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FINANCIAL IMPLICATIONS OF INVESTING IN THE GLOBAL ART MARKET: RISK, RETURN, AND DIVERSIFICATION

By

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A DISSERTATION

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Abstract

The global art market is a 60+ billion-dollar industry (Deloitte 2019); art indices measure market sentiment. Yet, art's influence on economic and financial markets is often overlooked in academic research. This study considers the financial implications of investing in the global art market including the variability between art indices providers. Using several financial market measures, and three independent providers of art indices—Artprice (AP), Art Market Research (AMR) and Sotheby's (SMM)—this study explores risk, return, and portfolio diversification following Markowitz's (1952) mean-variance optimization and efficient frontier models. The indices cover a range of years from 1858 through 2018. The art market data are externally developed by three distinct providers, mitigating selection bias and consists of comprehensive all-art indices and several sub-indices. The financial markets comprise U.S. security performance measures including the S&P 500, Russell 2000, T-Bills, and Corporate and Government Bonds. Consistent with portfolio theory, this research explores diversification prospects through construction of a financial portfolio adding art as a real asset. One-of-a-kind artworks are more complex to evaluate than traditional collectibles, since they are difficult to compare; therefore, this research explores asset allocation by adding art and a traditional collectible (classic cars) when salient to the milieu, to identify underlying trends in a financial portfolio. Diversification benefits of investing in subcategories of art are also examined by constructing art-asset portfolios. This research is unique in that it considers the viability of investing in art with three art indices simultaneously to track co-movements in the art investment field.

The findings of this research suggest that the risk and return on art differ depending on indices provider, the period of time examined, and the category of art, and that therefore generalization of art as an investment depends upon several factors. Contemporary Art dominated categories of paintings; however, the return on Sculpture was not consistent between periods nor art indices. While AMR's index outperformed equities 1998–2018 (11.0% vs. 8.1% S&P 500), SMM and AP underperformed at 5.3% and 2.8%, respectively. AMR slightly underperformed the market from 1976–2018 by 0.5%, SMM underperformed the S&P 500 by 4.0%. The rate of return for Old Masters varied depending upon time period and art indices providers and underperformed consistently. The S&P 500 had higher volatility than the art market. However, all comprehensive art market measures outperformed T-Bills with higher volatility. The findings support that investments in art-assets do provide diversification benefits in both multi-class and art-asset portfolios and may provide asset allocation strategy opportunities for investors in portfolio selection. Using AP, AMR, and SMM to proxy the art market—and S&P 500 to proxy the stock market—the empirical results suggest there is no significant correlation between the three art market measures. There was a significant correlation between AP and the S&P 500; however, correlation of AMR and SMM with S&P 500 was low during the period studied and may suggest that the underlying assets in the construction of the index (selection bias) may be the differentiating factor. The SMM decade-by-decade results support the low correlation between the art and stock markets historically, except during economic downturns.

Keywords: Art investment, alternative investing, global art market, mean-variance, portfolio-diversification, art, real asset, risk-return
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CHAPTER ONE: INTRODUCTION

1.1 Introduction and Background

The global art market is a 60+ billion-dollar industry (Deloitte, 2019); art indices measure market sentiment. Yet, art's influence on economic and financial markets is often overlooked in academic research. This study considers the financial implications of investing in the global art market including regulations and variability between art indices providers. This section introduces the topic of this research: the financial implications of the global art market with regard to risks, rates of returns, and diversification. A brief discussion highlights key financial regulations that impact art assets within the existing art market infrastructure.

In 2015, Kooning's abstract *Interchange* sold for $300 million to the owner of a Japanese gallery. In November 2017, Leonardo da Vinci's *Salvatore Mundo* sold at Christie's for $450.3 million to the Crown Prince Mahammad bin Salman of Saudi Arabia (Christies, n.d.). By 2018, art sales had grown into a $60 billion global market (McAndrew, 2018). The examples of da Vinci and Kooning may lead one to believe that the increase in art values over time represent a significant rate of return on such investments. Prior to the 2017 sale for $450.3 million, the da Vinci sold in 2013 for $127.5 million; a $322.8 million or 253.2% total return in four years, and a 37.1% compound annual growth rate (CAGR). Media reports have also given the impression that art investments provide significant returns (Frey & Eichenberger, 1995). Art prices during the 1980s and 2000s support this belief (Renneboog & Spaenjers, 2013). However, previous studies have also found low rates of return such as 0.6% (Baumol, 1986), 2.0% (Goetzmann, 1993), and 1.4% (Pesando & Shum, 1996). Morgan Stanley's

(2017) report on art as an asset called for an increase in accounting and financial advisory services to provide useful information to stakeholders of this hybrid industry, that Coslor and Spaenjers (2016) refer to as the "art investment field" (p. 50).

Investing in financial markets is commonplace around the world, with the S&P 500 index of the equity market measuring an average rate of return greater than eight percent annually. Portfolio theory posits that diversifying in a variety of financial assets that are not highly correlated will mitigate risk in an investor's overall investment portfolio (Markowitz, 1952). Adding real assets (such as collectibles) as an alternative investment has been considered a diversification strategy. However, assessing the rate of return on art is problematic, as there is no comparable unit to measure each individual asset against. Auction houses around the world are the primary mechanism to sell art, comprising approximately 50% of all art market sales, with private dealers and galleries making up the rest. Using analytic techniques, art indices are constructed to capture public auction sales. The indices include subcategories of the art market as well as the market as a whole, and measure market sentiment. The unique attributes of art contribute to the lack of transparency in assessing the financial implications (i.e., the worthiness of art as an investment), and is the problem this study will address.

