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Art Collectors as Venture-Stage Investors

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Abstract

Given the growing understanding in cultural economics of artists as entrepreneurs, we consider whether art collectors can be modeled as fellow risk-takers, that is, analogous to venture-stage investors. Employing a unique data set of the collection of 20th-century U.S.-based collectors Burton and Emily Hall Tremaine, we build a conceptual framework of criteria for collectors as venture-stage investors. We consider *risk* (how early in an artist's career they are collecting), *reputation* (collectors' museum-related strategy), and *rebalancing* (donation and sales). Regarding risk, we find that 69% of works in our study were purchased within a year of when the works were made indicating venture-stage risk-taking, though with notably longer holding periods than within a traditional venture "exit" strategy. Regarding reputation, we consider the market impact of the 1984 *Twentieth Century Masters* show of the Tremaine collection and find the value of the artworks rose five-fold from the museum exhibition to the auction four years later. We build an index of artists whose works were in the 1988 and 1991 Tremaine auctions and also find strong indications of the importance of the timing of those sales to the returns achieved. Regarding rebalancing, we look at museum donation strategy as part of investment analysis, and find substantially different patterns of annualized ROI and holding period for auction and donated works. This study contributes to our understanding of art collectors as risk-takers and to the portfolio management of art collections.

Keywords: Art investment, artists, museums, venture capital, venture-stage investing, portfolio management, tax-deductible donation

JEL Codes: G11, L31, D31, Z11

Declarations

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Data Availability: Our data are gathered through publicly available files in the Archives of American Art in combination with proprietary records of the Tremaine Foundation and database of auction returns.

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I. Introduction

In cultural economics and in adjacent fields of entrepreneurship and finance, artists have been modeled as entrepreneurs (Woronkiewicz and Noonan, 2019), but very little has been studied on art collectors as corresponding venture-stage investors. In this paper we consider this question of art collectors as venture-stage investors by analyzing a unique data set of Burton and Emily Hall Tremaines' collection and building a three-part conceptual framework around risk, reputation, and rebalancing. We find distinct patterns of early acquisition, the strategic management of museum partnerships, and a portfolio management strategy of donating both low-value and high-value works. We also find that the timing of sale is critical to the returns achieved. The analysis of art collectors as venture-stage investors contributes to our understanding of core theoretical concerns in cultural economics with regard to bridging the microeconomics of production and the risk-and-return framing of investment management.

Regarding artists as entrepreneurs, Woronkiewicz and Noonan (2019) find that 35% of artists were freelancers, as compared to 15% of the general population. They argue that this independence and autonomy indicates entrepreneurial activity. Feder and Woronkiewicz (2023) posit the origins of this “artist-entrepreneur” phenomenon in economic precarity, thus questioning whether artists were entrepreneurial by choice. Artistic precarity has varied across eras of artistic production. While Jensen (2023) finds that artists were often financially successful in their lifetimes in the late 19th and early, 20th centuries, contemporary artists have experienced structural economic precarity (Roberts, 2024; Ehlinger et al., 2024; Abbing, 2008; Greffe, 2002) given the difficulty of knowing, *ex ante*, the value of creative work (Caves, 2000). Gerber (2017) finds artists to be investors in their own work not only in financial terms but in decisions around flexibility and foregone income.

The literature on art collection as investment has tended to focus not so much on artists as investors and producers as on the general status of art as an asset class. These analyses, largely based on publicly available auction data, employ a method of repeat sales (Anderson, 1974; Baumol, 1986; Goetzmann, 1993; Mei and Moses, 2002, 2005) and hedonic regression or hybrid methods (cf. Renneboog and Spaenjers, 2013; Spaenjers et al., 2015; Korteweg et al., 2016). Returns to art have commonly been found to underperform equities and outperform corporate bonds but with substantially higher risk. For example, Renneboog and Spaenjers (2013, p. 49) find that art returned 3.97% in real terms from 1957 to 2007, but at a standard deviation of 19.05%. An extensive literature in art investment includes categorical differences in returns, e.g., by gender (Adams et al., 2021, Cameron et al., 2019, Bocart et al., 2022).

Instead of focusing on art as an asset class, we consider artworks as artifacts of an artist's production and investment activities. We look specifically at the perspective of art collectors to ask whether some art collectors can be understood as venture-stage investors in artists' work. Collectors make a "venture-stage" investment, rather than a "venture capital" investment per se, given the lack of lock-up, partnership-based investment decisions, and prioritization of exit. We study in particular the art collection of Burton and Emily Hall Tremaine, who championed artists unusually early in their careers and who spearheaded novel working relationships with art museums.

From an art collector's point of view, art investment is an exercise in portfolio management. The investment management of artworks both follows and creates exception to portfolio theory. In their reinterpretation of Markowitz's (1952) portfolio theory, Mao and Särndal (1966) model portfolio decisions as a set of probability determinations through which investors adjust expectations of future gains, using a Bayesian model of adjustments given prior information. With notable advances in decision analysis (Dyer and Smith, 2021), art markets still present difficulties in applying these probabilistic models given significant idiosyncratic and private value to art as an asset (Goetzmann et al., 2021), as well as heterogeneity and volatility of returns to art (Burton and Jacobsen, 1999), especially in the most expensive price brackets (Renneboog and Spaenjers, 2013). Additional complexity arises from the illiquidity of art as an asset (Ang et al., 2014), the differing motivations of collectors (Lovo and Spaenjers, 2018), and the possibility of bubbles in art markets (Pénasse and Renneboog, 2022).

In considering art asset management from the collector's point of view, three core questions arise which we term *risk*, *reputation*, and *rebalancing*.

Risk. The first question is whether we can understand art collectors as investors in early-stage entrepreneurial activity. The hallmark of such activity is taking relatively great risk and making collecting decisions early in an artist's career or early in the life of an individual artwork. That these decisions are understood later to have been successful underscores this framing.

Reputation. The second question is whether we can observe any reputational relationship between collector-driven museum exhibition activity and impact on the market value of works of art. Toward this end, we look at two unusual exhibitions that Burton and Emily Hall Tremaine coordinated: the 1947 exhibition *Painting Towards Architecture* of forty-five works in their collection which toured twenty-five U.S. cities (Housley, 2001, p. 100), and the 1984 exhibition *Twentieth Century Masters* at the Wadsworth Atheneum in Hartford, Connecticut, which featured 130 works from the collection, at a time the Tremaines were selling numerous masterpieces privately and four years before the first (1988) auction of signal works from the collection.

In order to understand the impact of the timing of sale, we build a hedonic index of the auctioned works. Because the Tremaines had their collection appraised in 1979, we are able to build an index between 1979 and the respective Tremaine auctions in 1988 and 1991, to see whether the collection was likely to have gained value sharply before those sales. While the timing of the auctions was down to chance—that is, timed to Mrs. and Mr. Tremaine’s respective deaths—we see evidence that the timing made a substantial difference to the returns achieved, likely in concert with both a booming art market in the 1980s and the landmark 1984 museum exhibition.

Rebalancing. The third question concerns the role of museum donations in art investment strategy (Robson, 2020; Clotfelter, 1990). In the United States, collectors donating to art museums typically receive a tax benefit equal to the appraised value of the artwork multiplied by their personal tax rate. Collectors making optimization decisions in the 1970s, when the highest marginal tax rate was 70%, would be able to include tax donation as part of their portfolio strategy, particularly in cases where the valuation of the work had a high degree of uncertainty or a high transaction cost. Tax planning could have been doubly important for collectors such as the Tremaines who carried substantial capital-gains tax burden from successful early investments in art.

Especially because institutional value—that value conferred by museums and critics—can influence commercial value—that value conferred by galleries and auction houses—(Velthuis, 2005, p. 12), the donations and sales to museums may also have benefited the portfolio overall by securing museums’ institutional imprimaturs on the artworks and the art collectors themselves. The museum’s exhibition or acceptance of the artwork has a credentializing effect on the artworks’ commercial value (Velthuis, 2005, p. 18). In this regard, museums are analogous to ratings agencies of the art market. As O’Doherty writes (1986, p. 109), there is an “academic apparatus that stabilizes ‘history’ – certifying, much as banks do, the holdings of its major repository, the museum. History in art is, ultimately, worth money.” In addition, as Greenwald (2019) argues, art markets have asymmetric information between buyer and seller and thus art historians, curators, and institutions serve a purpose of “certification” of value in lieu of buyers’ access to fuller information. Relationships with art dealers and curators can mitigate risk because of this ability to certify the value of artists and their work.

Overall, this analysis not only contributes novel and generalizable insights into our understanding of risk-taking and entrepreneurial ecosystems in the arts, it also contributes to our theoretical understanding of creative production as, *ex ante*, an act of investment as well as making. This work echoes some of the authors’ “speculation” in Mei et al. (2023) that residual variance (the average squared residuals) in art investment may correspond to greater risk-taking by the most

creative artists. Etro and Stepanova (2018) have proposed power-law explanations of concentrations of artists that could describe the portfolio of artists in the Tremaine collection as distributed across geographies and levels of artistic success but also concentrated at the top end. Mei et al. (2023) find residual variance is correlated to artworks with higher density of citation in publications and exhibition in museums. We also find evidence of this relationship of “institutional” value: conferred by museums and “commercial value” as captured in markets.

The remainder of this paper is organized as follows. Section II presents a biographical history of the Tremaines. Section III introduces our unique data and describes our methodological approach. Section IV discusses our main findings, and Section V concludes.

