in collaboration with the Mexican Foreign Trade institution and providing information to companies on alternative sources of technology.

There were other institutions, such as the National Registry of Technology Transfer (RNTT) which was established under the Ministry of Industry and Commerce, to evaluate and approve technology contracts, INFOTEC (Information Tecnica Para la Industria) or (Technical Information Trust Fund) created by CONACYT in 1972 as a technical information service, IMEC (Instiuto Mexicano de Investigaciones en Manufacturas Metalmecanica) or (The Mexican Institute of Research for Engineering Industries) which was created in 1976 to offer technological assistance to the engineering industries, and AIMED (Institute Mexicano de Investigacine Technologica) or (The Mexican Institute of Technological Research) which was founded by Banco de Mexico to offer technical

assistance to private industry. Under recently announced foreign investment laws, Mexico required prior authorization for investments involving construction and installations. In most cases, It is emphasised by the Mexican officials that Mexican technician personnel who operate the facilities should be involved in setting up the plants.

It is believed that the capital goods sector can make a very important contribution to creating domestic technological capability [48]. In comparison to the other NICs, Mexico appears to have had a revealed comparative advantage in capital goods. However it can be said that Mexico has had the least developed capital goods sector among NICs. Mexico's relatively poor performance in project exports can be attributable to its underdeveloped capital goods industry, which has been one of the constraints indicated by Mexican firms as limiting their technology exports. The Mexican capital goods sector has been more inward looking oriented in comparison with the more outward looking capital sector in other NICs. Therefore, the Mexican capital goods production has relatively been well-integrated into local economy and it possessed less international strength than that of other more export-oriented NICs. The expansion of capital goods production has been based widely on local technological capacity. Foreign technology was employed but only to the extent of its being a point of exploitation for local technological activities [49].

Of importance for the capital good industries have been the activities of the state as a major suppliers of cheap energy and basic metals and in facilitating imports for these industries. In spite of the various public and foreign involvement in capital goods, it can be said that capital goods production in Mexico has emerged and developed mainly as a result of private Mexican investment. It is also believed that the weak performance of Mexico's capital goods sector seems to result from a combination of imitating conditions rather than to any single factor [50]. Firstly, protection of capital goods has historically been fairly low relative to Mexico's duties on manufactured goods in general. The second factor is Mexico's proximity to the United States, which led to closed competition of its producers of capital inputs from both new and secondhand American goods. The third factor was the structure of the industry. Excessive diversifications of types, models, and the brands of machinery and intermediate inputs has led to the fragmentation of supply. Furthermore, prior to the early 1980s, Mexico's capital goods sector suffered from liberal import policies, insufficient institutional and financial support, the proximity to the United States, extensive periods of

an overvalued peso and other structural problems [51]. However the industrialisation model adopted in Mexico has not been responsible for the lag in the capital goods industry.

F.4 THE ROLE OF HUMAN RESOURCE DEVELOPMENT IN MEXICO'S DEVELOPMENT

The lack of human technological resources and skills is often considered the major obstacle to technological development in LDCs. Since 1960, the Mexican government has made considerable efforts to expand the nation's educational system. Total expenditure for public education increased significantly from 1, 959 million pesos in 1960 and 7,817 in 1970 to over 800,000 million (in current pesos) in 1984. The per capita expenditure on education also doubled with the result that the number of schools at all levels doubled. during the 1970s. These efforts resulted in an improved adult literacy rate (from 65% in 1960 to 81% in 1977) [52]. Having compared the educational level of Mexico with Brazil, it seems that the level of education in Mexico was higher than that of Brazil during a period of 20 years between 1960 and 1980. In fact considerable investment in education has been an important part of an industrial policy in Mexico aiming at greater self-reliance.

There has also been further emphasis on improving technical education in Mexico. The number of technicians and workers engaged in the on-the job training increased from about 140,000 in 1970 to 458,000 in 1985. There was also an increase in the number of students enrolled in institutions of higher education from 271,275 in 1970 to 1,200,000 students in 1985. The government in Mexico launched a project called "Programme Mexico", to devote funds to academic institutions in order to train human resources and to carry out research in technical areas. There were 56 enterprises participated in this programme in early 1988 which were to contribute some $ 40 million, more than 80 per cent of which was for electronics and information services [53]. Thus, it is obvious for Mexico that increasing investment in human resources can be the key to developing the infrastructure needed for becoming a technologically advanced country. The total expenditure on science and technology increased from 772 million pesos in 1970 to 4,729 million pesos in 1985 in constant prices. The government has almost made about 95 percent of all spending in the scientific and technological areas until 1985.

Having measured technological output and productivity in Mexico, it should be noted that in 1984 there were only seven scientific magazines published in Mexico and their total circulation did not exceed 20,000 copies. Moreover, Mexico in comparison with other Latin American countries has had an intermediate position with regard to the ratio between projects, researchers and R&D expenditures. For example, while Chile is needed 2 projects, 4.9 researchers and 90,000 to produce one scientific author, in Mexico, 14.6 projects, 11.2 researchers and $ 400,000 are required to produce one author. Furthermore, there were only 704 the total of 5,419 patent registration. As James (1985) has pointed out, Mexico lagged behind other major newly industrialising countries (NICs) such as Argentina, Brazil, South Korea in terms of two indicators of technological capability, technology exports and production of capital goods [54]. One can say that in most case the imported technology has been inadequate to Mexico's resource endowments or even obsolete. Furthermore, the imported of technology has been very poor substitute for indigenous technological capacity in Mexico. It should be noted that neither the law, nor the operation of the office for the registry of technology transfer, have been regarded as significant obstacles to the flows of technology into Mexico.

F.5 MEXICO TECHNOLOGICAL DEVELOPMENT POLICIES

It can be said that one of the reason for Mexico's technological gap with developed countries has been adopting science & technology policies aimed at accelerating growth without structural change. As Wionczek discussed, Mexico did not have a coherent technology policy. There were weak links between basic and applied research. There was also a scarcity of good scientific journals. Moreover there was little general awareness of the crucial role of science and technology in the development process. However, since shifting toward more outward-looking strategies, Mexico has increasingly paid most attention to adopting an appropriate policy for technology transfer. Mexico also considered its technology transfer policy to promote technical progress, adequately using the country's more abundant resources (labour and natural resources) as well as its scarcer resources (capital and foreign exchange).

As it pointed out earlier, Mexico's industrial policies in the past, did not include

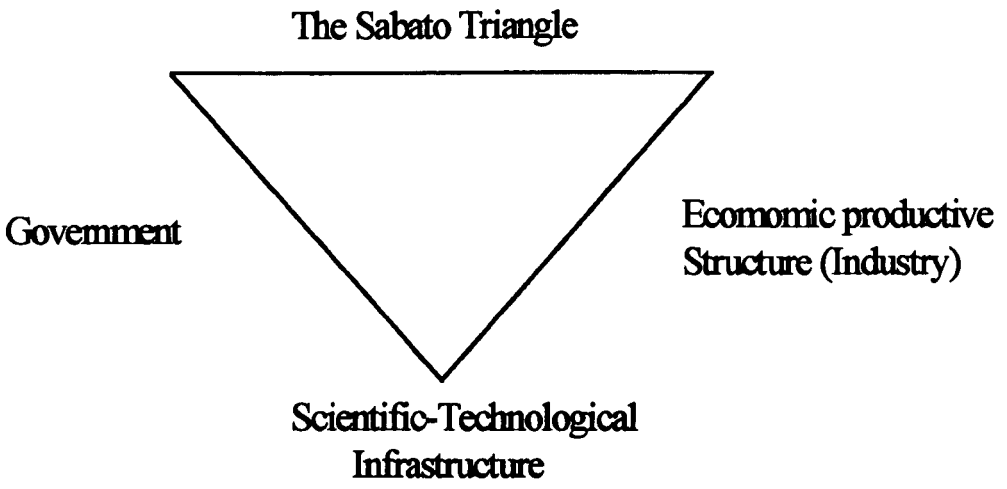
technological development of productivity growth as objectives. As a result, most Mexican firms remained highly dependent on foreign technology and capital goods. However, Mexico's state realised the need to transform industrial development policies in order to decrease its dependency on foreign technologies and to strengthen indigenous technological capability. Therefore, Mexico's technological development policy has changed toward developing the indigenous technological capability and technological self-reliance. In order to achieve to this objective, Mexican officials placed their emphasis on the following set of activities [55]:

1 Development of institutional capabilities to search internationally, evaluate, select, negotiate for, assimilate, adapt and generate new technology.
2. Regulation of foreign investment and technology transfer to limit foreign ownership and managerial control and to protect Mexican industry from powering foreign presence.
3. Expanding training of scientists, engineers, and technicians to move from supervised operational roles to management research, design, and engineering functions.