Mei and Moses (2002) studied risk and return of art using three painting categories and a combined painting dataset and encouraged researchers to explore diversification benefits of artworks as an alternative investment in a diversified financial portfolio. Worthington and Higgs (2004) researched risk and returns, and asset allocation, including the prospects of diversifying in both a financial portfolio and a portfolio of artworks (art-asset portfolio). Their study explored artworks that were classified as

paintings using Art Market Research's indices from 1976–2001. The present paper seeks to address the gaps in the extant literature by adding sculptures to the AMR dataset as an artwork category under consideration in an art-asset portfolio, extending the period covered, and adding two additional independent art datasets (AP and SMM) with multiple subcategories. Additionally, art as an investment is empirically investigated by analyzing the three datasets and their correlations to each other, simultaneously.

1.2 Purpose of the Study

Portfolio theory stipulates that financial asset portfolios should be highly diversified, resulting in the highest return for the minimum risk warranted (Markowitz, 1952). Deloitte's Art and Finance report found that 88% of wealth managers think art should be included as part of their service offerings (Deloitte, 2017), while half of art collectors surveyed considered investment returns a significant part of their art purchase (Deloitte, 2016). Similar motivation among many types of investors explains why it is important to understand return prospects (Baumol, 1986; Goetzmann, 1993; Pesando & Shum, 1999; Mei & Moses, 2002) as well to as to explore art as an investment from other analytical dimensions (Felton, 1998; Worthington & Higgs, 2004). As such, the purpose of this dissertation is to gain a perspicuous understanding into the financial implications of art as a real asset. To further understand the financial implications embedded in the art markets, this study empirically investigates the risk and return of art in the global art market from several periods between 1858 and 2018 and the prospects of diversification in financial and art-asset portfolios. Additionally, this study provides decision-useful information to stakeholders (including accounting and financial advisors) for capital market, investment, and risk strategies.

1.3 Research Question

Empirical academic research is important to understanding the financial performance of the art market and its correlation with financial markets and other investments to determine its viability as an investment strategy. Several features of the art market make artworks a unique investment. First, due to the luxury-good status and inelastic supply of art, the value can change depending on trends and individuals' preferences (Botha, Snowball, & Scott, 2016). Second, certain subcategories of art can provide returns that may outperform traditional assets (Landes, 2000). Third, during unstable currency markets, art may hold its value and therefore is a way to hedge on inflation—safeguarding value (Deloitte, 2017). Fourth, although some research has found that art produces lower returns, with higher risk than equities, art may be a consideration for portfolio diversification due to its low correlation with traditional financial assets (Mei & Moses, 2002). The tax implications can be either an advantage or detriment to holding art-assets (Rhodes, 2003), but are difficult to assess (Frey & Eichenberger, 1995). This study will address the question: what are the financial implications of investing in art as a real asset? This question involves several sub-questions:

1. Do art assets differ, in both risk and return, when considering various indices, categories, and periods?
2. Do risk and return for art assets differ from other real and financial assets when considering various indices, categories, and periods?
3. Do investments in art allow for diversification benefits when added to a financial portfolio?
4. Do investments in art allow for diversification benefits in an art-asset portfolio?

5. Do art and financial market, risk and reward relationships differ when considering returns from three independent art indices providers simultaneously?

1.4 Portfolio Theory

One analytical dimension of exploring art as an investment is to examine the potential benefits of diversification by adding art-assets within a financial portfolio, and adding subcategories of the art market within an art-asset portfolio. Portfolio theory provides an analytical framework for allocating assets that are not highly correlated, such that the expected return is maximized for an investor's acceptable level of risk (Markowitz, 1952). Portfolio diversification is widely accepted as an effective strategy to reduce investment risk in financial markets. Researchers have proposed alternative investments such as wines and paintings as an effective portfolio diversification strategy (e.g., Aytaç, Hoang, & Mandou, 2016; Burton, 1999; Frey & Pommerehne, 1989; Higgs, 2012; Pesando, 1993).

1.5 Alternative Investments

Real assets are fixed in supply and, in theory, insulated from currency movements providing both organizations and individuals an alternative exposure (Ankrim & Hensel, 1993). High-net-worth individuals (HNWI) often target alternative investments. Knight Frank's[1] Wealth Report highlights spending patterns of the world's ultra-high net worth individuals (UHNWIs), those who have at least $30 million in investible assets, of which art is included in the annual measurement of passion investments. In 2017, the report found that for the first time in a decade, UHNWIs invested more in art than in investment-grade wine. The report also details the motivation behind these purchases,

[1] Knight Frank is a UK-based global investment firm, specializing in investment funds and real estate.

finding that the number one reason was joy of ownership, followed by capital appreciation, safe-haven capital, and portfolio diversification (Wealth Report, 2017).

Published literature has explored the returns of alternative investments of collectibles such as stamps (Dimson & Spaenjers, 2011), wine (Aytaç, et al., 2016; Dimson, Rousseau & Spaenjers, 2015), violins (Graddy & Margolis, 2011), and classic cars (Laurs & Renneboog, 2019). The literature has also explored returns in art markets such as paintings (Baumol, 1986; Goetzmann, 1993; Mei & Moses, 2001; Korteweg, Kräussl & Verwijmeren, 2016), prints (Pesando, 1993; Pesando & Shum, 1996), and quilts (Gasper & Wingender, 2010).