II. About the Tremaines

Burton and Emily Hall Tremaine were prominent twentieth century collectors, primarily of American and European Art (Stourton, 2007). Mrs. Tremaine was particularly the catalyst of their art collecting activities. Her biography informs our understanding of a capacity for self-reliance and risk-taking as foundational to the Tremaines’ role as venture-stage investors in art.¹

Mrs. Tremaine was born in Butte, Montana, in 1908 (Housley, 2001, p. 2 and 13), to a prominent dentist who was also strongly involved in real estate investment and local mining (Housley, 2001, p. 10). Emily had an outdoorsy childhood replete with learning to fish and otherwise to fin for herself. Her first husband, Baron Maximilian von Romberg, was an adventurer and polo-playing thrill seeker described as “more like an amiable child than a responsible man” (Housley, 2001, p. 31). Although he was a miraculous survivor of many of his own exploits, he died in a plane crash—not his first—in 1938 (Housley, 2001, pp. 31-32 and 39-44). At the time of his death, he and Emily had been married for a decade (Housley, 2001, p. 26 and 44). After Emily’s brief and tumultuous second marriage to Adolph Spreckels, a sugar magnate (Housley, 2001, p. 46), she married Burton Tremaine in 1945 (Housley, 2001, p. 55). Mr. Tremaine was, throughout their marriage, the president of Miller Company, an industrial lighting corporation based in Meriden, Connecticut (Housley, 2001, p. 3). Through that company, the Tremaines would stage a pioneering series of museum exhibitions in 1947.

By the time of her 1945 marriage to Burton, Emily Hall Tremaine already owned several significant works of modern art, including *The Black Rose* by George Braques—the seminal painter who is credited alongside Pablo Picasso with inventing Cubism—as well as two works *On the Beach* and *Rampant Horses* by Giorgio de Chirico, (Housley, 2001, p. 57), the Italian painter

¹ The details of her biography are primarily sourced from the authorized biography *Collector on the Cusp* by Kathleen L. Housley (2001).

credited as a forebear of the Surrealists. In their collecting activities, the Tremaines were closely advised by Chick Austin, the director of the Wadsworth Athenaeum in Hartford, Connecticut (Housley, 2001, p. 57).

Please insert Table 1 around here

As Table 1 shows, the Tremaines collected 770 catalogued works. They collected first-rate modern and contemporary artworks by artists such as Piet Mondrian, Barnett Newman, Jackson Pollock, Robert Rauschenberg, and Jasper Johns. These works were interspersed with pieces by artists whose auction markets were less developed. For instance, a signal work in the collection, Piet Mondrian's *Victory Boogie Woogie* (1944), which Mrs. Tremaine had purchased in 1944—the year before her and Burton's marriage—for \$8,000 was sold after her death in a private sale to S.I. Newhouse for \$11 million in 1988 (Housley, 2001, p. 74-77 and 214). Other standout works that were in the collection include *Three Flags* (1958) by Jasper Johns and *Premier Disque* (1912) by Robert Delaunay.

Table 2 presents the top ten artists in the Tremaine collection, by number of works, with their corresponding rank via ArtPrice and ArtFacts. All of the top ten artists appear in the ArtPrice Top 500 list of artists globally, with an average rank of 134 as of December 2021. The top ranked artist, Pablo Picasso is ranked number 1, while the lowest ranked artist in the Tremaine top ten is Jean Arp at number 425. The Tremaine collection also includes numerous artists with no auction history at all as well as works by unnamed artisans.

Please insert Table 2 around here

The collection cost an estimated \$500,000, nominally, to acquire and was valued at \$84 million when Mrs. Tremaine died in 1987 (Housley, 2001, p. 5). The majority of the collection was sold or donated in the Tremaines' lifetimes or shortly after their deaths. Forty-one of the very strongest works were sold across marquee auctions in 1988 and 1991 (See Table 3).

Please insert Table 3 around here

With 41 major works sold via Christie's New York in 1988 and 1991, the Tremaines still donated over 281 works to museums and universities including the National Gallery of Art, the Museum of Modern Art, and the Yale University Art Gallery. Of the donated works, 49 went to Principia College, a Christian Science institution of higher education in Elmhurst, Illinois; 98 went to the Wadsworth Atheneum; and 76 went to the National Gallery of Art in Washington, D.C., in the aftermath of the Tremaines' attempt to create the International Art Foundation (see Table 1).²

Please insert Table 4 around here

The Tremaines' collecting story hinges on two events—their 1947 *Painting Through Architecture* exhibition and their failed attempt to start the International Art Foundation in the 1960s. The first event solidified and amplified the reputation of the collection. The second event hardened the Tremaines—particularly Mrs. Tremaine—to the idea of donating all of their works to nonprofit institutions. They came to see market value as proof of success.

First, in 1947, the Tremaines organized the exhibition *Painting Toward Architecture*. It was formally curated by the Yale professor Vincent Scully (in collaboration with Mary Chalmers Rathbun) and sponsored by the Miller Company, the company Mr. Tremaine founded (Housley, 2001, p. 95-98). The exhibition toured the United States and received major articles in the *New York Times*, *ArtNews*, the *New Yorker*, and the *Herald Tribune*. The value of the publicity of the exhibition was appraised at the time at \$500,000 (Housley, 2001, p. 100)—equivalent in nominal terms to the acquisition cost of the entire collection. It was unusual for a for-profit company to have such a close hand in the curation of an exhibition—not an arms-length corporate sponsorship but a role as a principal in showcasing a collection in museums across the U.S.

Second, because the Tremaines had bought works so early, they realized they would leave their heirs a substantial tax burden upon their deaths. At the same time, they were motivated to share the collection educationally. Thus in the 1960s, they conceived of the International Art Foundation, a “national lending library of artwork” (Housley, 2001, p. 193), loaning their works to regional museums without substantial first-rate holdings. The general rule would be that a regional museum could keep an artwork as long as it was on view. If the museum ever wished to put the

² While some donations records are incomplete, we use a 1979 insurance appraisal for the collection overall. We isolate for in-depth study the 30 works that were donated after this 1979 appraisal. (We have 34 records, then exclude four records for which we have incomplete primary-market acquisition data.)

work into storage, they would return it to the foundation. The Tremaines imagined the Wadsworth Atheneum as administrators of the foundation, with the Tremaines giving money to the Wadsworth to cover the costs of administration. However, the Tax Act of 1969 required foundations to disperse money each year, making the Tremaines' plan to circulate artworks rather than to grant funds ineligible for nonprofit tax status.

When the Tremaines were not able to start the foundation because of the change in tax code, they tried secondarily to start a lending library program in partnership with the National Gallery of Art, Washington, D.C.³ On a handshake deal, they donated works to the National Gallery with the understanding that the museum would run the art lending program internally. However, the experiment generally failed. It was hard for the National Gallery to manage the loans because of idiosyncratic governmental appropriation processes. At the same time, the Tremaines had, as National Gallery director J. Carter Brown later opined, given the museum second-rate works that were harder to lend (Housley, 2001, pp. 194-196). It was as if the Tremaines were waiting to see if the system worked before donating their best works.

After the National Gallery arrangement failed, the Tremaines started to believe they needed to sell works to museums for the museums to appreciate the works adequately (Housley, 2001, p. 192). As Mrs. Tremaine said, "Art is conveniently endowed with exactly the right characteristics to make its pursuit not only pleasurable, but also wise and virtuous....In addition, wisely chosen, art has again and again proved in the long run to be a sound, often an extraordinarily profitable, investment (Housley, 2001, pp. 61-62). In fact, they sold rather than donated a number of substantial works to museums including the landmark sale of Jasper Johns' *Three Flags* (1958) to the Whitney Museum in 1980 for what was then the record sum of \$1 million (Glueck 1984, Bernstein et al. 2016). They also sold Andy Warhol's *Marilyn Monroe Diptych* (1962) to the Tate Gallery that same year.

The Tremaines were still courted by museums. For example, the Tremaine collection received an eponymous 1984 exhibition at the Wadsworth Atheneum, as the museum was hoping for a bequest and exploring a purchase of the collection (Housley, 2001, p. 3). Characterizing conversations between museums and the Tremaines, Thomas Hoving, then director of the Metropolitan Museum of Art, called the Tremaines "will dangles" (Housley, 2001, p. 198) to mean that they were allowing museums to court them for donations that did not come to pass.

Even with their focus on the market as a barometer of value, the Tremaines were also friends with artists, mentors to other collectors—notably Agnes Gund, later the President of the

³ Prior to the National Gallery arrangement, the Tremaines tried and failed to secure an arrangement with the Museum of Modern Art under the directorship of Rene d'Harnoncourt.

Museum of Modern Art—and loyalists to their preferred dealer Leo Castelli, who represented artists such as Jasper Johns and Robert Rauschenberg. Throughout their collecting, the Tremaines were frugal stewards who requested discounts and had their collection appraised frequently. As Mrs. Tremaine’s friend Heugette Clark said, “Emily was known for her propensity to count pennies at the same time that she spent heavily” (Housley, 2001, p. 17).

When the Tremaines began to entertain selling their collection more seriously in the 1980s, they were courted by Larry Gagosian, the later famed gallerist who was ascendant at the time but less established. According to Mrs. Tremaine’s official biographer, Gagosian first met the Tremaines by getting their phone number from Connecticut Information, cold-calling them, and offering to buy their Brice Marden painting (Housley, 2001). His opening gambit worked. Gagosian would later sell a number of works, including a handful of masterpieces privately. In fact, Gagosian lobbied the Tremaines so successfully that when it came time to auction their collection in the late 1980s, Sotheby’s did not even bid on the consignment, thinking it was a *fait accompli* that Gagosian would offer the works exclusively, only to have Christie’s then represent the sale. Separate sales took place in 1988 and 1991 (Housley, 2001, p. 212). The sale of Mrs Tremaine’s portion of the collection seeded the Emily Hall Tremaine Foundation which gives grants to support curatorial exhibition research and the business education of artists.