While the past Mexico's policy on technology transfer had placed more emphasis on the selection and negotiation of technology transfer, the recent technology transfer policy has paid more attention on adaptation, absorption and diffusion of the imported technologies. Bueno (1986) explains this change in objectives for technology transfer policy, because of the following general reasons [56]:

1. the critical foreign exchange situation of Mexico
2. the change in the overall strategy for economic development in Mexico attaching greater significance to exports of non-petroleum products and
3. the larger potential of the technology transferred from abroad.

One useful principle for evaluating technology policy in LDCs generally and Mexico in particular, is the "Sabato triangle". Sabato's industry-government-research institute model describes a national or sectoral technological system. For some sectors or industries, or even for entire countries, the triangle may not exist, or the sides of triangle may be weak or non-existent.



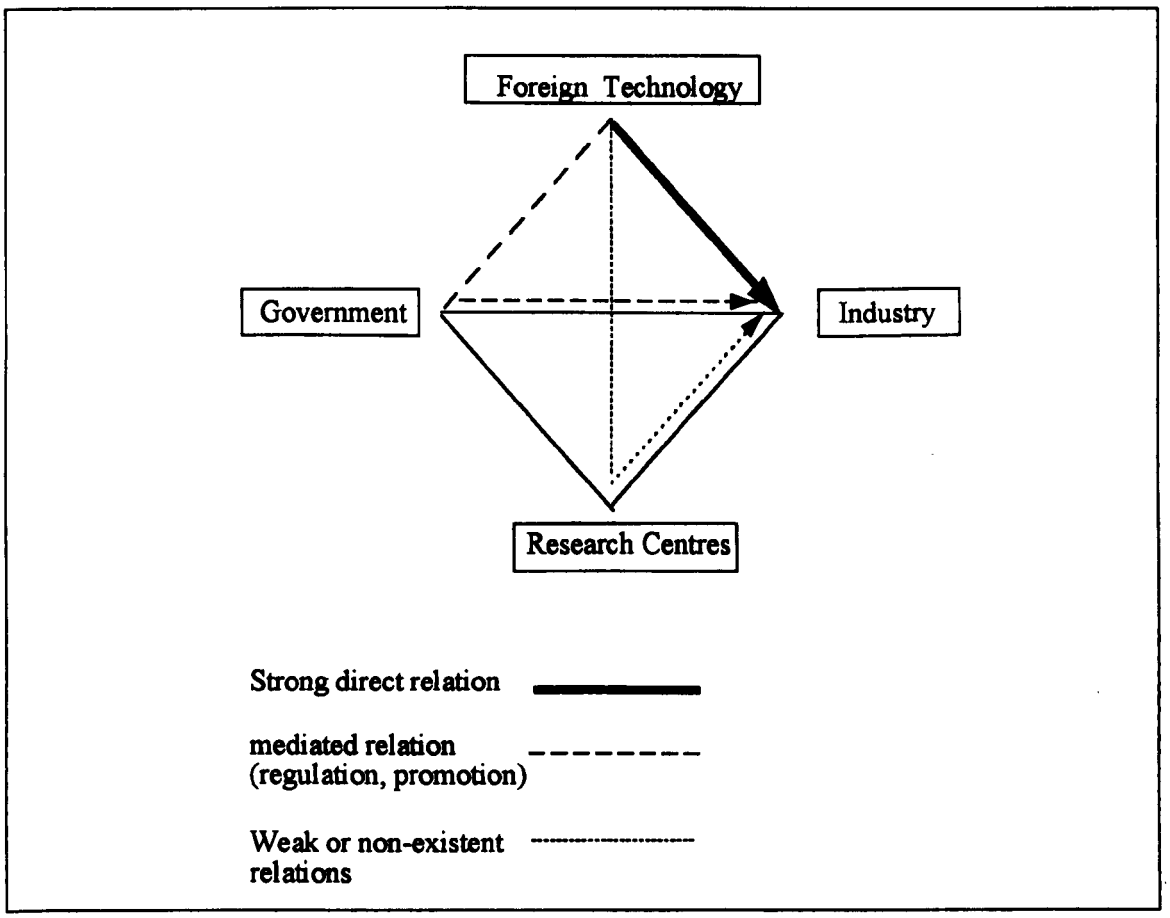


Figure F.2 Sabato's model of external relations between Industry-Government-Research Centres

Mexico has not succeeded in producing an indigenous technological capacity. As figure F.2 shows, foreign technology creates a series of external linkages to the Mexican triangle that are strongest between the foreign supplier of technology and the national recipient firm. Sabato's industry-government-research institute model also explains a national or sectoral technological system. Foreign technology can create a series of external linkage to the national triangle that are strongest between the foreign supplier of technology and the recipient. Sabato claimed that it is the availability of foreign technology which keeps the national triangle weak. As shown in its diagram, Sabato describes a vicious circle, which accelerates progressively. National firms accept available foreign technology, government avoids defining or implementing a policy of technological development, and the national research institute, dedicates itself to complementary activities rather than developing an independent research capacity. Sabato deplores the fact that institutions and individual officials often are actually unaware of the problem of technological dependence and its associated costs [57].

One of the weaknesses of Science & Technology in Mexico has been the lack of coordination between research centres and industry. Having looked at the linkages described by the Sabato triangle it can be found a rather strong link between government and industry and a fairly well-formed connection between research and government, but the links between research and industry are quite weak. Mexico began this process of awaking to the necessity of developing independent technology systems at the national and industry level, if only to make possible the bright selection and incorporation of foreign technology. Therefore, foreign suppliers of technology are required to strengthen their ties to all three vertices of technology triangle; industry, government, and research. The focus of policy on technology transfer is thus likely to shift from reducing its costs toward increasing benefits, from regulation of technology transfer to promotion of technological development. Therefore, one can see that the Sabato triangle may also help LDCs whose firms import most of their technology from transnationals.

Technology transfer to Mexico has also been directed with flexibility and openness in order to serve Mexican overall policy objectives, such as creating employment, generating exports, substituting for imports and promoting a favoured industry. It can also be said that the

country could reach a higher competitive position internationally through technology transfer, since imported technology increased quality and lowered prices, local firms which had benefitted from technology transfer had greater success in the export market [58]. The national plan for science and technology in Mexico has generally relied on three main objectives: science & technology development, cultural autonomy, and technological self-determination. In order to attain these objectives, there were some lines of actions such as incorporating science and technology policy into Mexico's overall development policy. The plan also proposed institutional changes in the management of science and technology activities. It was also proposed that the state design financial and other incentives to increase domestic R&D capability and develop self-reliant in science and technology development. However, the content of the national science and technology development programme for 1984-88, showed the inflexibility of some problems in Mexico, which arose from the lack of long term approach to science and technology policy.

It can be said that technological change had several effects on the industrial sector in Mexico. The spread of technology and its rapid diffusion contributed to increased competition in industry, working through the market to make technology rapidly available. However, the very rapid technological change of technological leaders particularly in some technology-intensive industries such as pharmaceutical and computers, could threaten to withhold advanced technology and prevent Mexico access to the most advanced technological development [59]. Moreover, Mexico's R&D expenditure as a percentage of its GNP has been very low in comparison with many other NICs. Total R&D per GNP decreased from 0.6 in 1985 to 0.2 in 1989. Moreover, most of the R&D activities in Mexico was performed by the government [60].

F. 6 SUMMARY AND CONCLUSION

In sum, as discussed in detail earlier, Mexico adopted an import-substitution industrialisation strategy shortly after the second world war which was followed by a long period of high economic growth and significant industrial development. When, in the mid-1970s, import substitution had reached its limits, it was replaced by a growth model based upon the development of the petroleum sector. After the severe economic crisis in early 1980s caused

by the oil price declining and heavy debt, policy makers in Mexico abandoned the previous growth model and adopt an outward-looking export-oriented strategy. As a result of this change in Mexico's strategy, many state-owned firms were privatised and competition was given a much more important role in the development process than it had ever had since the second war.

As discussed earlier, maquiladoras in Mexico can be seen as another factor in Mexico's industrial and technological progress. The maquiladora sector was established in 1965 as a part of Mexico's border industrialisation program which was designed to attract foreign manufacturing facilities to the border area in order to create new employment opportunities. The maquiladora sector has expanded rapidly in the 1980s as Mexico became an increasingly attractive location for labour intensive assembly operations. It can generally be said that even if there are some criticisms of maquiladoras, its products have been an important part of growth in manufactured exports of Mexico. Mexico's entry to join the North American Free Trade Agreement in early 1990s along with trade liberalisation policies which were implemented since mid-1980s has brought significant achievements for its economic and industrial development.

Having compared the overall industrial and technological policies of the newly industrialised countries in Latin America such as Brazil and Mexico with those of Southeast Asia, one can refer to some main differences such as their market size and development strategy. The Latin American NICs, particularly Brazil and Mexico, have considerably larger domestic markets than the more advanced southeast Asian NICs such as S. Korea and Taiwan. The Latin American experience with import-substitution strategies has significantly been longer than those of NICs in Southeast Asia. Moreover, the government role in the industrialisation and technological development of NICs in Southeast Asia (such as Korea and Taiwan) has been different in comparison with that of Latin American NICs (such as Brazil and Mexico). As discussed earlier in the case of Korea and Taiwan, the government in these countries has played a key role in the economic and industrial development of these countries. Government intervention in these countries did not alter the market mechanism, but rather supplemented it. It should also be noted that state regulation of trade and investment in new technologies has been less focused than in Asian NICs. It can also be said that state intervention has been far less effective in the Latin American NICs in strengthening

industrial competitiveness than it has been in the Asian NICs.