Aytaç et al. (2016), for example, researched wine diversification, stating that new studies were warranted as a result of online platforms increasing investor interest. Worthington and Higgs (2004), researched the prospects for portfolio diversification of paintings in an art-asset portfolio as well as within a financial portfolio. Academic research into alternative investment diversification especially in the art investment field is still relatively limited. This study seeks to extend the research in the ever-changing marketplace, especially under the availability of technological advances in measuring art investment prospects through art indices. These indices are constructed by art market researchers and organizations from public price data available through auction houses.

1.6 Art Sales

Auction houses serve as the intersecting points of supply and demand by providing a mechanism of capturing the information for determining prices. Although not as efficient as financial markets, they have played a key role in the art market since at least the 17th century (Ashenfelter & Graddy, 2003). The two largest, best-known art

auction houses in the world are Sotheby's and Christies; the world's oldest is Stockholm's Auktionsverk, established in 1674 (Auktionsverket, n.d.). These auction houses, along with many smaller ones, are tracked throughout the world by art market investment analyst companies, hereinafter referred to as *art indices providers.* These companies follow price movements of art, collectibles, and antiques—giving a global picture of the art market based on worldwide sales. Specifically, art indices providers track art auction sales and construct art indices to measure market sentiment. The indices are classified by type of art or collection, similar to a security. Comprehensive art indices representing the global market provide benchmarks for the art market in which historical prices can be compared over time, and with financial market indices, such as the S&P 500.

1.7 Art Indices

Analyzing art as an investment is challenging because of the lack of frequency of trades compared to financial assets, and difficulty in comparing one piece of art to another due to heterogeneity (Mei & Moses 2002; Worthington & Higgs, 2004). Indices provide an opportunity to observe trends and track volatility in the art market. Art index companies provide art market data to: (a) the premier auction houses; (b) accounting, investment, and finance companies; (c) media outlets such as the Wall Street Journal and CNN; and (d) institutional and private sectors. These indices do not include all art sales—only those in the auction market that account for approximately 50% of the global market; the remaining art sales are made up of gallery and dealer sales. When measuring art performance, art index methodology is important to consider. Varying methodologies may contribute to the mixed results on the real rate of return of art identified in the

existing literature such as 0.6% (Baumol, 1986), and 4.9% (Mei & Moses, 2002), as well as nominal rate of returns such as 52.9% (Mok et al., 1993) and 3.0% (Worthington & Higgs, 2004).

This study is unique in that it considers risk and nominal rate of return measures from three independent comprehensive art indices, simultaneously, to identify trends and art market sentiment (see Figure 1.1). This design strengthens the internal validity of this study through the use of consistent analytical techniques applied to the various indices and mitigates variations in methodologies in order to remove research bias.

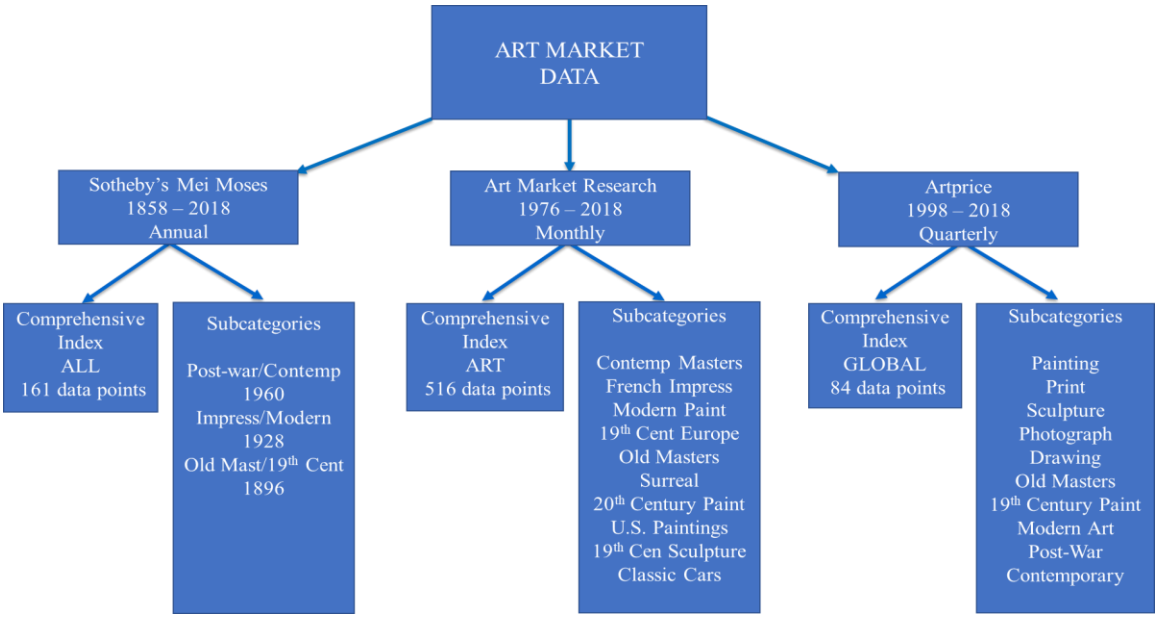

Figure 1.1. Art Market Indices.