III. Data and Approach

We approach this larger framing of art collecting as venture-stage investing by observing acquisition, sales, and donation practices of the Burton and Emily Hall Tremaine collection of primarily, 20th-century Modern and Contemporary American and European art. The Tremaine collection provides a unique and untapped ground for study in two key regards. First, the Tremaines were unusually pioneering collectors. The major works later sold at auction had been bought from the primary market or even in some cases from the artists themselves. They bought works so close to the date of creation that they took on an unusually high risk on the value of artworks. Second, their work unusually crossed over the lines of museums and markets including numerous sales and donations to museums and notable exhibitions in 1947 and 1984.⁴

This kind of collection information is more often kept private and not accessible to researchers. We have obtained this data both through archival research and through the Tremaine Foundation, which has shared records with us. The archival data comes from the Archives of American Art, which houses both the Burton and Emily Hall Tremaine Papers and those of the

⁴ In addition to the auctions, some works were sold privately, most notably via the dealer Larry Gagosian. We exclude these sales because we have incomplete or unverified data.

Tremaines' preferred dealer, Leo Castelli.⁵ The Tremaine data are unusually robust. Records of the collection exist in multiple related copies including Mrs' Tremaines' personal binders of the collection and index cards of each artwork, and various detailed records related to the ongoing appraisal and insurance of the collection. In addition, the authorized biography of Mrs. Tremaine by Housley (2001) complements these records.

We cross-reference the Tremaine auction sales to a database of over 6 million sales records worldwide. Our auction data come from the Blouin Art Sales Index (BASI), an independent database on artworks sold at over 1,380 auction houses worldwide, including the two major players Christie's and Sotheby's.⁶ We employ these auction prices with primary-market prices which we have sourced from the archival records.⁷

A. Risk

We isolate two aspects of risk: The first is taking early bets. The second is analyzing whether those bets were also of exceptional quality. We isolate the first aspect—taking early bets—by looking at time lapse from art-making to purchase. We look at the second aspect—the quality measure of risk, *ex post*—by considering the thirty-two artists in the Tremaine collection who are also in Galenson's (2001) landmark study of the age at which artists make their greatest contributions. Early investment relative to Galenson's measure of peak creativity indicates not only early investment but high-quality early investment.

1. Venture-stage investors

In order to calculate the length of time between their purchase of an artwork and the artwork's creation date, we isolate the works that the Tremaines purchased after their 1945 marriage and for which we have complete creation and acquisition data. Of the 770 catalogued works, we are able

⁵ We hold the required permissions from the Tremaine family. The Castelli and Tremaine papers are available to researchers.

⁶ BASI sources its data from Hislop's Art Sales Index, the primary source of price information in the world of fine art, supplemented with catalogue data from auction houses (both electronic and hard copy). For each sold painting in our data set, we have detailed information about the painting, the artist, and the auction it got sold. We know the painting's title, artist, year of creation, size, whether it was signed or stamped by the artist, and its medium (e.g., "oil on canvas", or "oil on board"). For each artist, we observe their name, nationality, year of birth, and year of death (where applicable). We also know the date of the auction, and the auction house and its location at which the painting was brought up for sale.

⁷ Studies that employ primary-market data include the Chambers et al. (2020) study of the collection of John Maynard Keynes, the Graddy (2013) study of artworks favored by the critic Roger de Piles, Greenwald's (2021) economic analysis of art historical records, and Whitaker and Kräussl's (2020) consideration of retained fractional equity in art. The approach of pairing auction and primary-market records has results in smaller data sets but new information from the inclusion of primary markets.

to study artwork creation date to Tremaine purchase date for 390 works.⁸ We find that the average elapsed time from artwork creation to acquisition is 4.49 years with a standard deviation of 10.29 years.⁹

Please insert Figure 1 around here

The median elapsed time from creation to purchase is one year, with 69% percent of artworks purchased within one year of creation date, and 48% of works in the collection purchased within the same year that they were created.¹⁰ Figure 1 shows the distribution of the elapsed time from artwork creation to purchase by the Tremaines. The largest elapsed time from creation to purchase is 67 years for Pablo Picasso's *Le Repast Frugal* (1904). While the Tremaines purchased other blue chip artworks with longer lag from creation to purchase (e.g., Alberto Giacometti's *Spoon Woman* (1926) in 1971), that was still before the more recent stratospheric returns for that artist. These blue chip works were purchased alongside works by far less known artists with comparable lags from creation to purchase, for instance two works by Dino Abedine from 1913 that were purchased in 1958.

2. Assessing quality of early investment

As a second check on the Tremaines as venture-stage investors, we consider the *ex-post* determination of quality of their investments by examining U.S. artists studied by Galenson (2001, Table 2.2 for U.S. artists, p. 17).¹¹ We reason that if the Tremaines were collecting *before* peak value, then they had a venture-capital-like role in early risk-taking and support of the artist's capacity to make work. Of the 57 artists in Galenson's study, we find 32 of them (56%) are

⁸ We exclude 380 works, including: 13 works purchased before their marriage, 159 works for which we do not have the artwork creation date (including some Indigenous works), 197 works for which we do not have the purchase date (not found in the Tremaine papers), and 11 works for which archival data is internally inconsistent (e.g., the listed acquisition date is twenty years before the artwork creation date).

⁹ We use annualized data. Thus, "same year" means an artwork with a 1959 creation date was listed as purchased by the Tremaines in 1959. Theoretically, that work could have been made in January of 1959 and purchased in December 1959. For works for which we estimated time frame (e.g., created 1956-1957 and computed as 1956.5), we rounded up, so that a work purchased 1.5 years of creation date is listed under 2 years in this table. These figures are based on the 390 works purchased by the Tremaines during their marriage and for which we have full and consistent data for artwork creation and Tremaine purchase.

¹⁰ Of the 390 works, 189 works were purchased in the year that they were made and a further 81 were purchased within the year following creation.

¹¹ We do not use Galenson's table of French artists. Although some of these artists (e.g., Henri Matisse) are in the Tremaine collection, overall, we exclude them for two reasons. First, so many of the artists were working in the late 19th and early, 20th century, their peak occurs well before the Tremaines' 1945 marriage. Second, the Tremaines hold some of these artists as single lithographs and not as paintings.

represented in the Tremaine collection. This inclusion indicates the presence of “winners,” given Galenson’s larger focus on the study of artistic mastery and genius. At the same time, the Tremaine collection also holds works by many other artists. Those 32 artists only represent 10% of the 305 artists in the overall Tremaine collection, and 169 of 770 catalogued works (21.95%), indicating a concentration of gains but risks taken early enough to include a much broader array of returns.

We find that, in many cases, the Tremaines collected artists well ahead of their respective peak values. For example, the artist Ad Reinhardt’s peak value year is 1956; the Tremaines collected work made from 1947, which the Tremaines acquired in the year it was made. Figure 2 shows the relationship between peak value and earliest artwork creation date for the artists in the collection. Figure 3 shows the year of earliest acquisition of work relative to peak value year. In an extreme example, the artist Robert Motherwell’s peak value year is 1987; the Tremaines collected works made as early as 1953, and acquired those works as early as 1957. We find that on average, the Tremaines purchased artist’s works 1.54 years before the year of the artist’s respective peak value—but with a standard deviation of 11.18.

Please insert Table 4 around here

Please insert Figure 2 around here

Please insert Figure 3 around here

We note that the peak value sometimes occurs early in an artist’s career, at a stage of either very early artistic experimentation or economic precarity, or both. In the case of Sol LeWitt, the peak value year is 1960, eight years before the artist’s first Wall Drawing. In the case of Robert Rauschenberg, the peak year is 1956, two years before the artist’s first solo exhibition at the Leo Castelli Gallery. Taken together, these analyses indicate both very early collecting and the inclusion of very high quality works.

B. Reputation

We define reputation here as concern with the “institutional” value of a work of art, by which we mean the role of museums and other institutions to confer non-monetary accolades and credentializing that may also have an impact on the “commercial” or financial value of a work of art. As such, museums can be seen within the art market as analogous to rating agencies in financial markets.

The Tremaines were unusual in their explicit work with art museums. In 1984, they lent 130 works to an exhibition, *The Tremaine Collection: Twentieth Century Masters*, at the Wadsworth Atheneum. Typical of the format, the exhibition seemed an audition by the museum for the collectors to donate works of art to the institution. The Tremaines instead sold many of the masterpieces at auction.

1. Auction timing and collections appraisal

In order to investigate whether the timing of the exhibition had an impact on the prices achieved at auction, we look at the overlap of the 1988 auction following Mrs. Tremaine’s death and the 130 works in *Twentieth Century Masters*. Thirty works in the auction (all but four) were in the 1984 exhibition. For those works, we compare the 1979 appraisal, the 1984 insurance value, and the 1988 auction. The total value of those works went from \$2.26 million in 1979 to \$5.71 million in 1984 to \$24.82 million in 1988, doubling in the first five years and then quintupling in the next five. While it is not possible to isolate these figures entirely from the macro-trends of the art market in the 1980s, these figures support the narrative that the 1984 exhibition solidified reputationally the art historical significance of the works later auctioned.

2. Constructing a hedonic index of artists with works sold at auction

We analyze this aspect of timing further by creating a “Tremaine Index” defined as a multivariate hedonic index of all of the artists whose works were included in the Tremaine auctions. (These are artists with works listed in Table 3).

Part 1: Tremaine Index 1979-1988

After deleting buy-ins, paintings with missing information, and paintings with hammer prices below USD 1,000, the final sample consists of 958 paintings sold at auction over the period 1979 to 1988. Table 5 shows the artists and the number of works for each.

Please insert Table 5 around here

To describe/identify each artwork, we collected the title (or “Untitled”), the date of creation (if available), the medium (e.g., oil on canvas), the dimensions, and whether the work is signed or otherwise given an identifying mark by the artist. For the transaction, we know the auction house, date of sale, lot number, hammer price (i.e., the price registered in the auction room, excluding any buyer’s premium paid to the auction house), and whether an artwork failed to meet the reserve price and thus was a buy-in.