The state in Latin American NICs (such as Brazil and Mexico) has also been highly interventionist in industrial and technology policy making. However, it is believed that Brazil's state intervention has been widest in scope, reflected in the relatively large weight of state enterprises in the economy. Government in Mexico has also played a major role in allocating resources for growth in encouraging foreign investment and in fostering technical change. State-owned enterprises in Mexico have been of major importance in the economy, especially in energy, transportation, communications, and fertilizers. However, the government's privatization program moved rapidly to transfer state enterprises to the private sector. In technology, the shift to liberal policies reflects the weakness of Mexico's technological base and of state as innovator. As a World Bank report noted in a study of five countries, Mexico's technological exports such as capital goods have mostly been by multinational firms though state regulatory bargaining may serve as a stimulus [61].

Not only has government in Mexico financed construction of numerous industrial parks, but it has also supported the maquilas by providing land, roads, and public utilities. In 1988, 44 percent of the maquilas and 75 percent of the jobs were found in specialised industrial parks for the maquila sector. Mexican capitalists and professionals have also played an important role in the maquila sector mainly by setting up industrial parks, providing services, and acting as subcontractors. The role of the state as innovator has also become one of the stimulating the absorption of foreign technology. The state as financier has become a state struggling to balance its budget and stimulate exports. Although Mexico has reduced the number of its state enterprises from more than 1000 to about 500, this is still five times the number of enterprises that existed in the state sector in 1970. There is little evidence of state retreat from its role as primary producer of raw materials and basic services [62].

Having compared the educational system in NICs of Southeast Asia with that of Latin American countries, the Asian NICs have very highly educated populations. For example, the percentage of tertiary students in engineering in S.Korea has been at least double the figure for the Latin American NICs [63]. One can add that secondary educational levels in Latin American NICs have been on average one-third lower than with that of Southeastern NICs. However the fact that the Latin American NICs have send a lower proportion of their

post-secondary students for training abroad than Southeastern Asian NICs partially reflects their higher level of development of educational structures. For instance, the number of scientists and engineers density for Brazil has been higher than in countries like S.Korea.

Comparing in method of technological acquisition, the Latin American NICs (such sa Brazil and Mexico) have relied to a larger degree on foreign direct investment than Southeast NICS. The Asian NICS, on the other hand, have generally adopted fairly liberal policies regarding FDI. S. Korea has probably had the most restrictive FDI policy and has used other methods such as technology licensing and joint ventures as the major source of the foreign technology acquisition. However, some Latin American NICs, have faced tremendous problems in the transferring of technology through foreign direct investment because of the depressed state of their internal markets. A country like Mexico has been in somewhat better position given vast flow of investment from U.S. market. It can be said that good management of this investment from the perspective of technological learning could contribute significantly to an increase in Mexico's technological absorptive capacity [64].

Because of the limited international experience and weak components and parts sectors in most Latin American NICs (with the exception of Mexico's maquiladoras), they have had limited experience in assembly subcontracting in comparison with the Asian NICs. While the Southeast Asian NICs and Mexico have relied more heavily on assembly subcontracting in the past, S.Korea and Taiwan in particular focused more on supplying finished products to original equipment manufactures. In conclusion, there is certainly something that can be learned from a comparative assessment of the Asian and Latin American NICs experience, but generally it would not be easy for the other LDCs to replicate their model given the vastly different historical experiences, as well as contemporary political, social , economic, and cultural factors.

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APPENDIX G

THE INDUSTRIALISATION EXPERIENCE OF TURKEY

Turkey is located in one of the most strategic geographical areas of the world, with the area of 779,452 km square, and has been as a republic since 29 October 1923. Unlike some of the developing countries in East Asia such as Indonesia and Malaysia, Turkey is not a resource-rich country, with only about 246,000 km square of land used in agriculture and some minerals such as coal, chromites and copper. Since the establishment of a republic and in particular after the second World War, Turkish economy has improved very rapidly with an average GDP growth rate of about 6 percent during the period 1923 to 1953. After the second World War, GDP increased at a rate of 8.7 per cent, industry growing 9.7 per cent and agriculture 9.4 per cent [1]. After 1951-53 and despite the recession during the late 1950s, industry continued growing rapidly at a rate of 8.5 per cent until 1961-63; agriculture growth slowed to 2.7 per cent and agriculture lost its role as a leading growth sector. The industry sector has been the most rapidly developing sector of Turkish economy since 1962, with an average annual growth rate of close to 10 per cent during 1962-1967. As a result, the importance of industry sector in the economy has increased steadily and the share of industry in GNP rose from 13.5 per cent in 1948 to about 18 per cent in 1968 [2].

The manufacturing industry became the leading sector in terms of contribution to total growth by 22.5 per cent, but the increase was small, from 20.1 per cent in 1951-53 to 1961-63, and did not compensate for the decline in the contribution of agriculture. Turkey experienced a rapid succession of stop-go policies during the period between 1953-63. Multiple exchange rate and quantitative restrictions were the main instruments used to control the demand for foreign exchange, though some export incentives were added. Export incentives were not maintained because of a continuously overvalued exchange rate [3]. However, during the period between (1968 - 73) the contribution of exports rose to 10.4 per cent, although the increase was small, it did reflect a shift in incentives and perhaps provided an indication of what Turkey could accomplish, as confirmed by the effect of its shift toward an open development strategy in the 1980s. Although the Turkish export incentives from 1970-73 tended to be unsuccessful, largely because the government allowed

incentives to move against exports, this was a preliminary base for Turkey to enter to a new period of rapid and successful export promotion. The observed phasing suggests the hypothesis that a period of protected import substitution is essential to build a base from which a successful export drive can be started.

The First Five-Year Plan for 1963-1967 formed the first stage of a fifteen year development program, aimed at an annual increase in GNP of 7 per cent to be accomplished mainly by increasing the share of investment in the GNP to an average of 18.3 per cent over this period [4]. During the period between 1962-72, manufacturing industry accounted for 93 per cent of total industrial products. The second Five-Year Development Plan (1968- 72) proposed an annual growth rate of 12 per cent in industry, as a result of which the industry sector accounted for 20.5 per cent of GNP in 1972, as compared with 17 per cent in 1967 [5]. One can see that the industry sector played a key role in Turkish development strategies and was a driving force in the development of economy. It is also believed that the strong growth performance of the Turkish economy during the 1960s is explained largely by movements of labour from agriculture to industry and the high level of industrial activity [6].

The Second Plan (1968-72), also considered a balanced distribution of resources among various industries to accelerate industrial growth. The expansion in industrial production was expected to be achieved through the generation of new capacities rather than technological improvement of existing industries. The actual growth rates accomplished during the First and Second plan were 6.7 and 6.9 per cent respectively, which were very close to the targeted annual growth rate of 7 per cent. However, the annual growth rate in industry during the second plan (1968-72) lagged behind the planned target of 12%, achieving only 7.6 %. The share of industry sector in GNP rose from 16.8 percent in 1963 to 20.6 in 1971 [7]. Despite the very rapid growth rate of Turkish manufacturing, it is argued that the growth of productivity in the Turkish manufacturing sector lagged behind some of the fast growing developed and developing countries. According to a study by Nishimizu and Robinson (1984), which compared the growth rates of total productivity in manufacturing for the period 1963-76 in Japan, Korea, Turkey and Yugoslavia, growth rates were lower in Turkey than in Korea and Japan, but higher than in Yugoslavia [8].

Turkey like many other developing countries has adopted import substitution in its early

stage of industrialisation, which aimed at creating of strong industry sector through extensive protective policies and also developing domestic production of previously imported manufactured goods. The import substitution provided considerable protection to domestic industry through a system of import licensing, import quotas, and restricted access to foreign exchange, and restrictions on imports of consumer goods. The import-licensing system was employed to prevent imports of goods competing with domestic production. The import substitution policies also formed the basic framework of the Five-Year development plans until the end of the 1970s. It was also essential for the rapid industrial growth as the imports of nondurable consumer goods were replaced by domestic production. Therefore, one can say that Turkey had been quite successful in its early stage of import substitution strategy in 1960s. By the end of the decade the share of consumer goods in the total imports was only 5 per cent [9].