1.7.1 Artprice

The first dataset of indices explored is provided by Artprice. "The Abode of Chaos" (Artprice, 2019) is a contemporary museum in Lyon, France, and the headquarters of Artprice, representing the epitome of spaces to converge two cultures: art

and econometrics.[2] As the world leader of big data in the art-market, housing tens of millions of data, their "goal is to make the art market accessible to all, with absolute transparency, to establishing confidence between market players" (Artprice, 2019). From their efforts, trends in the art market were explored, as a means to differentiate the risk and returns of investing in art within classes of art, and among financial classes. Their econometrics department developed a set of algorithmic indices consisting of ten subcategories and a global art index (Artprice, 2017). Thierry Ehrmann founded the French company in 1997; it provides over 30 million auction results from over 700,000 artists (Artprice, 2019). The company also publishes an Art Market Confidence Index® that tracks daily sentiment on the art market from approximately 4.5 million members.

1.7.2 Art Market Research

The second set of indices is furnished by Art Market Research (AMR). Based in London, AMR compiles data on collectibles such as wine, classic cars, and real estate. AMR launched the first monthly alternative investment report in 1978. AMR is the original index provider for tracking price movements of art and collectibles (AMR, 2020). According to Robin Duthy, the founder of AMR, "Without Knowledge, people are not merely less likely to make money, it is rather that without knowledge they are very likely to lose it" (AMR, 2020 p. 1). AMR primarily transacts with institutional audiences, and teamed up with Knight Frank, producing the Luxury Investment Index, published in the annual "Wealth Report" (Art Market Research, n.d.). Covering art sales since 1976, the Art Market Research dataset includes nine subcategories and one comprehensive art index.

[2] https://www.artprice.com/

1.7.3 Sotheby's Mei Moses

The third set of indices considered in this study are the Sotheby's Mei Moses Art indices, created by NYU professors Jianping Mei and Michael Moses and sold to Sotheby's in 2016. Originally compiled annually from 1875–2000 (Mei & Moses, 2002), these indices cover artworks that have been sold at auction more than once, using a repeated-sales regression model. The indices are recognized as a leading measure of the art market, tracking the successful art sales from Christies and Sotheby's art auctions. The Sotheby's Mei Moses dataset comprises three subcategory and one comprehensive art index (ALL) with over 60,000 repeated sales pairs. The SMM's all-art index currently covers sales dating back to 1858.

1.8 Contribution to the Literature

This research extends the literature on the risk, return, and diversification of art as an investment under several conditions. First, this research explores risk and return of art assets from three art indices providers and presents the results through a consistent research methodology. By doing so, this study adds to the literature on the impact of economic trends of art as an investment. Second, this study specifically expands upon the Worthington and Higgs (2004) study that utilized AMR data to explore the financial performance of major paintings categories. Specifically, this study extends the time period through 2018 and adds additional AMR data to explore: (a) the investment performance of sculptures, (b) a traditional collectible (classic cars), and (c) additional subcategories of art from AP and SMM.[3] Third, AMR had updated their methodology of creating their indices, and therefore, this study was conducted with the improved

[3] Classic Cars is added to a Mixed Portfolio with other traditional assets.

underlying index construction methodology. Fourth, optimized portfolio diversification models are constructed from three independent art research organizations in order to identify trends and variations due to differences in underlying index methodology. Fifth, similar to Mei and Moses' (2002) study on real rates of return, this study explores nominal returns with their extended dataset and compares it to two other datasets: the indices include Artprice (1998–2018), Art Market Research (1976–2018), and Sotheby's Mei Moses (1858–2018). This is the first known study to consider the risk and reward relationship variances between three leading independent art market measures, simultaneously. And finally, this study is the first known study to report the decade-by-decade annual risk, return, and correlation over the period 1859–2018 in order to reveal the variability of correlation between the art and equity markets.

1.9 Methodology

To empirically investigate the hypotheses, all price indices are compiled and transformed into nominal returns. Monthly and quarterly indices are annualized, and arithmetic means, standard deviations, co-efficient of variance, and correlations are calculated. The financial and art returns are compiled into portfolios where the risk and reward relationships, and diversification benefits are analyzed.

This research investigates asset allocation and the *efficient frontier* through the use of the classical mean-variance optimization (MVO) analysis proposed by Markowitz (1959) in a financial portfolio and adds an all-art index as an alternative investment. The portfolios are built upon those similar to investor risk profiles and optimized portfolios are constructed based on a variety of risk levels. To constitute the financial portfolios, annual returns from 1928 forward were obtained for the (a) S&P 500, (b) U.S. Treasury

Bonds, and (c) U.S. Treasury Bills from times series data available from the website of NYU professor Aswath Damodaran (Damodaran, 2019). The monthly Corporate Bond index was retrieved from Bloomberg and Russel 2000 (RUT2K) index from Yahoo Finance, and converted into continuously-compounded annual returns. The datasets from three independent art market indices providers mitigate selection bias. The art market indices are provided by AP, AMR, and SMM for various time periods as described in Table 2.1. AMR's Classic Car index is also included in order to add a traditional alternative collectible to a financial portfolio. The methodology also considers the efficient frontier and mean-variance optimization analysis proposed in an art-asset portfolio with several categories of art. The methodology used to examine the variances between the three indices providers includes correlation and trend analysis. Risk and return characteristics of the historic art market and the relationship with the U.S. equity market are explored with the Sotheby's Mei Moses art data from 1858 forward as a proxy for the art market, and the S&P 500 stock market data extended to 1871 (henceforward referred to as SPX) serves as a proxy for the stock market compiled from Shiller's (2019) historical S&P composite data from 1871–1927, and Damodaran's S&P 500 data from 1928 forward (Damodaran, 2019).[4]

1.10 Financial Regulations

Similar to financial assets, regulations are imposed on art assets regarding rules, measures, treatment, and presentation in the financial statements in order to mitigate inherent risk and create consistency for stakeholders including investors, creditors, and