We define the dependent variable of the natural logarithm of the auction sales price expressed in US dollars. We define as the independent variables the surface size, medium, the auction house, the location of the sale, whether the artwork has been signed, and the auction date.¹² The independent variables of the hedonic regression of artists listed in Table 6 whose works were included in the 1988 and 1991 Tremaine auctions are defined as follows:

Surface is defined as each painting’s size, length in cm multiplied by width, then converted to the log of the surface area.

Medium is defined with *oil on canvas* as the reference variable, with six other painting mediums (*acrylic on canvas*, *oil on board*, *oil on panel*, *oil on paper*, *mixed media*, and *tempera*) each given separate dummy variables, defining each dummy D_{it} as having a value of one when one of the dummies has the appointed medium. I expect the highest prices for oil on canvas and thus anticipate negative coefficient estimates.

Auction house includes separate dummy variables to isolate factors of reputation (e.g., Christie’s and Sotheby’s) and location (e.g., New York or London). These dummy variables allow me to reflect de la Barre et al.’s (1994) findings that the reputation of an auction house has a significant positive effect on the price of an individual painting, as well as Renneboog and Spaenjers’s (2013) findings that less familiar works by major artists are often sold by smaller auction houses. One dummy variable *AHDummy* (1/0) denotes the auction house company a Pissarro painting was sold at: a painting sold at Christie’s or Sotheby’s receives a 1, all else a 0, thus, I do expect a positive coefficient. Another dummy variable *AHLDummy* (1/0) denotes the location of the auction sale: a painting sold in London or New York receives a 1, all else a 0, thus, I do expect a positive regression coefficient.

Signature is a dummy variable (1/0) denoting whether the painting was signed. I expect the highest value for signed artworks and thus anticipate a positive coefficient.

¹² Given the high degree of correlation across these variables, we avoid the problem of multicollinearity and related inflation of the number of standard errors of the regression coefficient by assigning each dummy variable a reference variable which was then deleted from the sample.

Sales date is a dummy variable defined as the year of sale, between 1995 and 2024. A value of one indicates the painting is sold in period t using the respective art index.

We perform an ordinary least squares (OLS) regression on the auction price database, constructing the following hedonic regression model over the period 1979 to 1998:

$$\ln P_{it} = \alpha + \sum_{j=1}^z \beta_j X_{ij} + \sum_{t=0}^{\tau} \gamma_t D_{it} + \varepsilon_{it} \quad \varepsilon \sim N(0, \sigma^2),$$

where P_{it} represents the price of painting i at time t , α is the regression intercept, β_j is the coefficient for the quality characteristic X_j , and X_{ij} is the quality characteristic representing the value of the painting i , ε_{it} is the error or residual term. The antilog of γ_t is the coefficient that reflects the time dummy, and D_{it} is the dummy variable, where a value of one is assigned when the painting was sold in the time period t . Table 6 shows the semi-annual index over the period 1979 to 1998. Figure 4 shows the index graphically.

Please insert Table 6 around here

Please insert Figure 4 around here

We observe that the index starts in January 1979 at 100 and ends in December 1988 at a value of 727. This implies that a theoretical investment of USD 1,000,000 in January 1979 into the *Tremaine Index* would be hypothetically worth USD 7,270,000 at the end of December 1988. This corresponds to a theoretical annualized return on investment (ROI) of 21.95%, which is a very strong performance. Most of the gains of the index occur from 1986 to 1988. As shown in Figure 4 and Table 7, the index pegs up from 156 in the first half of 1986 to 727 in the second half of 1988, indicating a strong role of timing in the overall returns to the portfolio.

Part 2. Tremaine 1979 – 1991

We repeat the analysis for artists whose works were sold in the 1991 auction (See Table 3).¹³ After deleting buy-ins, paintings with missing information, and paintings with hammer prices below USD 1,000, the final sample consists of 929 paintings sold at auction over the period 1979 to 1991, including the complete pricing and artwork information. Table 7 lists the artists included in the index and the number of auction sales for each artist. We compute a *Tremaine Index* from 1979 to 1991 using the same method described above. Table 8 shows the semi-annual index over the period 1979 to 1991. Figure 5 shows this index in graphical form.

Please insert Table 7 around here

Please insert Table 8 around here

Please insert Figure 5 around here

We observe that the index starts in January 1979 at 100 and ends in December 1991 at a value of 822. This implies that a theoretical investment of USD 1,000,000 in January 1979 into the *Tremaine Index* would be hypothetically worth USD 8,220,000 at the end of December 1991. This corresponds to a theoretical annualized return on investment (ROI) of 17.60%, which is also a very strong performance. As shown in Table 9 and Figure 5, the index doubles from 239 in the first half of 1986 to 492 in the second half of 1988. Yet it then grows to a peak of 1,224 in the first half of 1990, before falling precipitously to 464 in early 1991 and rebounding to 822 by the end of 1991. The data indicate that market timing had a substantial impact on the returns to the portfolio.

C. Rebalancing

Finally, in order to analyze the Tremaine's overall (art) portfolio management, we consider the artworks that were donated or sold by separating out those groups of auctioned and donated works. While tax policy will have changing and idiosyncratic impact on collectors—both income tax and capital gains tax—we can model in a simple way the impact of donations on overall portfolio

¹³ Although there are only seven artists with works in this auction, they had a larger number of auctioned works per artist. For instance, Fernand Leger had 327 auctioned works.

management, particularly given the tax bill associated with selling artworks with such substantial return profiles and the potential advantages of donating works that may have been difficult to sell.

For the auction sales, we have complete data for thirty-four of the forty-one auction results. For the thirty-four sales, we find the annualized return on investment (ROI) from the original purchase by the Tremaines to the auction result (see Table 3).¹⁴ These works, selected for auction, represent some of the strongest works in the collection.¹⁵ The average annual ROI was 21.56%, with an average holding period of 29.57 years. The maximum ROI was 35.65% p.a. for Roy Lichtenstein's *I Can See the Whole Room and There's Nobody in It* (1961), which was held for 27 years. The minimum was 10.9%, for George Braque's *The Black Rose* (1927), which was acquired in 1936 and then held for 55 years.

Please insert Table 3 around here

It is interesting to analyze the average returns and holding periods for the sample of auctioned works versus the sample of donated works. The average annualized ROI for the auctioned works (21.56 percent) is substantially higher than that for the donated works at 16.14 percent. Further, the average holding period of 29.57 years for the auctioned works is twice as long as for the donated works at 14.33 years. The auctioned works overall were both held for longer and had higher annualized ROIs. The donated works were held for shorter periods with lower annualized ROIs.

Although tax documents around donations are not part of the archival records, we can see in the granular data we do have that there are a number of examples of museum donations that effectively write off lesser performing artworks. For instance Gerald Laing's *Small Arc* (1967) was

¹⁴ Because artworks are not "marked to market" or regularly and externally priced in the manner of public equities or other more liquid assets, we use auction sales and then infer an annual rate of return over the intervening years. We simplify and impute a linear return at a constant compounding rate over the period of time between the first sale and the auction date. Our model also assumes that all primary sales took place on July 1 of each year. We do not adjust these figures for inflation because our analytic aim is to see return by year as compared to holding period; the shorter holding periods are during more inflationary periods such as the 1970s, and thus this presentation is more conservative relative to our purposes of analysis.

¹⁵ We note that there are more high value works than were auctioned, with noteworthy private sales, many arranged by Larry Gagosian in the 1980s and for which we generally do not have reliable pricing information. We also note that we are considering roughly thirty of over 281 donated works. We anticipate that the other donated works—those donated before the 1979 appraisal—could have similar characteristics of shorter holding period and lower returns, indicating the likelihood of a disciplined deaccessioning strategy of collectors toward museums rather than, more typically of deaccessioning, from museums to other collectors.

purchased in 1968—one year after creation date—for \$113 and valued in 1979 at \$120, the year it was donated. The lower ROI and shorter holding period we observe for donated works would support this interpretation that some donations were forms of deaccessioning underperforming works from their own collection. We observe that smaller value works were donated to institutions with which the Tremaines had particularly close relationships (e.g., Principia College and the Wadsworth Atheneum) and that larger donations—and sales—went to museums such as the Whitney, the Tate, or the National Gallery of Art.

We consider the donations in the context of U.S. income tax policy which allows a tax deduction based on the appraised value of the work and the collector's tax rate. For example, if an artwork is valued at \$100 and a collector has a 35% personal income tax rate, the donation decreases the collector's larger taxes owed by \$35. Our data on U.S. tax rates comes from Tax Foundation (2021), a U.S. nonprofit policy organization. Over the time of the Tremaines' donations from the 1960s to the 1980s, U.S. tax rates for the highest income bracket was 91% from 1958 until 1963, before dropping to 77% in 1964 and then to 70%, where it remained from 1965 until 1981. From 1982 to 1986, the upper marginal tax rate dropped to 50%, before dropping to 38.5% in 1987, 28% from 1988 through 1990, then rising to 31% in 1991. Capital gains tax rates ranged as high as 35% over the same period. Although we are unable to know the Tremaines' tax position from the data, we reason that, their donation strategy likely had especially strong tax benefit, whether against their income or to defray capital gains from early art purchases.

IV. Discussion of Results

The idea that art collectors are venture-stage investors adds to our understanding of art as an idiosyncratic asset class. The Tremaine case shows early risk-taking and strong performance in a smaller number of works. It also shows the importance of reputational impact of the collection, in their case through museum exhibitions in 1947 and 1984, along with sales as well as donations to museums. Within the portfolio, the donation of high value works would create a strong tax benefit, reputational capital, and philanthropic enjoyment, while the donation of the low value works would form a structural deaccessioning practice. The shorter holding period of donated works (14.33 years instead of 29.56 years for auctioned works) supports this idea that some museum donations functioned as an exit strategy for lower performing works.