However the replacement of the imports of intermediate and capital intensive goods in the second stage of import substitution which required relatively sophisticated technology and large-scale production, for efficient operation caused high cost for the Turkish limited domestic market. Therefore, after initial successes, the application of an inward-oriented development policy in Turkey encountered increasing difficulties as high-cost import substitution, worsened by inefficiencies in state-owned enterprises, led to a decline in the productivity of investment and the slowdown in employment creation. Nevertheless, as the OECD survey of first Five-Year plan indicated, the inevitability of an import substitution policy was clearly recognised because of formidable difficulties in the way of export development [10]. It is also believed that the period from 1965 to 1976, during which Turkey made a general effort to industrialise through the implementation of import substitution strategy, was the most successful period in terms of both the level and stability of growth. However, as Krueger (1974) pointed out, alternative or modified import substitution policies would have allowed Turkey to realise much bigger gains in employment, exports and industrial production. Under policy options she called " moderate import substitution" and "balanced export promotion and import substitution", the Second Five Year Development Plan, for instance, would have yield significantly better results [11].

Turkey's poor export performance in the 1970s is considered to be mostly because of internal factors such as an overvalued exchange rate and political instability in that period,

and external factors such as world recession and the rise of protectionism in the developed countries in mid-1970s. As Dervis and Robinson (1978) pointed out, Turkish policy strongly favoured import substitution both through direct protection and through import rationing and exchange rate policy. The result has been severe discrimination against exports They also refer to the overvalued exchange rate after 1970 which significantly restricted exports. They estimated that by 1977, the lira was overvalued by 55 %, which had negative impacts on Turkey's export performance [12]. The value of exports fell at a rate of 4.3 percent per annum for the period between 1973-77 and the volume of imports rose at a compound rate of 10.4 per cent per annum. The average annual growth rate of Turkish exports dropped from 1.6 per cent during 1960-70 to 0.8 per cent during 1970-77 [13].

The Third (1973-77) and the Fourth (1979-83) Five Year Plans formulated in the early 1970s aimed at increasing the level of income, speeding up industrialisation, reducing the dependence of foreign resources, improving the balance of payments and making the economy self-sufficient [14]. During the Third Plan period (1973-77), the annual growth rate of GNP was increased to 7.9 per cent. The manufacturing sector was the main contributor to this significant growth rate. Whereas manufacturing had accounted for almost a third of private capital formation during 1973-77, this decreased to just below 29 per cent in 1979. Nevertheless, by the mid and late 1970s the private sector had come to play a substantial role in Turkish industry. In 1975, its shares of production, employment and investment among the large manufacturing firms were 62.5 per cent, 64.6 per cent and 67 per cent respectively. With all manufacturing firms included, the share of the private sector in value added approached 70 per cent in 1978 [15].

Although the continuing import substitution policy during this period (1973-77), the overall dependence of Turkish economy on imports in particular imports of capital goods did not decrease. The import substitution strategy had created an industry which was highly protected and was heavily dependent on imports of raw materials, intermediate goods and equipment. For example, one can refer to the Turkish automobile manufacturing sector, which alone needed $ 700 million in direct imports (or about 20 per cent of total Turkey's non-oil imports) for its assembly production in 1979, while total automotive exports did not exceed $ 7 million [16]. On the other hand, the share of exports per GNP remained at a weak rate of 4 percent in 1974. Even though the overemphasis on import substitution had

initially brought about impressive results, by the 1970s most opportunities for successful import substitution were exhausted. Furthermore, as a result of the import substitution policy, manufacturing industry failed to expand into new markets and the average annual growth rate of manufacturing production slowed from 10.2 % in 1960-73 to 5.2 % in 1973-79 [17].

While in the early stage of import substitution in 1960s the Turkish economy was engaged in replacing the imports of non-durable consumer goods such as food processing, and textiles. In the later stage, Turkey replaced the imports of intermediate and capital goods such as steel and petrochemicals, and consumer durable such as vehicles, by domestic production. It should be noted that Turkey's industrialisation process in the 1970s became increasingly import intensive, creating a rigid structural dependence on imported inputs. The rigidity in the substitution of manufactured imports for domestic output was a major source of difficulty in adjusting to reduced capital inflows during the 1978-80 crisis, and therefore set the stage for the export drive in the 1980s [18]. Following the balance of payments crisis in 1977, there was a revision in import-substitution policy. This was mostly because of the high cost of domestically produced intermediate and capital products (such as iron, steel and petrochemicals), along with oil shocks of the 1970's which caused a large imbalance of payments and a 107 per cent rate of inflation in 1980. Moreover, the growth rate of GNP declined from 3.0 per cent in 1977 to - 0.7 per cent in 1979, and country's external debt reached to an explosive figure of $ 11.4 billion. There was also a sharp decline in the share of imports in GDP between 1977 and 1979, imports of goods fell by 21 percent in 1978 and rose by only 10 per cent in 1979. The current account deficit increased sharply with a $ 3.2 billion oil import bill larger than total commodity exports of $ 2.9 billion [19]. There was also an increase in the rate of unemployment in the late 1970s, which had reached 3.5 million or 20 per cent of the labour force by 1978 [20]. It is argued that the fall in the GNP growth rate during the late 1970s can be mostly attributed to a sharp fall in the productivity of capital, caused by exogenous factors which the Turkish policy makers had failed to predict [21].

On January 24, 1980, the Turkish government announced comprehensive economic reforms, stabilisation and liberalisation programs aimed not only at correcting the deteriorating economic situation, but also at changing the entire orientation of Turkey's development

strategy from its position of an inward-oriented to that of more open and outward-looking strategy. Moreover, the other important objectives of these new policies included improving the balance of payments and increasing Turkey's international competitiveness, raising the efficiency of Turkish state owned enterprises through their privatisation, and opening the economy as much as possible in order to give greater freedom to the market in determining resource allocation. Most of the previous policies changed such as change in exchange rate including a 33 per cent devaluation of the Turkish Lira, liberalisation of imports involving the elimination of quotas and the reduction of the tariffs, and a transition from previous import substitution to export-expansion policy including a large numbers of export incentives such as introduction of direct tax rebates for export of manufacturing goods.

These programs were extensively supported by international organisations such as International Monetary Funds (IMF), the World Bank and the Organisation for Economic Cooperation and Development (OECD). The OECD granted $ 4.2 billion during the period between 1980-1985 and IMF provided 1.2 billion in Special Drawing Rights (approximately $ 1.6 billion) in June 1980 and a further 225 million in April 1984 for helping Turkey's debt repayment, and the World Bank contributed $ 1.6 billion through five structural adjustment loans to support the stabilisation and liberalisation programmes [22]. The implementation of these appropriate policies, in particular the successful trade liberalisation policy which made Turkey a model of trade liberalisation for other developing countries, had a remarkable impact on the overall Turkish economy. The immediate impressive impact of the adjustment policy of 1980 included an immediate fall of the inflation rate to 37 per cent in 1981 from over 107 per cent in previous year, an over 4 per cent growth in GNP in 1981 following the negative figures in 1979 and 1980, and a recovery in balance of payments (a sharp decrease in the current account deficit from 106.4 % in 1980 to 14.5 % in 1982). The significant growth rate of export performance was one of the most noticeable results of the stabilisation and the shift toward more outward-looking policies in the early 1980s. The overall exports grew by an annual average rate of 22.3 % during the period between 1980-87, and the share of exports in GNP rose from 5% in 1980 to 14.9% in 1985, and 21.3% in 1987. The value of merchandise exports rose from $ 2.9 billion in 1980 to $ 10.3 billion in 1987 [23].

It is noteworthy to indicate the rapid increase in the share of industrial goods in overall exports was mostly due to increasing competitiveness of Turkish industry. The share of manufacturing products in total exports increased from 36.8 % in 1980 to 79 % in 1987, with an average annual growth rate of 38.2 per cent during the same period [24]. In particular, one should also refer to the magnificent growth rate of industrial products from $ 1.047 billion in 1980 to about $ 8.065 billion in 1987. Of the total increase in value of exports by about $ 5,697 million from the period between 1980-1985, about $ 5,210 million was in processed and manufactured products, more than 45% of which was in labour intensive industries such as textiles and clothing, processed agricultural products, and hides and leather (light industries), and about 23.4 % was in scale intensive industries such as iron and steel , transport equipment, glass and paper products [25]. One can therefore argue that the export boom of the 1980s was, by and large, due to an increase in share of manufactured exports from 26.9 per cent to 66 per cent during the period between 1980-1987. It is also generally believed that Turkey's satisfactory export performance in comparison with other developing countries, led to an increase in Turkey's share in overall exports of developing countries from 0.86 per cent in 1980 to 2.27 per cent in 1987 [26].

It is believed that the success story of Turkish export performance during the period of 1980s can be mostly attributed to the implementation of the trade liberalisation and a shift from import substitution policy toward export promotion policy. The real depreciation of Turkish Lira, along with additional export subsidies and tax exemptions to the exporters were among the most important measures taken by Turkish authorities to accelerate the export growth. Moreover, an improved political and economic climate along with the availability of unused capacity can be considered as other important factors for the significant growth rate of exports in early 1980s. The strategic geographical location of Turkey has been among the external factors of its significant export performance [27].