[4] SPX stands for *stock market extended* and represents the S&P 500 index extended with Shiller's S&P composite data back to 1871. The composite index is not comprised of the top 500 companies during these early years.

institutions. There is a long history and debate about art assets in accounting regulation in the literature that contributes to the question of art's worthiness as an investment (e.g., Glazer & Jaenicke, 1991; O'Hare, 2008; Barton, 2005; Biondi & Lapsley, 2014; Ellwood & Greenwood, 2016). In 1990 the Financial Accounting Standards Board issued an *exposure draft* regarding whether the capitalization of works of art and similar assets should be reflected in a non-profit's financial statements (FASB, 1990). An exposure draft is the legal means of soliciting public comment on a proposed new accounting regulation (FASB, n.d.). A formal regulation was never issued. U.S. Generally Accepted Accounting Principles (GAAP) do not require art collections to be reported in the financial statements of non-profits and for profit entities, "because it is often impractical to determine the value" (Glazier & Jaenicke, 1991, p. 28). However, while "collections" can be excluded from reporting, art that is "not part of a collection," are required to be reported in the financial statements (FASB, n.d.). The FASB Accounting Standards Codification (ASC) explicitly states that art and similar assets "[t]hat are not part of a collection shall be recognized as assets in financial statements." (FASB, ASC 958-360-252). The accounting regulations are important in pricing and valuing art assets. If the accounting rules required entities to capitalize or report the fair market value of art collections on their financial statements, it could impact the art market overall. The global art market, specifically in Europe, has created strict regulations, EU fifth Money Laundering Directive (5AMLD), effective January 10, 2020, in order to curtail the art market's key threat to its reputation (money laundering) as it relates to art assets (Deloitte, 2019). Additionally, there is considerable need for additional regulation due to the increase in investors adding art as an asset class to their portfolios.

The new regulations in response to the new risks support the evolution of the art investment field. Law firms are responding to these investment needs and are organizing to better prepare themselves for specific art legal services in response to the "increasingly professionalized art world" (Kinsella, 2020, p. 1) to include support services for due diligence research, copyright clearance, financial transactions, and anti-money laundering controls to support the new regulations in the art market. Attorney John Calhill was quoted by Kinsella (2020), stating "sophisticated financial arrangements have entered the art market; the numbers and risk are bigger across the board, and everyone in the art world—collectors, advisors, dealers, and even artists—need to understand the risks and get the right tools" (Kinsella, 2020). Where financial risks exist, there will also be a need to measure the global art transactions and risks; therefore, there will be a greater need for accountants to respond accordingly. Assurance is one of the most important services provided by CPA firms, involving analysis of historical financial information and determining valuation and accuracy and providing risk assessments. Assurance services can provide numerous key insights to decision makers. Booth (2018) argues that speculation is not limited to finance. As art evolves into the banking and investment fields, it is important to have systems to manage and control the related financial risks—creating a need for increased regulation. Shifts in how society views art have "placed art and finance on closer parallels such that they have begun to mirror one another" (Booth, 2018, p. 131). Public accounting firms such as Deloitte have taken the lead in offering financial services within the art market—the firm holds an annual Deloitte Art Finance Conference to address and communicate the tools available to manage these global financial transactions.

Accountants are also skilled at finding fraud and assessing financial risks; with the new anti-money laundering laws that focus on historical provenance, there will be greater demand for applying these skills to the art investment field.[5] Accountants have transferrable skills to the art investment field. These skills could provide support for the growing financial regulations applicable to art investments through insights into mitigating risks and in providing confidence in the global art marketplace—similar to how an audit in the financial marketplace instills confidence in securities investors. Therefore, understanding the implications of investing in art is applicable and important for legal, accounting, and financial advisors.

Although art-funds have been available to HNWI, there has been a demand for selling art as a security. While several organizations have attempted, it was only recently in 2017 when the first U.S. company was granted by the U.S. Securities and Exchange Commission (SEC) the ability to buy shares in art through Masterworks, an art investment company, founded by Scott Lynn. Masterworks (2020) provides access to invest in blue-chip art. Investors purchase shares representing ownership in a specific artwork similar to a traditional company on the stock exchange. An offering circular with the SEC is filed to offer it publicly, investors buy shares in the piece, the piece is held in a private gallery accessible to members, and when the piece is sold, the net proceeds are distributed to the owners (Masterworks, 2020).

1.11 Summary of the Introduction

This study will consider the financial implications to organizations and individuals in holding art as a real asset. Specifically, this chapter introduced the unique

[5] Provenance is the confirmed documentation of authenticity through ownership history.

financial and accounting regulations in Section 1.10 that impact art assets. This research aims to: (a) investigate the risk and return of holding art as an investment; (b) explore the differences in risk and return from other real and financial assets; (c) examine whether investments in art allow for diversification benefits; (d) evaluate if risk or return increases when art is added to a financial or art-asset portfolio, following the mean-variance portfolio framework and efficient frontier (Markowitz, 1952, 1959); and (e) consider the relationships between three independent art indices. This study provides empirical evidence of the financial implications of art as an alternative investment. The archival data consists of global art and collectible indices prepared and obtained by econometricians from three countries: France, U.K., and the U.S. The period of data ranges from annual data from 1858 through 2018 (SMM), monthly data from 1976 through 2018 (AMR), and quarterly data from 1998 through 2018 (AP). The art indices cover several classifications, periods, and genres of art. All financial data are sourced from the U.S. markets and have been gathered from open source data or Bloomberg terminals. Methods include correlation analysis measures to explore whether art investments have diversification benefits; construction of minimum-variance, naïve, maximum-return at equally-weighted-risk, and optimal portfolios, creating schematics of efficient frontiers through optimization modeling techniques and performing trend analysis to compare indices of art returns.