Although our aim was to investigate the role of collectors as early risk-takers, our analysis also contributes to the literature by providing further evidence of the importance of market timing to the returns on art as an asset class. The 1988 and 1991 auction results would have likely been

very different had they occurred a year or two earlier in either case. Those auction dates were determined by the death of Emily and of Burton in December 1987 and March 1991, respectively.

In some regards, the analysis of the Tremaine collection brings to the surface the unintended consequences—and sometimes collateral damage—of tax policy design. Had it not been for the passage of the Tax Act of 1969, it is likely that the Tremaines would have started the International Art Foundation’s art lending program so that their artworks could circulate among museums, creating broader access to great works of art while exerting their personal control over keeping those works from languishing in museum storage.

While the development of the 1969 tax policy may have been determinative, the Tremaines went on to support the arts in a different way through the Emily Hall Tremaine Foundation, which is a leading supporter of business education for artists. The legacy of the Tremaines—in their intricate navigation of tax law, museum practice, and art investment—has implications beyond the arts given their risk-taking and remarkably early acquisition of works. They collected works substantially before artists’ peak date of output according to Galenson.

The Tremaines’ navigation of the overlapping domains of market and nonprofit structures and early collecting have implications to longstanding financial management questions in the intersections of markets and regulation and of early-stage investing in creative work.

V. Conclusion

The Tremaines’ story begins and ends with artists. While artists’ economic livelihoods are difficult to study in a systematic, quantified way, we know that it is economically precarious to be an artist (Abbing, 2008; Ehlinger et al., 2024), that becoming an artist is complicated by gate-keeping and selection processes (Fraiberger et al., 2018; Wijnberg and Gemser, 2000), and that artists have riskier, less predictable patterns of income (Woronkiewicz and Noonan, 2019). In this context, a key question of the Tremaines’ collecting story is also whether artists benefitted from this long arc of collector value. As in studies of creator royalties and fractional equity (Whitaker and Kräussl, 2020), there is a much more profound dilemma in how societies incentivize, support, and reward creative work, and whether that is done by philanthropy, policy, labor, or art markets. Artists who do not receive resale royalties or retain fractional equity are arguably analogous to start-up founders who do not hold equity in their own ventures. The Tremaines’ role as early-stage investors illustrates, in its own way, the nature of artistic practice as a form of investment.

Although fractionalization of art and technologies for its management are outside the scope of this paper, there are more companies now offering shares in art than in the Tremaines’ time. While access to fractional ownership can help collectors to diversify their portfolios,

fractionalization also leads to the new possibility that there are numerous minority shareholders in works of art when they are sold or donated. In such cases, the strategy of museum donation has consequences to these shareholders. For the minority shareholders, the value of the asset would be truncated to the tax deduction. This consideration of museum donation is non-trivial given the large number of works—sometimes 50% (Whitaker and Kräussl, 2020)—in major collections that are donated to museums instead of reaching auction. There are also questions of how museum donation strategy—which benefitted the Tremaines as investors—had an impact on donor governance (Yermack, 2017), particularly in the separation of fundraising and curation.

Framing art collectors as venture-stage investors highlights the risk-taking that is inherent in collecting art, and the partnership between collectors as venture-stage investors and artists as entrepreneurs. As cultural economics confronts pluralistic definitions of value, early investment in art is consequential to what artists continue to sustain livelihoods and what art is made.

The analysis of the Tremaines as venture-stage investors gives rise to the question of whether the underlying artists in their portfolio benefitted as well. That latter question is neither as hollow in its provocation nor as distant as we might think from the urgent horizon of questions about whether creators whose work trains large language models (i.e., artificial intelligence) should have some fractional claim to the programs that their work informs. Those questions, in turn, are not far from societal concerns about the design of collective economic infrastructure in which everyone who contributes creatively benefits and shares risk. These experiments in art collecting may seem reduceable to storytelling—in part because collectors like the Tremaines are both charismatic and pioneering. Yet these stories are also experimental findings with something to teach us about the future for how we structure and understand enabling investments in the evolving frontiers of early-stage creative risk in the arts and beyond.

References

- Abbing, H. 2008. *Why Are Artists Poor?: The Exceptional Economy of the Arts*. Amsterdam University Press.
- Adams, R.B. Kräussl, R., Navone, M. & Verwijmeren, P, (2021). Gendered prices. *Review of Financial Studies* (34)8, 3789–3839.
- Anderson, R. C., 1974. Paintings as an investment. *Economic Inquiry* 12(1), 13–26.
- Ang, A., Papanikolaou, D., and Westerfield, M. 2014. Portfolio choice with illiquid assets. *Management Science* 60(11), 2737–61.
- Ashenfelter, O., and Graddy, K., 2003. Auctions and the price of art. *Journal of Economic Literature* 41(3), 763–86.
- Baumol, W., 1986. Unnatural value: Or art investment as floating crap game. *American Economic Review* 76(2), 10–14.
- Bocart, F., Gertsberg, M., Pownall, R.A.J.. 2022. An empirical analysis of price differences for male and female artists in the global art market. *Journal of Cultural Economics* 46(3), 543-565.
- Burton, B. T., and Jacobsen, J. P., 1999. Measuring returns on investments in collectibles. *Journal of Economic Perspectives* 13(4), 193–212.
- Cameron, L., Goetzmann, W. N. and Nozari, M. 2019. Art and gender: Market bias or selection bias? *Journal of Cultural Economics* 43(2), 279-307.
- Chambers, D., Dimson E., and Spaenjers, C., 2020. Art as an asset: Evidence from Keynes the collector. *Review of Asset Pricing Studies* 10(3), 490-520.
- Clotfelter, C.T. 1990. The impact of tax reform on charitable giving: A 1989 perspective, NBER Working Paper #3273.
- Ehlinger, A, Thomas, A., Kretschmer, M., Battisti, M. & Saenz de Juano Ribes, H. 2024. *UK visual artists 2024: A survey of earnings and contracts*. Design and Artists Copyright Society.
- Fraiberger, S., R. Sinatra, M. Resch, C. Riedl, and A. Barabási, 2018. Quantifying reputation and success in art. *Science* 362(6416), 825-829.

Dyer, J.S. & Smith, J.E. 2021. Innovations in the science and practice of decision analysis: The rome of *Management Science*. ***Management Science*** 67(9), 5364-5378.

Emily Hall Tremain Papers. circa 1890-2004. Archives of American Art, Smithsonian, Washington, D.C.

Etro, F. & Stepanova, E. 2018. Power-laws in art. ***Physica A*** 506, 217–220.

Feder, T. & Woronkiewicz, J. 2023. Reluctantly independent: Motivations for self-employed artistic work. ***Journal of Cultural Economics*** 47(4), 589-607.

Galenson, D. W. 2001. *Painting Outside the Lines: Patterns of Creativity in Modern Art*. Cambridge, MA: Harvard University Press.

Gerber, A. 2017. *The Work of Art: Value in Creative Careers*. Stanford, CA: Stanford University Press.

Glueck, G., 1980. Painting by Jasper Johns sold for million, a record. ***New York Times***.
<https://www.nytimes.com/1980/09/27/archives/painting-by-jasper-johns-sold-for-million-a-record-the-whitney-buys.html>. September 27, p. 1.

Goetzmann, W. N., 1993. Accounting for taste: Art and financial markets over three centuries,” ***American Economic Review*** 83(5), 1370–76.

Goetzmann, W. N., Spaenjers, C., and van Nieuwerburgh, S., 2021. Real and private-value assets. ***Review of Financial Studies*** 34(8), 3497-3526.

Graddy, K., 2013. Taste endures! The rankings of Roger de Piles (†1709) and three centuries of art prices. ***Journal of Economic History*** 73(3), 766–791.

Greenwald, D. S., 2021. *Painting by Numbers: Economic Histories of Art*. Princeton, NJ: Princeton University Press.

Greenwald, D.S. (2019). Used cars and canvases: Information economics, art history, and the art market. *American Art* 33(3). <https://doi.org/10.1086/707468>

Grefe, X. (2002). *Art and Artists from an Economic Perspective* (Trans. L. Saghal). UNESCO.

- Jensen, R. 2023. The rise and fall and rise again of the contemporary art market. *Journal of Cultural Economics* 47(3), 461-488.
- Korteweg, A., Kräussl, R., and Verwijmeren, P., 2016. Does it pay to invest in art? A selection-corrected returns perspective. *Review of Financial Studies* 29(4), 1007-1038.
- Leo Castelli Gallery records, circa 1880-2000, bulk 1957-1999. *Archives of American Art*. Washington, D.C.: Smithsonian Institution.
- Lovo, S., and Spaenjers, C., 2018. A model of trading in the art market, *American Economic Review* 108(3), 744-774.
- Mandel, B. R., 2009. Art as an investment and conspicuous consumption good. *American Economic Review* 99(4), 1653–63.
- Mao, J. C. T., and Särndal, C. E. 1966. A decision theory approach to portfolio selection. *Management Science* 12(8), B-323-B-333.
- Markowitz, H., 1952. Portfolio selection. *Journal of Finance* 7(1), 77-91.
- McAndrew, C., and Thompson, R., 2007. The collateral value of fine art. *Journal of Banking and Finance* 31(3), 589-607.
- Mei, J., and Moses, M., 2002. Art as an investment and the underperformance of masterpieces. *American Economic Review* 92(5), 1656–68.
- Mei, J., and Moses, M., 2005. Vested interest and biased price estimates: Evidence from an auction market. *Journal of Finance* 60(5), 2409–2435.
- Mei, J., Moses, M. & Zhou, Y. 2023. Residual variance and asset pricing in the art market. *Journal of Cultural Economics* 47(3), 513–545.
- O’Doherty, B. 1986. *Inside the White Cube: The Ideology of the Gallery Space*. Expanded edition. Berkeley, CA: University of California Press.
- Pénasse, J., and Renneboog, L., 2022. Speculative trading and bubbles: Evidence from the art market. *Management Science* 68(7), 4939-4963.
- Renneboog, L., and Spaenjers, C., 2013. Buying beauty: On prices and returns in the art market.