Another factor which can be attributed to the Turkish export performance during the early 1980s was the government's strong commitment to exports. A number of incentives were introduced or enhanced for exporters by Turkish authorities. Exporters were permitted to retain 5 per cent or $ 10,000 (whichever was larger) of their receipts. There were also a reduction in the cost of importing the inputs necessary for the production of exports. It is believed that tax rebates were the crucial element of these export incentives of the 1980s,

with an increase of the average amount from 8.91 per cent in 1980 to 22.31 per cent in 1984. The considerable reduction in domestic demand and the shift of production from domestic to foreign markets has also been another factor explaining the significant Turkish export performance in 1980s [28].

The other factor contributing to export performance, which was not linked with specific policy tools, was the ability to sustain a high level of intermediate goods imports. It should be noted that despite the implementation of substantial export incentives such as reductions of tariff rates and production taxes, these tariff reductions mainly applied to capital and intermediate goods while consumer goods faced tax increases. Therefore, one can say that import substitution policy was not entirely abolished. Moreover, it is believed that the potential of Turkey's manufacturing industry, a heritage of the import substituting pattern of industrialisation of the last decades, was the basis of the export performance of the 1980 [29]. The other factor that led to Turkey's successful export performance in the early 1980s, was the creation of a huge excess capacity as a result of the crisis of 1977-1979 which had depressed industrial outputs. This capacity utilisation particularly in private industry stood at 51 per cent in 1980 [30].

It is argued that Turkish export performance during the 1980s has had both structural weaknesses and encouraging aspects. On the one hand, due to some export incentive measures in particular a policy of gradual real depreciation of the exchange rate, Turkey's international competitiveness has improved considerably, and on the other hand, the product structure of Turkish merchandise exports needed to be improved through greater diversification of production and a shift from unprocessed goods to the higher value added products. Moreover, despite its contributions to growth and more significantly to the balance of payments, there is, however, no evidence to suggest that the export drive and the major changes in trade and industrialisation policies associated with it have led to increased efficiency and competitiveness in the public and private sector enterprises [31]. It can also be argued that it was the major devaluation and exchange rate policy of early 1980s along with Turkey's advantage in the geographical proximity and access to the European Community markets, rather than cheap labour and tax-burden that made Turkish merchandise exports more competitive in international markets. Turkish firms could also use high - tech methods of production such as Just In Time (JIT) production methods and

Computer Aided Design (CAD) and manufacturing systems which included for a growing part of its exports [32].

The Middle Eastern countries, in particular Iran and Iraq, took an increasing share in Turkey's exports markets; about 45% of total Turkish exports in 1982, mainly due to easy access of Turkish exporters to their markets. Turkish exports to other countries, mostly the major OECD countries, also grew at an annual average rate of 17.5 per cent and reached to 52% in 1985 [33]. The composition of Turkish exports changed in 1991, which exports to the EC and OECD countries increased to 65.1 % of total exports, while the share of Middle East countries decreased to 20.1% [34]. The second stage of trade liberalisation and stabilisation began with an announcement by the Turkish authorities in December 1983, intended to provide incentives through a unified exchange rate for all transactions, and more simplification of import procedures. Accordingly, the real exchange rate was further depreciated by about 3.6 per cent in 1985. Moreover, additional measures were taken to increase Turkey's attractiveness for foreign investors, including easing of conditions controlling the transfer of profits and flow of capital, as well as the general relaxation of capital and exchange market controls [35].

However, due to sharp fall in exports of manufactured products, the total export volume decreased in 1986 for the first time in six years. The strong decline of Turkish industrial exports in 1986 was mostly due to new policy of removal of government subsidies on industrial exports. Another reason for a decline in Turkish exports is believed to be the sharp fall of oil prices in 1986 which reduced the foreign currencies of the Middle Eastern oil exporters and made them curtail to a large extent their imports from Turkey. It is also believed that one of the principal causes of Turkey's inability to sustain the pace of rapid export expansion was inadequate private investment in manufacturing, which in turn has been closely associated with the growing macro-economic imbalances in the economy [36]. In order to recover the strong decline of industrial exports, Turkish authorities reintroduced tax rebates for export sales in 1986.

It should be noted that despite the substantial achievements of liberalisation and stabilisation program, they have been insufficient and lacked the necessary strength to move the economy toward the frontier [37]. It is also believed that the liberalisation attempts did not lead to a

significant reductions in the effective rates of protection. The imports of a large number of agricultural and light manufacture were mostly prohibited [38]. Some of the macroeconomic stabilisation objectives announced in January 1980 were only partially and temporarily achieved, and some overall problems such as inflation remained as an economic and political problem. Despite the sharp decrease from about 107 % in 1980 to about 30 % in 1983, the inflation rate rose thereafter and stood at rates between 65 and 75 % in the late 1980s [39].

In addition to inflation, there were other unsolved problems, such as the worsening income distribution, fiscal deficits and unemployment, which affected the significant achievements of the trade liberalisation and structural adjustment policies of early 1980s. In terms of the effect of the stabilisation and liberalisation programs on the income distribution, one can say that not only did these policies not succeed in bringing about improvement in distribution of income, they made it even worse by reducing the share of wages particularly in the agriculture sector by almost 50 per cent during the period between 1980-88 [40]. Moreover, during the adjustment and stabilisation programs, the recorded rate of unemployment increased from 14.8 per cent in 1980 to 16.3 per cent in 1985. This increase in rate of unemployment can be mainly attributed to a decline in agricultural employment. However, some non-agricultural sectors had an average annual growth rate of 2.8 per cent in the employment during the implementation adjustment program period [41].

It should also be added that despite of an increase in the merchandise exports as a result of trade liberalisation of 1980s, the Turkish economic structure remained unchanged. There are three reasons which can attributed to the general failure to alter the economic structure of the country. Firstly, from 1980 onward, although both total exports and the share of manufactured goods in total export increased over this period, the growth rate of manufacturing industry remained more or less unchanged. It is argued that there was no correlation between the growth rates of the manufacturing sector and manufactured exports. It is also believed that increased exports resulted mostly from a decrease in domestic demand, so that there was no great modification in both the structure and the export capacity of Turkish industry. Secondly, one can argue that a decrease in the price of Turkish exports in comparison with international prices was mainly due to the introduction of some export incentives such as export subsidies and real devaluation of Turkish lira rather than a reduction in cost of domestic production. It is also argued that export prices were just

artificially reduced through the introduction of these export incentives and therefore carried no considerable impact in favour of changing the structure of the Turkish economy. Finally, it is believed that the improvement of export / import ratio was mostly due to slowing down of importing capital goods rather than increasing exports. This resulted from a lack of new investments, which could have contributed to a modification of the structure of economy [42].

The Turkish authorities continued to emphasise their determination to follow trade liberalisation policies after 1986, through further tariff cuts for imports of raw materials and some export incentives such as tax rebates and preferential credits for industrial enterprueners and exporters. The GNP grew by 7.9 % in 1986, which exceeded the proposed target of 5.0. On the other hand, industrial output grew by 10.9 % in 1986, exceeding the projected target of 5.5 % and the previous rate of 6.6%. Another important feature of 1986 was the increase in the share of manufacturing in GDP, measured at constant prices, from 27.5 % to 28% [43]. Non-metallic mineral products, glass and ceramics, food processing industries, textiles and clothing, metal products such as iron and steel, manufacturing of machinery and transport equipment industries were among the most important Turkish industrial products.

The continuous trade liberalisation brought about some considerable economic achievement such as an increase in real GNP by 7.4% in 1987 [44]. GNP grew approximately by 50% per year from 1983 to 1987 and 70% from 1987 to 1990. The Turkish lira depreciated by more than 100 per cent relative to its level in 1979. This enhanced the international competitiveness of Turkish exports. Despite removal of some export incentives in the late 1980s, the overall exports reached $12,960 million in 1990. In particular, there was an increase in export of some manufacturing such as metal products and machinery, electrical appliances, leather products, cement and chemicals in late 1980s. The share of industrial products in overall exports rose to 78.2 per cent in 1989. Following the tariff reductions and exchange rate appreciation in 1989, the import increased and resulted in a current account deficit in 1990. It is also argued that the exchange rate appreciation in 1989-90 weakened export propensities in intermediate and capital goods with an unfavourable impact on export diversification [45].

The export of manufactured products increased by 6.2 per cent in volume and by $ 1,626 billion, in 1992, due to the effect of real depreciation of the Turkish Lira in the first half of the year. Exports of manufactured products were heavily concentrated in a few sectors; textiles and clothing, and iron and steel, together included over half of manufactured exports in early 1990s. There was also a strong increase in the exports of ready-wear and other textile products, as well as electrical appliances, cement and non-electrical machinery in 1992. It is argued that even though the successful export performance of Turkey in the early stages of trade liberalisation policies can be partly attributed to large export subsidies, it is however believed that the decrease of export subsidies in the late 1980s provided some overall welfare benefits for some industrial sectors in Turkey. One can refer to some problems which were caused by export subsidies such as budgetary problems for the government and various types of rent-seeking behaviour among exporters, such as distorting export documents which may lead to corruption. It is also argued that when a country such as Turkey has liberalised imports, while at a same time maintaining significant export subsidies, further import liberalisation must be balanced with further reductions in export subsidies [46].