This research is important because the global art industry exceeds $60 billion (Deloitte, 2019) annually and has nearly doubled in the past 10 years. Even more significant, technology and big data has increased the transparency of the art market, impacting the way business in the art market is transacted. This study will extend the

research on portfolio theory and adds to the growing economic and finance literature of art as an investment as an emerging global industry. Additionally, it will add to the accounting literature by demonstrating the impact of regulations on the acquisition, retention, and holding art as a real asset. This will be the first known study to consider the variance between investment returns of art assets based on the index provider.

1.12 Organization of the Dissertation

The remaining paper is organized as follows. The second chapter presents the literature review of risk and return as well as portfolio theory on art and introduces the main hypotheses. The third chapter describes the data and methodologies of compiling the indices used in the study. The fourth and fifth chapters provides the results and descriptive statistics of risk and return utilizing three independent providers' art indices, and comparing risk and return, and a related discussion. Additionally, this study follows Markowitz's (1952; 1959) portfolio theory and portfolio combinations are constructed with various risk-return characteristics in Chapters Six and Seven and provides the reward and diversification results of investing in art. Chapter Eight presents the results of the risk, return and reward of diversification relationships when considering the three independent art indices simultaneously with the S&P 500. Chapter Nine concludes with a discussion of the implications of the results of the research—its contributions to the literature and to practice—along with the limitations of the study and recommendations for future research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section defines art as an asset under several financial dimensions followed by a discussion of the type of art is covered in this study. A review of the literature on portfolio theory's risk-return trade-off, asset allocation strategies for investment performance, and diversification benefits is presented. This paper then reviews the literature on alternative investments, investing in art, and measuring risk and return of art amid financial markets. This chapter concludes with the development of the hypotheses regarding the financial implications of investing in the global art market

2.2 Definitions

2.2.1 Art Defined

There are multiple dimensions to defining art as an asset. This study considers art assets to be cultural assets, also known as heritage assets, that are defined as "items of artistic, archeological, ethnological or historical interest" (Rhodes, 2003, p. 181). This is consistent with the definitions used by museums such as the British Art Museum (British Art Museum, n.d.). This study is limited to fine art such as paintings, drawings, prints, and sculptures. When an individual or entity owns a group of these cultural assets, it is called a collection. Fine art is a subcategory of collectibles, similar to other assets such as wine, violins, or cars. Financial and legal definitions of assets and art assets may differ depending upon the discipline and the user's perspective as itemized below. Specific to this research, the term "art" is used to define fine art as a real asset, that may be considered in the literature as either an alternative investment or an asset class and is

often taxed by U.S. tax agencies as a collectible. The following is a list of definitions to inform the reader.

2.2.2 Types of Assets

- Asset: For accounting purposes, the Financial Accounting Standards Board (FASB) in the United States and the International Accounting Standards Board (IASB) define an asset as having future economic benefits. According to the FASB's Statement of Financial Accounting Concepts (SFAC) no. 6, an asset involves:

  > "Probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events. An asset has three essential characteristics: (a) it embodies a probable future benefit that involves a capacity, singly or in combination with other assets, to contribute directly or indirectly to future net cash inflows; (b) a particular entity can obtain the benefit and control others' access to it; and (c) the transaction or other event giving rise to the entity's right to or control of the benefit has already occurred" (Financial Accounting Standards Board, 1985, SFAC 6, p. 24).

  How art is used in a business environment further defines its status as an asset to an entity. If art is held for investment purposes, it is categorized as an "investment." Art sold through normal business operations is classified as "inventory." Art held for decorative purposes would be considered a "fixed asset." In the case of governmental or non-profit entities such as a museum, it also may be considered a "heritage" or "cultural asset." Works of arts held for education, research, or public exhibition rather than financial gains are defined as "collections" (FASB, ASC 958-10-65-3).

- Financial Asset: Non-physical asset that derives its value from an underlying agreement or contractual claim (FASB, n.d.). Examples include traditional investments such as equities and bonds.

- Real Asset: The broad group of tangible assets (Campello & Giambona, 2013) that have intrinsic value and can be traded for other goods or services are called “real assets” (Ankrim & Hensel, 1993). They are fixed in supply, prices tend to increase as inflation rates rise, and value is insulated from movements in the purchasing power of the currency (Ankrim & Hensel, 1993).
- Asset Class: Assets are often categorized by their “asset class.” Greer (1997) defined an asset class as a set of assets that bear some fundamental characteristics, making them distinct from other assets. Examples of traditional asset classes include equities and bonds. Assets that are not categorized with their individual class are called “alternative investments” (Campbell, 2008). Art is often considered an alternative investment.
- Capital Asset: Any category of property that includes both financial assets and real assets, excluding assets that are intended for sale in the regular course of business such as inventory (26 IRC §1221).
- Collectible: For U.S. federal tax purposes, Internal Revenue Service (IRS) Publication 550 (2018, p. 67) defines collectibles as capital assets that are “a work of art, rug, antique, metal (such as gold, silver, and platinum bullion), gem, stamp, coin or alcoholic beverage.”

2.2.3 Types of Portfolios

Investors construct investment portfolios to hold equity securities such as stocks, and debt securities such as bonds as a diversification strategy to align financial goals with risk tolerance. Asset allocation is the proportion of an asset class held in a portfolio. This

study explores art as it relates to portfolio theory; therefore, two types of portfolios are defined below.