Management Science 59(1), 36–53.

Roberts, V. 2024. *Day Jobs*. Radius Books.

Robson, D., 2019. A law of “unintended consequences?”: United States federal taxation and the market for modern art in the United States. *Journal of Art Market Studies* 3(1), 1-16.

Spaenjers, C., Goetzmann, W. N., and Mamonova, E., 2015. The economics of aesthetics and record prices for art since 1701. *Explorations in Economic History* 57, 79-94.

Stourton, J. (2007). *Great Collectors of Our Time: Art Collecting Since 1945*. London: Scala Publishers.

Tax Foundation, 2021. Historical U.S. Federal Individual Income Tax Rates & Brackets, 1862-2021. <https://taxfoundation.org/historical-income-tax-rates-brackets/>

Velthuis, O., 2005. *Talking Prices: Symbolic Meanings of Prices on the Market for Contemporary Art*. Princeton, NJ: Princeton University Press.

Whitaker, A., and Kräussl, R., 2020. Fractional equity, blockchain, and the future of creative work. *Management Science* 66(10), 4359-4919.

Wijnberg, N. & Gemser, G. 2000. Adding value to innovation: Impressionism and the transformation of the selection system in visual arts. *Organization Science* 11(3), 323-329.

Woronkiewicz, J., & Noonan, D. S. 2019. Who goes freelance? The determinants of self-employment for artists. *Entrepreneurship Theory and Practice* 43(4), 651–672.

Yermack, D., 2017. Donor governance and financial management in prominent US art museums. *Journal of Cultural Economics* 41, 215-235.

Table 1. Summary Statistics

This table gives a snapshot of the catalogued works of the Tremaine Collection. Of the 770 works in the collection, 281 works were donated, including 49 works to Principia College, 98 works to the Wadsworth Atheneum, and 76 works to the National Gallery of Art. Approximately 40% of the collection (296 works) appear in the 1979 insurance appraisal, providing 1979 valuation as well as, in most cases, its purchase price. The auctions of 1988 and 1991 included 41 works.

Number of works in the collection	770
Works donated to Principia College	49
Works donated to the Wadsworth Atheneum	98
Works donated to the National Gallery of Art	76
Total Number of works donated	281
Works appraised in 1979	296
Works sold in 1988 and 1991 auctions	41

Table 2. Top 10 Artists of the Tremaine Collection

This table shows the top ten artists in the Tremaine Collection, defined by number of artworks. We present also the rankings of these artists in both ArtPrice and ArtFacts. This table demonstrates that the Tremaines were holding works by first-rate artists while also simultaneously, as shown elsewhere in median time lapse from creation to purchase, collecting works very early on. The combined data indicate the Tremaines' role as early stage investors and successful ones.

Ranking	Artist	Number of Works	ArtPrice Ranking 2021	ArtFacts Ranking 2021
1	Roy Lichtenstein (1923-1997)	33	16	40
2	Andy Warhol (1928-1987)	23	3	1
3	Pablo Picasso (1881-1973)	16	1	2
4	Robert Rauschenberg (1925-2008)	15	100	13
5	Jean Arp (1886-1986)	12	425	189
6	Jasper Johns (1930-)	12	133	90
7	Tom Wesselmann (1931-2004)	10	139	317
8	Paul Klee (1879-1940)	9	194	51
9	Frank Stella (1936-)	9	88	128
10	Robert Irwin (1928-2023)	8	246	1,764

Table 3. Tremaine Auctions: Return on Investment of Artworks Sold at Auction

This table shows the 33 works across the 1988 and 1991 auctions for which we have detailed purchase information. It shows the purchase date, the purchase price in USD, the auction date, the hammer price at auction in USD, and the annualized return on investment (ROI).

Artist	Artwork	Purchase Date	Purchase Price (in USD)	Auction Date	Auction Price (Hammer in USD)	Annualized ROI (in %)
Josef Albers	<i>Homage to the Square (Arrival Series)</i> (1963)	1964	5,000	November 9, 1988	150,000	14.97
Richard Artschwager	<i>Relief I</i> (1965)	1966	275	November 9, 1988	42,000	25.20
John Chamberlain	<i>Arch Brown</i> (1962)	1962	2,000	November 9, 1988	130,000	17.15
Christo	<i>Double Store Front</i> (196x)	1964	350	November 9, 1988	140,000	27.86
Walter De Maria	<i>Bronze Steel Shaft</i>	1966	2,000	November 9, 1988	55,000	15.96
Walter De Maria	<i>Elle</i>	1966	1,500	November 9, 1988	55,000	17.47
Willem De Kooning	<i>Yellow Woman</i> (1952)	1956	450	November 9, 1988	650,000	25.19
Jim Dine	<i>The Hammer Acts</i> (1962)	1962	900	November 9, 1988	60,000	17.26
Jim Dine	<i>The Small Black Screwdriver</i> (1962)	1962	180	November 9, 1988	45,000	23.28
Raoul Hague	<i>Swamp Pepperwood</i> (1956)	1956	1,200	November 9, 1988	55,000	12.54
Jasper Johns	<i>White Flag</i> (1955-58)	1958	1,350	November 9, 1988	6,400,000	32.13
Franz Kline	<i>Lehigh</i> (1956)	1958	4,000	November 9, 1988	2,100,000	22.90
Franz Kline	<i>Untitled</i> (1950)	1961	2,400	November 9, 1988	200,000	17.53
Roy Lichtenstein	<i>Ceramic Sculpture #7</i> (1966)	1966	495	November 9, 1988	100,000	26.77
Roy Lichtenstein	<i>I Can See the Whole Room and There's Nobody in It</i> (1961)	1961	450	November 9, 1988	1,900,000	35.65
Piero Manzoni	<i>Petit Subject</i> (1958)	1958	38	November 9, 1988	200,000	32.59
Barnett Newman	<i>The Moment</i> (1969)	1978	270,000	November 9, 1988	900,000	12.32

Claes Oldenberg	<i>Studies for Store Objects - Pie, 7-Up, Flag, Oranges, Fifteen Cents</i> (1961)	1961	75	November 9, 1988	80,000	29.00
Jackson Pollock	<i>Frieze</i> (1953-55)	1956	2,000	November 9, 1988	5,200,000	27.49
Robert Rauschenberg	<i>Combine Drawing on White Paper (Cup)</i> (1958)	1960	810	November 9, 1988	130,000	19.60
Robert Rauschenberg	<i>Construction (Untitled)</i> (1958)	1958	270	November 9, 1988	150,000	23.13
James Rosenquist	<i>Mask (Come Play with Me/Hey, Let's Go For a Ride)</i> (1961)	1961	350	November 9, 1988	400,000	29.33
Mark Rothko	<i>No. 8</i> (1952)	1953	1,350	November 9, 1988	2,400,000	23.55
Lucas Samaras	<i>One Work Box #51</i> (1966)	1966	1,800	November 9, 1988	55,000	16.51
Richard Tuttle	<i>Mist</i> (1965)	1965	350	November 9, 1988	40,000	22.47
Andy Warhol	<i>S & H Green Stamps</i>	1962	150	November 9, 1988	130,000	29.24
George Braque	<i>The Black Rose</i> (1927)	1936	3,250	November 5, 1991	1,000,000	10.90
Robert Delaunay	<i>Premier Disque</i> (1912)	1953	3,276	November 5, 1991	4,700,000	20.85
Juan Gris	<i>Still Life with Pears (Piores et Raisins sur une Table)</i> (1913)	1947	6,500	November 5, 1991	3,000,000	14.82
Paul Klee	<i>Scheinbar Bescheiden (Seemingly Modest)</i> (1937)	1953	700	November 5, 1991	150,000	15.01
Le Corbusier	<i>Still Life</i> (1925)	1948	2,500	November 5, 1991	290,000	11.58
Fernand Leger	<i>Le Petit Dejeuner</i> (1921)	1957	2,500	November 5, 1991	7,000,000	25.98
Ben Nicholson	<i>Still Life</i> (1949)	1949	350	November 5, 1991	150,000	15.38

Table 4. Comparison of Tremaine Artists and Year of Peak Value

This table shows the 32 Tremaine artists who also appear in Galenson's (2001, p. 17) table of U.S. artists by peak value. The table shows the creation date of the earliest artwork by that artist in the Tremaine collection and also the earliest year at which the Tremaines purchased that work. Those dates are compared with the year of peak value to show how far ahead or after this peak value year the Tremaines purchased the work.