Turkey's sixth Five-Year plan, which covered 1990-94 supported the continued outward orientation of the economy, with an enhanced role for the private sector, backed by a more efficient public sector. The principal objectives of the sixth plan (1990-1994) were further liberalisation of the economy through increased reliance on market forces and to shift resources from the public to the private sector and from consumption to saving and investment. The Sixth development plan has also aimed at an average annual growth rate of 7 per cent. Private sector investments are targeted to grow at an annual rate of 11 per cent, with growth reaching 15 per cent by the end of plan. Exports have been projected to grow at an average of 15 per cent a year and to exceed $ 22, 000 million by 1994, and inflation has also been projected to fall to 10 per cent a year by the end of 1994 [47].

The trade and development strategies of Turkey in early 1990s have been the continuous import liberalisation and export expansion of late 1980s with more emphasis on lowering protection on imported goods favoured in the domestic market and diverting investment into exportable goods [48]. The strategy of the seventh plan (1995-1999) published in April 1993, emphasised Turkey's increasing share in world trade, and further integration of the

Turkish economy with the global economy, increasing reliance on free market forces, raising productivity and increasing share of industry and services in total employment and industrialisation taking into account the environment effects. The Turkish economy continues its rapid growth in the 1990s with a much more open economy in comparison with the past, and a significantly improved infrastructure in transport, energy and communications. To many observers, Turkey in 1990s is indicative of Spain a decade or two decades ago, and may be experienced a similar take off [49].

One of the other points which has played an important role in the Turkish economy has been the State Economic Enterprises (SEEs). The State Economic Enterprises where founded during the 1930s, and constituted the primary engine of economic growth associated with the preliminary phase of import substitution. Their share in GDP and industrial output were 9 % and 49 % respectively in the period between 1978-1983 and they also employed about 750,000 people or about 4 per cent of total and 30 per cent of industrial labour force [50]. SEEs were subject to lower rates of interest on their borrowing than were their private counterparts. They were also able to obtain some of their domestically-produced purchased inputs at lower prices than were their private competitors. Despite these incentives given by the Turkish government in order to make their products competitive in the marketplace with those of the private sectors, the rate of profits was so low in some SEEs that they incurred fairly substantial losses [51].

Since the implementation of trade liberalisation and stabilisation programs, the Turkish government decided to enhance the efficiency and productivity of state economic enterprises through reducing their dependency on government credits. Certain State Economic Enterprises (SEEs) were permitted greater freedom in setting prices in an effort to improve their profitability and reduce deficits. Furthermore, the privatisation program launched by the Turkish authorities in 1986 aimed at improving the efficiency of SEEs through sales of most SEEs shares on the newly created Istanbul Stock Exchange. The relatively comprehensive privatisation program has been mostly focused on the State Economic Enterprises which were active in areas such as switchboard equipment, cement, airport service, petrochemicals, steel-iron, petroleum refinery, hotel chains and airlines. Some overall objectives of the privatisation program included reducing the financial burden of the SEEs on the general budget, transferring the decision-making process from public to private

sector, promoting competition, improve efficiency and increasing productivity of the public enterprises, and raising revenue through sales of public assets to private and foreign investors who could transfer modern technology and the foreign exchange needed by the government to service its external debt [52].

However, despite the government efforts to make SEEs behave like private firms, there was little progress in privatising these firms. The narrow size and instability of Turkish capital markets has been a factor in delaying planned sales of shares of SEEs. As an example, one can refer to major difficulties encountered in the sale of TELETAS shares (a telecommunications equipment firm in which the state had a 40 per cent share) due to the fall of stock prices in the autumn of 1987 and the continual weakness of the Istanbul Stock Exchange in the following year [53]. Moreover, the limited success of the Istanbul exchange market has been attributed as another failure factor in the privatisation of SEEs [54]. Some of the other overall barriers of successful implementation of the privatisation program can also be added such as political and macroeconomic instability and uncertainty and a relatively weak and underdeveloped capital market in Turkey [55]. It can generally be said that the State Economic Enterprises have played a dual role in Turkish economy. On the one hand, they represent one of the most important bases for Turkey's industrial development, and on the other hand, due to their heavy investment requirements and inefficient operations have been considered as a one of the main obstacles to Turkish dynamic growth [56]. Despite some successful examples in the first stage of SEEs's privatisation, the majority suffer from low investment, low productivity, poor standards of quality and weak management. Following the change of government in October 1991, the new government has reviewed its previous privatisation strategy. There has been an attempt to restructure the SEEs before putting their shares in the stock exchange market and the privatisation process is mostly guided by the ability of the market to absorb assets and sales of shares [57].

In 1993, when the government budget deficit was estimated at Turkish lira (TL) 170 trillion ($ 15.5 billion), the losses of state economic enterprises amounted to TL 48 trillion ($ 4.4 billion). The burden of loss-making SEEs falls not only on the government, but also on private companies using expensive intermediate goods (such as iron, steel, and paper) and services (energy and telecommunications) provided by the public sector [58]. It is believed

that despite several attempts by the Turkish authorities to remove the obstacles, the inefficiency and weaknesses of the SEEs is likely to continue in the 1990s unless a comprehensive reform focusing on privatisation is carried out to restructure this sector and to bring about a fundamental change in the ways in which they have been operated.

Although there is a perceived agreement on the success of Turkish experience, the driving force behind it remained a matter of debate. Most observers of the Turkish economy would agree that export performance has been the principal success story, notably during the first half of the 1980s. Some stressed Turkey's liberal provision of export incentives. Other have concentrated on the macroeconomic and import liberalisation policies in Turkey that resulted in sustained real depreciation of exchange rates [59]. Whether the significant export performance in particular the manufacturing exports or any other important factors such as trade liberalisation and structural adjustment policies of early 1980s have been the cause of Turkish success, one can generally say that Turkey's relatively successful transition to an open market and export oriented economy can support other developing countries which want to follow the same path of late industrialisation policies.

G.1 THE ROLE OF FOREIGN DIRECT INVESTMENT AND TECHNOLOGY TRANSFER

Foreign investment played a negligible role in the Turkish development strategy in the post second world war period. In spite of a fairly liberal foreign capital law which was enacted in 1954, only $ 228 million of foreign capital came to Turkey over the period between 1954-1980. In 1980, Turkey received the only $ 65 million of foreign investment which could hardly be regarded as a significant contribution to closing Turkey's domestic savings and foreign exchange gaps [60]. A number of factors have been indicated as reasons for the low share of foreign investment in the Turkish economy. One can refer to some of the most important factors, such as political instability, administrative delays and bottlenecks in responding to foreign investment applications, continued high inflation, and periodic currency crises. Furthermore, much of the FDI before 1980 was domestic market oriented, in other words, concentrated in the import substitution industries and did not contribute significantly to the development and growth of Turkish exports [61].

The Turkish authorities adopted various policies to attract foreign investment and technology to participate in the country's development. In order to promote more private foreign investment, apart from simplifying the regulations concerning application for foreign investors, the government introduced new incentives through the stabilisation and structural adjustment of the 1980s. The establishment of customs-free industrial trade zones at some industrial areas such as Antalya and Mersin in 1986 which benefited from exemptions and relaxed currency controls, were among the most important measures to boost foreign investment. These zones were successful in increasing export oriented investment and production in Turkey, accelerating the entry of foreign capital and technology. Other measures included a 100 % custom exemption for a period of up to five years for the investment project and production, complete or partial tax rebates on the capital goods and raw materials imported for industrial investments, and investment tax credits. The government also attempted to attract foreign investment into infrastructural projects, such as harbours, airports and power plants. However, foreign investors tended to concentrate more in manufacturing and services, while in infrastructural investments, they were involved mostly in the construction of dams [62]. Furthermore, the establishment of a Foreign Investment Department under the supervision of the state planning organisation has been one of the first steps undertaken under the adjustment and stabilisation programs of the 1980s, in order to attract more foreign capital. The Department was authorised to approve foreign investment projects of up to US $ 50 million, with foreign equity participation limited to less than 50 per cent. However, in the later stage of trade liberalisation policy, there was a major relaxation of foreign investment regulations, and the limit on foreign ownership was abolished [63].

According to the foreign investment law (No:6224), foreign capital is permitted in sectors open to Turkish private enterprises which tend to promote the economic development of the country and do not involve a monopoly or special privilege. The Turkish government has also given more priority to joint venture projects between Turkish enterprises and their foreign trade partners, to strengthen the development of country's industry, technology and managerial skills. The Turkish government also tended to use foreign investment in those branches of industry where Turkish firms have not been active for lack of sufficient technical knowledge, experience, and capital [64]. Some other incentives were given to the investors,

including exemption from custom duties and taxes on imported machinery and equipment, investment allowances of up to 100% for approved projects, low interest rate loans and tax exemptions [65].