- Financial Portfolio: This is a group of assets held by an individual or organizational investor and consists of a variety of financial assets such as securities. Investors may choose to diversify their holdings in financial assets and add real assets, such as real-estate, gold, stamps, classic cars, etc. The investor can then allocate the assets according to different proportions for each asset class.
- Art Asset Portfolio: This is a group of assets held by an individual or institutional investor and consists of a variety of art classifications. Investing in an art portfolio could include masterpieces, contemporary art, impressionist paintings, or 19th century sculpture. Since each classification of art may have different returns, an investor would allocate the assets in different proportions.
- Art Investment Fund: This is an organized art-asset portfolio and managed by a professional art investment advisory firm similar to a mutual fund. Unlike securities, they are generally not open to the public, and require a significant investment. Since they are private, data from these funds are not accessible for research.

2.3 Literature Review

2.3.1 Portfolio Theory

Markowitz's (1952) seminal research developed a quantitative model of allocating assets known as Portfolio Theory. Portfolio diversification is a core investment strategy to reduce unsystematic risk caused by movements specific to the market. The

theory assumes that investors are risk-adverse. By creating portfolios of individual investments that are highly uncorrelated, an investor can reduce the overall risk and attain a higher combined risk-adjusted return (Markowitz, 1952). Diversification benefits are often seen when correlations between securities are low. The objective is to avoid investing in securities with high covariances. Markowitz, (1952) argued that an informed investor could choose the preferred rate for the two elements, expected return and risk, and then construct a portfolio to produce the desired outcome. Markowitz's (1952) study found there is a rate at which the investor can increase the expected return by taking on variance or reduce variance by giving up expected return. Markowitz (1959) extended the theory and provided a framework for optimizing the maximum expected return for a given level of risk based on the set of efficient mean-variance combinations, known as the "efficient frontier." Portfolio theory continues to be extensively researched in the literature to study asset allocation strategies (e.g., Geczy, 2014; Levy, 2017; Pavlou, Doumpos, & Zopounidis, 2019; Pfiffelmann, Roger, & Bourachnikova, 2016; Theron & van Vuuren, 2018).

2.3.2 Alternative Investments

This section reviews the literature on investing in alternative assets as a diversification strategy. A growing body of literature has appeared in recent years examining risk, return, and the prospects for portfolio diversification in both the global and financial markets. Collectible "emotional assets" (also known as "passion assets") are an important factor in the portfolios of investors around the world in which high-net-worth individuals (HNWI) carry 10% of their wealth in artworks, antiques, jewelry and fine wine on average (Dimson & Spaenjers, 2014). HNWI have investible assets greater

than one million dollars, not including their houses (Capgemini, 2018). The emotional connection owners form with their artwork often results in long-term investment cycles (averaging 30–40 years) that are not subject to constant market exchange (Potocki & Rogozinska, 2015). Potocki and Rogozinska (2015) argue that art is also purchased as an indication of social status and accumulation of wealth, and therefore corresponds to the intergenerational wealth transfer model. Accounting firms and financial institutions provide data analysis, financial services, and investment advice on emotional assets to assess the viability of these real assets as alternative investments (Coslor & Spaenjers, 2013). The international accounting firm Deloitte Touche Tohmatsu Limited (Deloitte) incorporates art collections and collectibles into client investment strategies through their Art, Tax, and Finance Group (Deloitte, 2017).

Several studies have examined collectibles as an alternative to traditional investments. Dimson and Spaenjers (2014) examined three categories of collectibles—art, stamps, and violins. Other studies have included rare coins (Dickie, Delorme, & Humphreys, 1994), Stradivarius violins (Ross & Zondervan, 1989), oil painting and works on paper (Renneboog & Spaenjers, 2013), wine (Aytaç, Hoang, & Mandou, 2016; Dimson, Rousseau, & Spaenjers, 2015), and quilts (Gasper & Wingender, 2002). Frey and Eichenberger (1995) provided an overview of returns on investments in art and collectibles from 15 prior studies and found a range with real rates of return in the lows of -2.3% (for antique firearms) and highs of 15.8% (for watercolors). In their survey study of emotional and passionate assets, it is evident that the majority of the previous research focused on paintings or subcategories of paintings. Burton & Jacobson (1999) conducted a meta-analysis of over 65 research studies on collectible returns. Their study

reported a broad range of nominal returns from -2.6% (for Barbizon paintings) to 176% (for Beanie Babies).

2.3.3 Art as an Investment

A unique feature of art is that it can be considered: (a) a consumer durable, yielding nonmonetary viewing benefits; (b) a financial asset, yielding appreciation returns over time; and (c) a luxury good, with high income elasticity of demand (McAndrew, 2010). Research into art as a financial asset is relatively scarce; consequently, the studies often offer mixed results on art as an alternative investment. Mandel (2009) argued that art is a conspicuous consumption good and measured returns by calibrating a consumption-based capital asset pricing model.

Anderson (1974) and Stein (1977) were some of the first studies to explore the returns for paintings; these scholars developed an alternative investment index. Anderson (1974) studied the returns on painting under the hedonic and repeat-sales method. Stein (1977) studied auction prices of paintings using repeat-sales regression in both Britain and the United States from 1946–1967. He argued that art is both a consumer good and a financial asset, concluding that returns were neither greater than those of financial assets nor did they maintain their value during an economic recession (Anderson, 1974). The research did find non-systematic risk in the returns, suggesting that there were diversification benefits for collectors.