Artist	Year of birth	Peak age	Galenson year of peak work	Number of the artist's works in Tremaine collection	Creation date of first work purchased by Tremaines	Earliest Tremaine purchase date
Davis	1892	68	1960	3	1934	1942
de Kooning	1904	43	1947	2	1952	1956
Dine	1935	42	1977	5	1961	1962
Frances	1923	31	1954	1	1959	1961
Johns	1930	27	1957	12	1955	1958
Kline	1910	51	1961	6	1950	1957
LeWitt	1928	32	1960	3	1967	1967
Lichtenstein	1923	35	1958	33	1961	1961
Mangold	1937	50	1987	2	1974	1974
Marin	1870	54	1924	1	1928	1948
Martin	1912	52	1964	4	1967	1970
Moskowitz	1935	48	1983	4	1960	1961
Motherwell	1915	71	1986	3	1953	1958
Newman	1905	40	1945	7	1947	1958
Pollock	1912	38	1950	2	1950	1956
Poons	1937	27	1964	3	1963	1963
Porter	1907	68	1975	2	1969	1969
Rauschenberg	1925	31	1956	15	1958	1958
Reinhardt	1913	43	1956	5	1947	1947
Rosenquist	1933	29	1962	2	1961	1961
Rothko	1903	54	1957	3	1950	1953
Stella (F.)	1936	24	1960	8	1959	1960
Tobey	1890	61	1951	1	1944	1947
Warhol	1928	33	1961	23	1962	1962
Wesselman	1931	28	1959	10	1960	1961

Table 5. Artists Included in Sample for Tremaine Index 1979-1988

ARTIST	AUCTION SALES
Josef Albers (1888-1976)	122
Richard Artschwager (1923-2013)	11
Christo (1935-2020)	8
Willem de Kooning (1904-1997)	128
Jim Dine (*1935)	44
Jasper Johns (*1930)	23
Franz Kline (1910-1962)	93
Roy Lichtenstein (1923-1997)	74
Piero Manzoni (1933-1963)	35
Barnett Newman (1905-1970)	9
Claes Oldenburg (1929-2022)	3
Jackson Pollock (1912-1956)	27
Robert Rauschenberg (1925-2008)	32
James Rosenquist (1933-2017)	46
Mark Rothko (1903-1970)	55
Lucas Samaras (1936-1988)	2
Richard Tuttle (*1941)	1
Andy Warhol (1928-1987)	245
SUM	958

Table 6. Tremaine Index, 1979 – 1988

Year	1978H2	1979H1	1979H2	1980H1	1980H2	1981H1	1981H2
Index	<i>100</i>	<i>115</i>	<i>101</i>	<i>95</i>	<i>101</i>	<i>98</i>	<i>105</i>
Year	1982H1	1982H2	1983H1	1983H2	1984H1	1984H2	1985H1
Index	<i>130</i>	<i>143</i>	<i>103</i>	<i>204</i>	<i>118</i>	<i>142</i>	<i>166</i>
Year	1985H2	1986H1	1986H2	1987H1	1987H2	1988H1	1988H2
Index	<i>160</i>	<i>156</i>	<i>272</i>	<i>355</i>	<i>431</i>	<i>574</i>	<i>727</i>

Table 7. Artists Included in Sample for Tremaine Index 1979 – 1991

ARTIST	AUCTION SALES
Georges Braque (1882-1964)	212
Marcel Delaunay (1876-1959)	2
Juan Gris (1887-1927)	77
Paul Klee (1879-1940)	110
Le Corbusier (1887-1965)	2
Fernand Leger (1881-1955)	327
Ben Nicholson (1894-1982)	199
SUM	929

Table 8. Tremaine Index, 1979 – 1991

Year	1978H2	1979H1	1979H2	1980H1	1980H2	1981H1	1981H2
Index	<i>100</i>	<i>98</i>	<i>147</i>	<i>128</i>	<i>149</i>	<i>158</i>	<i>128</i>
Year	1982H1	1982H2	1983H1	1983H2	1984H1	1984H2	1985H1
Index	<i>131</i>	<i>149</i>	<i>155</i>	<i>114</i>	<i>156</i>	<i>168</i>	<i>128</i>
Year	1985H2	1986H1	1986H2	1987H1	1987H2	1988H1	1988H2
Index	<i>191</i>	<i>239</i>	<i>381</i>	<i>353</i>	<i>449</i>	<i>465</i>	<i>492</i>
Year	1989H1	1989H2	1990H1	1990H2	1991H1	1991H2	
Index	<i>791</i>	<i>1189</i>	<i>1224</i>	<i>997</i>	<i>464</i>	<i>822</i>	

Figure 1. Elapsed Time from Artwork Creation to Tremaine Purchase

This figure shows the amount of time that passed from the year of creation of an artwork to the year in which the Tremaines purchased the work. Our data are annualized.

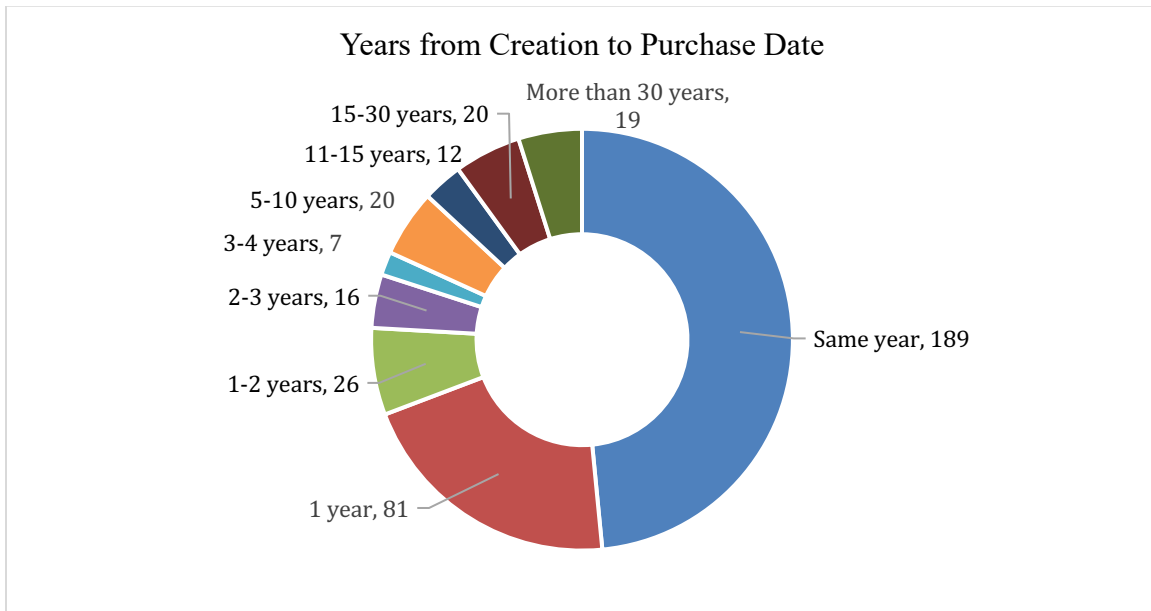


Figure 2. Years from Peak Year to Artwork Creation Date

This figure shows the number of years between the creation date of the earliest artwork in the Tremaine collection and the peak value date in Galenson's study (2001, p. 17) of U.S. artists. For example, Motherwell's peak value year is 1987, and the Tremaines collected work by Motherwell made as early as 1953.

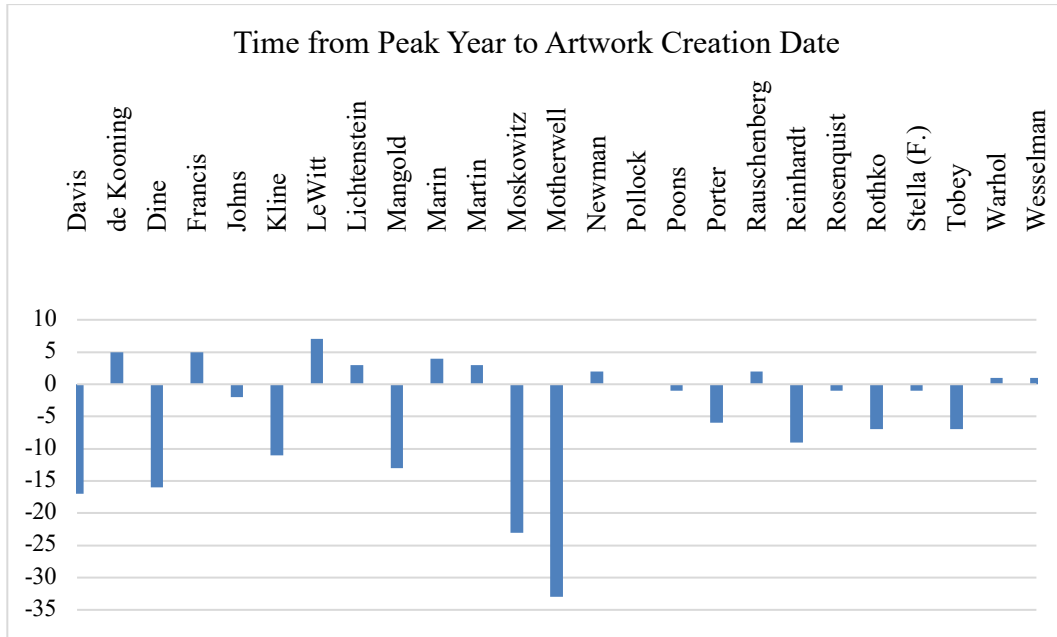


Figure 3. Time from Peak Year to Tremaine Artwork Purchase Date

This figure shows the number of years between the creation date of the earliest artwork in the Tremaine collection and the peak value date in Galenson's study (2001, p. 17) of U.S. artists. For example, Motherwell's peak value year is 1987, and the Tremaines collected work by Motherwell as early as 1958.