Following the implementation of these measures, the amount of foreign capital reached $ 1,429 million during the period between 1980-1985, which was almost five times the whole amount during the 25 years 1954-1980. The total authorised foreign investment increased from $ 325.1 million in 1980, to $ 662.6 million in 1981, $ 829 million in 1982 and $ 932.3 million in 1983 [66]. The number of investors increased from 100 in 1980 to 610 in 1986. Of the total foreign firms operating in Turkey, 54% were from European countries, with Switzerland (63 firms) on the top list of foreign investors in Turkey in 1985, followed by U.S and German firms with 60 and 59 firms respectively. Among the total of Middle Eastern countries involved in setting up capital and investment projects in Turkey, Iran was the front-runner with 17 companies followed by Saudi Arabia and Syria with 10 firms [67].

Turkish authorities gave further incentives and highly liberalised the foreign investment in the second half of the 1980s, raising the net foreign capital inflows to increase from $ 354.0 million in 1988 to $ 663.0 million in 1989, and to $1,784 million, recording an 87.3 per cent increase over 1988 [68]. Most foreign investments were concentrated in the manufacturing and service sectors. Within the services, banking was the most important sector with about 20 per cent of total value of FDI in 1986 [69]. Within the manufacturing sector, food processing industries, chemicals and transportation vehicles were the relatively more important sectors in attracting more foreign investment [70]. Moreover, foreign investors have also become involved in Turkish textiles and electronic industries. As a result of the massive investment in textile industries which were more export-oriented, Turkey has recently replaced Hong Kong as the biggest textile supplier to the European community. The foreign investment in electronic industries however has been more oriented to the domestic market than to exports, mainly because the market is protected by high tariffs and has shown strong growth. There have been successful joint venture and licensing agreements in the electronic industry such as the Bestal plant at Manisa to make T.V sets, home computers and microwave ovens in a joint venture with Goldstar of Korea. In terms of vehicles manufacturing, there have been thirty-eight local companies (including many with foreign share holdings) and thirty-two foreign licensees involved in vehicle production in

Turkey. In addition to producing a national car, "Anatol" many years ago, in 1987 Turkish vehicle manufacturing firms have produced 88,000 cars which although considerable has not been adequate enough to meet increasing domestic demands [71].

In order to increase the level of private and foreign investment, the Turkish government introduced further investment incentives in 1990. These new incentives were introduced for projects concerning car production. For example, projects involving automotive side industries benefitted from a 35 % premium. There were also some new incentives in order to attract more foreign investment in tourism, ship building and electronic industry projects particularly in Turkish free trade zones [72]. However, as a result of Persian Gulf conflict (Iraqi invasion of Kuwait) in 1990, the total portfolio of investments, which had amounted to $ 1,586 million in 1989, decreased to $ 547 million in 1990 but rose to $ 648 million in 1991.The manufacturing and services respectively accounted for 55 per cent and 42 per cent of total foreign investment in 1991. The food and tobacco, chemical industry, electrical machinery, iron and steel, and cement were the major sectors within manufacturing sector in 1991.The banking, tourism and commercial sub-sectors attracted more foreign investment within the service sector in the same year [73]. By 1992, there were 2,271 firms with foreign capital participation with an average share of 51 per cent of foreign capital. Inflows of direct investment amounted to around $ 1.1 billion in 1992. However, the flow of foreign investment to Turkey decreased in the following years and reached a total value of only $ 432 million in 1994, which shows the inadequacy of flowing foreign capital and investment in Turkey [74].

As discussed earlier, macroeconomic and political instability is the major factor influencing the low amount of FDI flowing to Turkey. The increasing inflation, inconstant exchange rate, political crisis and more recently stronger labour union pressures for real wage increases, are among the most important indicators explaining the macroeconomic instability [75]. It is also argued that due to the sensitivity of FDI to macroeconomic factors, Turkey's success in attracting more FDI will largely depend on the future economic and political stability of Turkish economy. There were a number of problems regarding the past experiences of FDI in Turkey. One of the problems with foreign direct investment, as opposed to foreign loans, is that it required a higher rate of return. In addition, foreign investment did not necessarily bring in fresh new capital. It is also argued that the Turkish

Free Trade Zones (FTZs), which were established in order to accelerate the flow of foreign investment were not as successful as the free trade areas in other developing countries. This was mainly because of the dependency of these zones on importing considerable quantities of raw materials. Moreover, it is believed that these zones could not solve Turkey's problems of unemployment and foreign exchange shortage. In addition, export oriented facilities in free trade zones required infrastructural investments which require external loans in order to be serviced [76].

It is clear that foreign investment has also been one of the most important ways of transferring foreign technologies and managerial skills for Less Developed Countries (LDCs) such as Turkey. It is argued that foreign direct investment in Turkish manufacturing has obtained significant and even absolute net benefits in the transfer and diffusion of foreign technologies and the training of domestic labour. Since the bulk of FDI went into sectors in which Turkey had no comparative advantage, for example, the automotive industry, the technological net benefits although directly, i.e., in and by themselves quite substantial, did not in the final analysis contribute to the generation of total real income benefits. Perhaps in the long-run, these technological benefits can be channelled into the development of those sectors, such as non-electrical machinery and metal products, in which Turkey might have comparative advantage [77].

Although the relatively importance role of FDI as a source of attracting foreign technologies which were essential to increasing the productivity and international competitiveness of Turkish manufacturing products, foreign technologies were also transferred through other channels, in particular licensing and know-how agreements. Turkish policy-makers have emphasised more the importing of technology than its adaptation and diffusion in the past. However, there has recently been more tendency towards strengthening the domestic technological capability through the acquisition and assimilation of foreign technologies. The Turkish government supported the establishment of a sector specific technology institution in order to develop the diffusion of new technologies by an efficient institutional network [78].

Following the trade liberalisation and stabilisation policies of the 1980s, a diverse range of foreign capital and intermediate products and technologies were imported into Turkish market, which forced local firms to compete by upgrading the quality of their products. As imported goods mostly cost more than the domestic alternatives, local firms competed on the basis of quality rather than price [79]. In addition to the import of foreign technologies, Turkey has also exported some small-scale labour intensive technologies to other developing countries, in particular those of its neighbouring and other Middle Eastern countries. Most of these technologies were transferred licensing, consulting and technical services and project exports respectively. Direct foreign investment (which were all joint venture investments with firms in other developing countries) seems to be a relatively unimportant technology export method for Turkish firms [80].

The Research and Development (R&D) expenditure accounted for a small proportion of the Gross National Products (GNP) in comparison with other developing countries. The R&D expenditure has decreased from between 0.3 per cent and 0.4 per cent of GNP during 1960s to 0.2 - 0.3 per cent in the 1970s and 1980s. The industrial research and development is carried out mainly by a number of Turkish R&D institutes such as the Turkish Scientific and Technical Research Council (TUBITAK) which was established in 1963 and has been largely oriented towards the public sector and also lacked the specialisation to adapt foreign technology to local conditions. Another major Turkish R&D institutes, the Marmara Scientific and Industrial Research Institute, set up in 1966 under the sponsorship of TUBITAK, and has mainly concentrated on metallurgical and material problems [81].

Having realised the fact that cheap labour can no longer be expected to remain the comparative advantage for Turkey due to gradual wage rises of its labour, Turkish authorities are fully concerned to strengthen technological capability through combining relatively cheap labour with new technologies, such as individual automation technologies in operations strategic for quality improvement. As an example one can refer to the Turkish automobile industry, which has employed a strategy of selective automation and labour intensive technologies in order to increase its competitiveness [82]. It is argued that the government can play a considerable strategic role in setting general conditions which encourage the development of Turkey's technological capability. This is largely relied on the government's ability to clear away adverse externalities such as macroeconomic instability

and infrastructural (physical, human and technological) problems limiting the diffusion and adaptation of technology. Moreover, in the case of low domestic demand for new technologies, in order to promote local technology production, the government has restricted the imports of new technologies. In the long term, encouraging investments and the resulting demand on new technologies can motivate their local production. Furthermore, increasing public and private expenditure for more research and development activities and more coordination of the R&D activities with universities and industries, along with the designing of industry-relevant technology research programs and developing an effective system of industrial standards and of quality control are among major government programs to enhance local technological capability [83].

G.2 THE ROLE OF HUMAN RESOURCE DEVELOPMENT

The development of human resources was emphasised in the Turkish development plans starting from first Five-Year Plan (1963-67) which presented the details of projected programs for developing high-quality human labour. The base of Turkey's educational system has been a free, five year primary school, attendance at which was legally compulsory for those between seven and twelve years. Turkey has pursued an education policy with emphasis on elementary education and with strict controls on admission to higher education. Almost all children received primary education, and 58 per cent of school-age children attended secondary school in 1991. In addition to a variety of adult education programs, the military bases have also played an important role in the development of high level technical and managerial human labour in Turkey during the 1960s and 1970s [84].