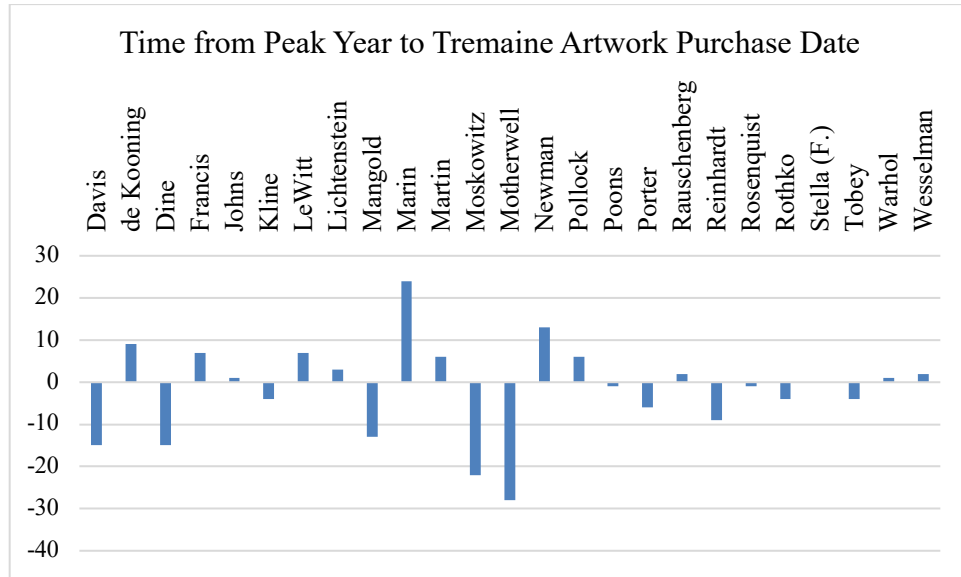


Figure 4. Tremaine Index, 1979-1988

Figure 4 shows the index of all artists included in the 1988 Tremaine auction, based on auction results for those artists from 1979 to 1989.

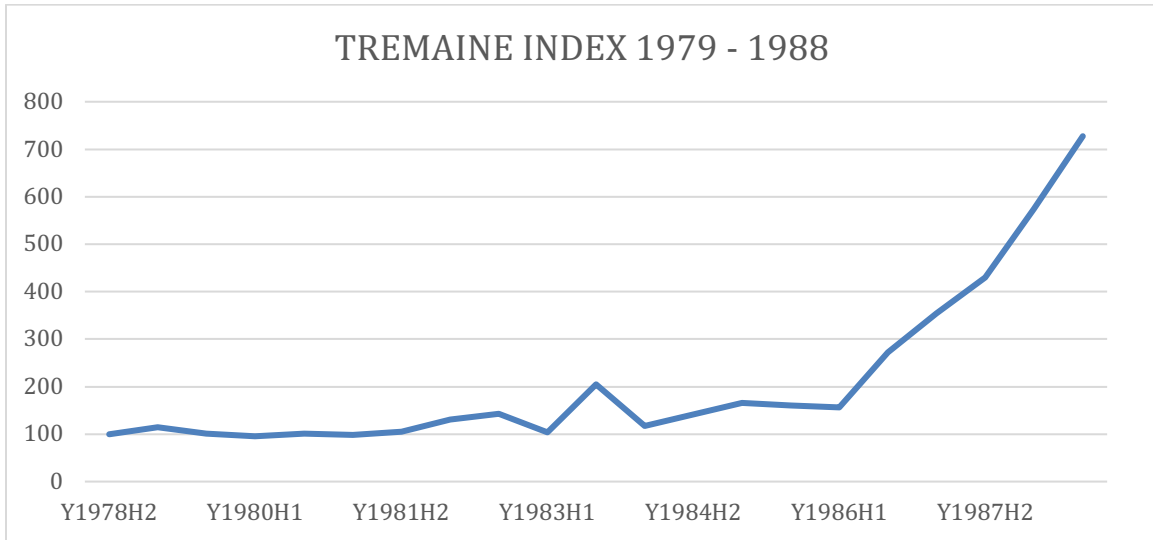
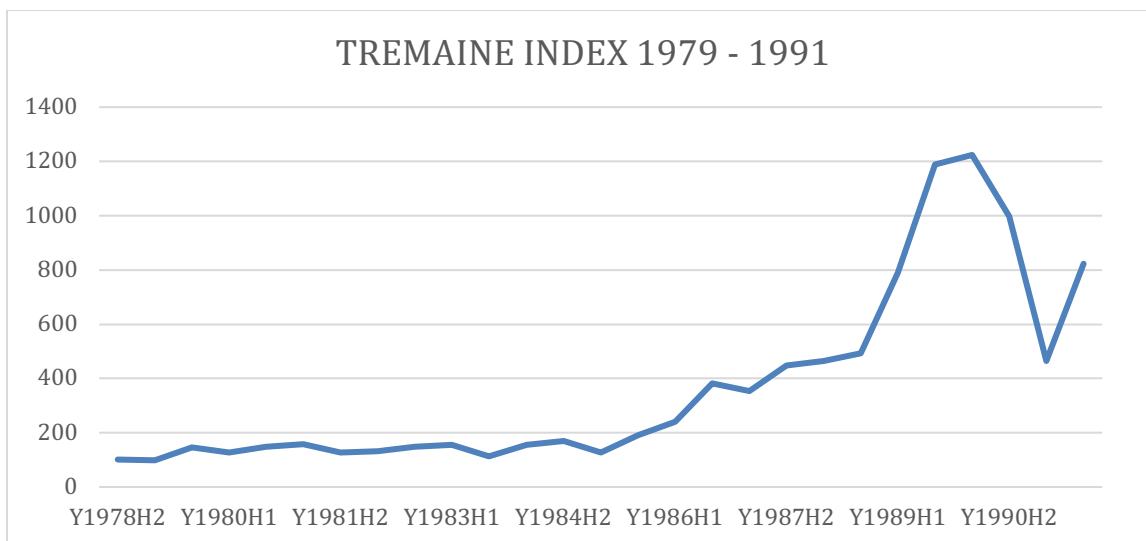


Figure 5. Tremaine Index, 1979-1991

Figure 5 shows the index of all artists included in the 1991 Tremaine auction, based on auction results for those artists from 1979 to 1991.



Appendix A. Mrs. Tremaine's Index Card for Jasper Johns *Three Flags* (1958)

Appendix A shows one of several of Mrs. Tremaine's methods of cataloging the collection. A set of index cards lists artworks along with provenance information such as source of acquisition and inclusion in exhibitions or catalogue materials. Notes of sale are added, here to the upper right corner. (The work was sold to the Whitney Museum in 1980.) Many of the index cards list purchase price on the reverse side. Comparable records exist in two binders as well.

JOHNS, JASPER 1930 *Added 1980 by Whitney
So. Carolina present*

TITLE & DATE THREE FLAGS 1958

MEDIUM & SIZE - ENCAUSTIC ON CANVAS
30 7/8 x 45 1/2 x 5"

PROVENANCE. Acquired from Leo Castelli -
Bibliography: *Zodiaco* #8 - Milan 1961 (color cover)

Illustrated in *Shincho-sha*, Tokyo - 1959 p. 108
" *Art Internationale* VIII/2 (March 20, '64) p. 44
" *Art News* - Feb. 1964 - p. 45 (color)
" *Arts* April 1964 p. 24 (rev) 45/1

Appendix B. Page from the Tremaine 1979 Insurance Appraisal

Appendix B shows the 1979 insurance appraisal of the full collection. This record is especially helpful as it shows the purchase price for the works as well as an estimate of the 1979 market price.

ARTIST CODE	ARTIST NAME	NAME AND DESCRIPTION OF FINE ARTS	LOC	INSURED VALUE	DATE	PURCHASED VALUE	COST	MARKET DATE	MARKET VALUE
27	PN0201 ROEL, GEORGES	UNTILED, 1973 OIL & SAND ON CANVAS 6" SQUARE	WA	5,400	73	5,400	281 T 79	5,400	
	PN0202 ROEL, GEORGES	BLUE COMPOSITION OIL ON CANVAS 10" X 6"	WA	6,500	72	2,500	141 T 72	6,500	
	PN0203 ROEL, GEORGES	WHITE COMPOSITION OIL ON CANVAS 10" X 13"	WA	3,500	72	1,500	141 T 72	3,500	
	PI1103 PICASSO, PABLO	GIRL WITH HAT, 1939-40 OIL ON CANVAS 24-1/2" X 20"	WA	200,000	47	5,500	5,500	79	200,000 *
30	PP0501 POONS, L.	JULIE, 1963 LIQUITEX & FABRIC DYE ON LINEN 80" X 90"	WA	25,000	63	945	945	79	25,000 *
	PR1103 RAUSCHENBERG, ROBERT	STILL LIFE, 1962 COMBINE ON CANVAS, DOUBLE PANEL 95" X 42" 48" X 42"	WA	100,000	62	5,000	5,000 T 79	100,000 *	
32	PR1104 RAUSCHENBERG, ROBERT	WINDWARD, 1963 OIL ON CANVAS 96" X 70" SIGNED BACK CENTER LEFT	WA	95,000	63	7,000	7,000	79	95,000 *
35	PRY102 RYMAN, ROBERT	BEACON, 1974 OIL ON LINEN 71" X 71"	WA	24,000	74	17,000	603 T 79	24,000	
37	PS1305 STELLA, FRANK	SINGERI VARIATION IV, 1968 FLUORESCENT POLYMER PAINT ON CANVAS 10" CIRCLE DISC	WA	50,000	70	40,000	1,376 T 79	50,000 *	
	PRY101 VAN DOESBURG, THEO	COMPOSITION, 1939 OIL ON CANVAS 36-1/2" X 27-1/2"	WA	150,000	49	1,300	1,300 T 79	150,000 *	
	PRY101 WARHOL, ANDY	CAMPBELL SOUP CAN W/ CAN OPENER OIL ON CANVAS 72" X 55-1/2"	WA	80,000	62	800	600 T 79	80,000 *	
42	PWA207 WARHOL, ANDY	MARILYN MONROE, 1962 COLORED 82" X 57" SIGNED UPPER LEFT ON BACK	WA	120,000	62	775	775	79	120,000 *
41	PWA208 WARHOL, ANDY	MARILYN MONROE, 1962 BLACK & WHITE SIGNED UPPER LEFT ON BACK	WA	150,000	62	775	775	79	150,000 *
44	PZA101 ZAKANYCH, ROBERT	ANGELMAN I, 1967	WA	3,600	68	900	900	79	3,600