The improving and expanding of education and training has also been one of the other important objectives of the structural adjustment and stabilisation policies of the 1980s. The key role of development of human resources was emphasised in the Turkish national plan during the period 1985-1989, which indicated the maximum exploitation of the Turkey's potential of human resources through appropriate education and training. In 1985, the total enrolment in elementary education amounted to approximately 6.6 million. However, the budgetary allocations to the Education Ministry fell from 2.5 per cent of GNP in 1983 to 2.1 percent in 1986. Between the academic years 1983-84 and 1985-86 the schooling ratio

has increased in primary education from 98.3 to 98.9 per cent, in middle school from 43.7 to 54.4 per cent, and in secondary education from 26.4 to 31.4 per cent. The number of primary schools and students increased from 47,355 and 6,500,539 respectively in 1983-84 to 51,370 and 233,441 in 1990-91. The rapid process of industrial development in 1980s necessitated the need for skilled human labour with professional and technical knowledge. Hence, the government increased the number of vocational and technical schools from 1,356 in 1983- 84 to 1,963 schools in 1990-91. There were also an increase in the number of students and teachers of these schools from 370,176 students and 36,684 teachers in 1983-84 to 620,244 students and 48,369 teachers in 1990-91 [85].

There is no simple or comprehensive measure for human resource development. However, there is a useful and simple summary measure by United Nations Human Development Index (HDI) based on literacy (mean years of schooling), life expectancy and real per- capita GDP. On the HDI measure, Turkey was among the top ten countries in terms of improvement over the period 1960-92, leaving the ranks of the low and entering the ranks of the medium level countries. By 1992, Turkey ranked 68th (71st in 1990) among 173 countries. This improvement in ranking was due to above-average economic performance, as Turkey lagged in education outcomes [86]. Despite substantial quantitative achievements, the Turkish educational system has been often criticised for its excessively academic nature and lack of practical orientation [87]. The rapid growth in enrolments, coupled with increasing funding problems, has brought signs of declining quality in school provision. It is also argued that for those who have been at upper-secondary educational level, there were about 30 per cent of the 15-17 year-olds remained in the formal system. Another figure shows that in 1984-85, only 41 per cent of 12 to 17 year-olds stayed on in formal schooling. Lacking an adequate foundation of general knowledge as well as basic vocational skills, most of early school-leavers have been ill equipped to adapt to the future economic and social changes and therefore added to the unemployed group. Thus, the quantitative expansion and qualitative improvement of further education opportunities at the middle and upper secondary levels remained as a major challenge to Turkish educational policy [88].

Moreover, there were some serious imbalances between the number of engineers and technicians (about 3:5 ratio) and between doctors and nurses (about 6:1 ratio). The engineer and doctor therefore do the work of technician and nurse. Such imbalances

prevented proper utilisation of more highly trained personnel and forced them to spend much time in some activities which could be performed by lesser trained persons [89]. Although five-year primary education has been covered all children aged between 7-12, only 26 per cent of the relevant age group have received full-time secondary education in 1988. For tertiary (university) education, the figure was 12 per cent in the same year and the share of educational expenditure as a percentage of GDP was only 1.9 per cent. These figures which have been the lowest levels in OECD, put Turkey at the bottom of the OECD countries [90]. Despite a recent rapid increase in the both public and private expenditure on education, the rate of youth unemployment has remained high with about one-third of urban unemployed youths between the age of 15 and 24 and one-fifth between the ages of 25 and 30 [91].

In order to solve these problems and generally improve the national education system, the Turkish government has adopted some specific programs through the national development plans, including necessary measures to raise the quality of national education, further increasing of the schooling rate in all educational level, developing technological education at the primary and secondary level, emphasising an overall technical and vocational education and improving the quality of science and engineering in higher education. It is believed that because of certain factors and budgetary limitation, the implementation of these measures may not be completed until 2005.

G.3 SUMMARY AND CONCLUSIONS

One can draw several important lessons from the Turkish experience of industrialisation. A fundamental lesson to emerge from the Turkish experience concerns the powerlessness and vulnerability of a highly centralised state. In the Turkish context, the centralised state appeared to be particularly vulnerable in terms of its ability to generate tax revenues on an adequate scale, and to impose fiscal discipline [92]. Moreover, during the period of implementing import substitution in the 1960s and 1970s, the state in Turkey played a significantly larger role than that observed in many other developing countries pursuing the same pattern of industrialisation. The share of the state sector, predominately located in strategic branches, in manufacturing industry and in total investments were around 40 % and

50 % respectively during the 1960s and 1970s [93].

Having compared the role of state in industrialisation of Turkey with that of East Asian counterparts, one can say that the Turkish state has been weaker in terms of monitoring private sector activity and its ability to decipline private firms in return for the resources provided. It is also believed that the state in Turkey has been an "overextended" or "overloaded" in comparison with the East Asian countries. It has not only involved direct production through extensive state economic enterprises, but it has also sought to guide private production through a complex system of subsidies and investment incentives [94]. Moreover, in terms of the successful experience of East Asian countries in implementation of import substitution strategy in the early stage of their industrialisation, it is believed that the Turkish import substitution strategy has also been moderately successful, at least in the early stages. However, one of the most important factors which distinguished the Turkish and East Asian experience of ISI in the early stages of their industrialisation has been the lower degree of state autonomy and the insufficient degree of co-operation or collaboration between the state and business in Turkey which led to frustrating the development process and to the crisis of the late 1970s [95].

The Turkish case demonstrates the overall feasibility of switching from Import Substitution Strategy to Outward-orientation in the latter stages of the liberalisation process, but the transitional costs involved appear to be substantial. Moreover, Turkey's recent experience in trade liberalisation and stabilisation programs brings about the strong connections between macroeconomic policy and trade reforms. It shows that the interactions of adjustment policies can cause the macroeconomic instability such as high rate of inflation and unemployment and unbalanced income distribution, and this in turn has worsened the climate for new capital formation in manufacturing, which is central to sustained industrialisation in the long term. The Turkish case also illustrates the difficulties of sustaining a single minded export drive, in a country endowed with a large domestic market.

The experience of Turkish industrial development also shows that the early import-substitution strategy was highly conducive in giving an initial impetus to the Turkish industry during the 1960s. However, despite some momentous impacts on the Turkish economy, it is believed that this strategy failed to achieve all of its planned objectives. The 1980s

strategy of manufactured export-led growth, on the other hand, has been essential in increasing merchandise exports and also changing the country's economy structure in favour of the manufacturing industries. Nevertheless, this strategy could not provide adequate stimulate to the domestic economy when the export potential of the export promotion scheme has reached its limits. As suggested by Yeldan (1989), it seems that an appropriate development strategy for Turkey's future is the continuing of the current export promotion policy along with a primarily domestic demand-oriented industrialisation strategy. This strategy is based on the expansion of the domestic market through emphasising more on agriculture sector, and also production of basic intermediate and capital goods together with domestic production of associated technologies, and aimed at improvement of income distribution, employment and social welfare, particularly in rural areas [96].

The Turkish experience of structural adjustment and stabilisation programs suggests that the effectiveness of these policies can benefit greatly from prompt and sizable external financial assistance especially during the initial period of the adjustment. It is only at a later stage, however, that an increasing portion of capital inflows can be expected to take place in the form of foreign direct investment which need to be improved in Turkey. One can say that the Turgut Ozal was the major architect of structural adjustment and trade liberalisation of the 1980s and appeared to have a Japanese model behind its thinking, and transition to an export oriented economy that Turkey underwent under his guidance identifies the 1980s quite clearly as the Ozal decade [97].

It is clear that the Turkish experience of structural adjustment and trade liberalisation policies and its transition to an open market export oriented economy since 1980 has had many similar criteria with the experience of some other late industrialising countries such as those of South East Asian countries and some Latin American countries. Most or all of these late industrialising countries have adopted these policies earlier or at the same time with Turkey, which usually accompanied with conditional assistance from international organisations such as IMF (International Monetary Fund) and World Bank. One can also refer to some particular convergence in their policy orientation, such as redefining the role of state and assigning a greater importance to the competitive discipline of market through a transition from inward looking to outward looking industrialisation policies. As an example, one can see an interesting parallel between the Turkish experience of post 1980s

and South Korea in the post 1964 period in terms of the significance of export subsidies as well as the sequencing of export promotion and import liberalisation. The empirical reality in late industrialising countries generally indicates, however, significant divergences in the forms of implementation as well as the degree of socioeconomic success of the fairly standard guidelines of the IMF type programs [98]. A comparison with the Latin American cases of the post 1982 era indicates that while stabilisation and reform in Latin America, in its early stages, was accompanied by drastic import compression. In Turkey the reverse was true, with significant import expansion accompanying the liberalisation programme. Since Turkey was heavily dependent on imports of intermediate and capital goods, an expansion of imports contributed to the recovery of domestic production as well as to the process of export expansion.

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