Of the prior studies on art as an investment; the majority considered only paintings as art (e.g., Anderson, 1974; Stein, 1977; Baumol, 1986; Goetzmann, 1993; Mei & Moses, 2002; Worthington & Higgs, 2004; Korteweg, Kräussl, & Verwijmeren, 2016). This study is unique in that it expands the research of art to include sculpture and

other subcategories of art and explores their investment characteristics in a portfolio of artworks. To put this in perspective, this study reviews the extant literature on the investment performance of art as a real asset, starting with the foundational study by Baumol (1986).

2.3.4 Investment Performance of Art

Baumol (1986) used an extensive dataset compiled by Gerald Reitlinger (1961) to track repeated painting sales consisting of 640 transactions from 1652 to 1961. Rates of returns on sales were calculated from the standard continuous formula and found the annual compounded rate of return revealed a meager 0.55 percent. Further, he found that ownership of paintings was extremely risky, and a substantial risk premium should be considered (Baumol, 1986). The study also reported that large gains and losses were experienced when holding periods were less than 50 years; returns ranged from -19% to 27% per year. He concluded “the lesson imparted by the test of time is the fickleness of taste whose meandering defy prediction” (Baumol, 1986, p. 14). It was evident that the rate of return results fluctuated depending upon the period, wealth, and length of time studied.

Goetzmann (1993) followed the work of Baumol using the same data from Reitlinger (1961, 1963, 1971), extended art price data from Enrique Mayer (1971–1987), and also used the Repeat Sales Regression method (RSR), the formula consistently used for real-estate returns. The study reported decade-by-decade annualized returns over the period 1720–1990 (Goetzmann, 1993). The researcher suggested that stratifying the data into 10-year periods reveals the variability in the returns. Goetzmann (1993) found there were three apparent bull markets and three bear markets in art. The bear markets

corresponded to the economic conditions in both the United States and Britain during those times. The study also revealed that the average return on art was 17.5% between 1900 and 1986. The study concluded that there was strong evidence of a causal relationship with art following stock-market trends, indicating that demand for paintings has a linear relationship to investor's wealth (Goetzmann, 1993).

In an attempt to test the economic efficiency of the art market, Pesando (1993) created a repeat sales semiannual index for modern prints from 1977–1992, finding that returns for art performed unfavorably compared to the financial markets at only 1.51%, with risk comparable to equities and bonds. The study argued that art prints would be more similar to the financial markets than paintings due to the increase in the number of repeated sales of published prints in comparison to original artworks. The research concluded that the market was inefficient when comparing rates of return to traditional investments.

In 1999, The *Journal of Cultural Economics* devoted an entire *special issue* to the art market due to renewed interest in the problem of measuring the rate of return on art (Pesando & Shum, 1999). There had been some evidence of high returns on art in July 1996 when the British Rail Pension Fund (BRPF) sold the remainder of its artworks and reported average annual returns of 13.8% (Burton & Jacobsen, 1999). Between 1971 and 1981, the BRPF, had invested over $70 million of its pension funds in artworks (Trucco, 1989). The Pension Fund's art-asset portfolio had outperformed its real estate portfolio during the period and mirrored the rate of U.K. bond returns.

Pesando and Shum (1999) argued that art *is* an investment; and in order to assess the difference in performance with financial assets, the focus should be on risk as well as

return. Pesando & Shum (1999) found that the return for Picasso prints from 1977–1996 was 1.48% with standard deviation (SD) of 21.86, while stock returns was 9.13% with SD of 16.84. A low correlation of 0.185 was found between stocks and prints signifying that although there is a low return, there may be diversification benefits. Through indices of prints, the data on returns can be readily aligned to the financial markets—such as in Pesando (1993) with 27,961 repeat sales, and Pesando and Shum (1999) with 8,257 repeat sales. Prints are published in multiples and come up frequently at auction; however, an additional factor to consider is that prints do not constitute a piece of original, unique art. Therefore, though there is an increase in repeat transactions, the underlying characteristics decrease the demand.

Mei and Moses (2002) studied the use of art as an investment and the financial underperformance of masterpieces. They constructed a new dataset for the American market of all art auction price records found at the New York Public library and the Metropolitan Museum of Art's Watson Library. They defined art for their indices to include all paintings categorized as: (a) American; (b) Nineteenth-Century and Old-Masters; or (c) Impressionist and Modern; that sold at Sotheby's and Christies with original purchase dating to the 17th century. The study identified discrepancies in the literature by comparing their results with past studies from Baumol (1986), Goetzmann (1993), and Pesando (1993). Their research included 4,896 price pairs; using a repeat-sales regression model from 1875 through 2000, they created the Mei and Moses Index (Mei & Moses, 2002) referred to in this study as SMM. The benefit of the repeat sales regression model is that it is based upon price relative to the same painting, and therefore, controls for the quality of painting. The purpose was to determine if risk-return

characteristics of paintings over or under-performed traditional financial assets. Specifically, they sought to find empirical evidence of whether expensive masterpieces should be purchased over other pieces when economically feasible, and found their results were inconclusive due to mixed results. Stratifying the data into three time frames, they found annual compounded art real returns equaled 8.2% compared to 8.89% of the S&P 500 from 1950–1999, while from 1990–1999 and 1875–1999, art trailed the S&P 500 by 0.7% and 1.7% respectively. "Contrary to earlier studies, they found art has been a more glamorous investment than some fixed-income securities, with less volatility and lower correlation than previous studies" (Mei & Moses, 2002, p. 1666). The art index outperformed T-Bills and Government and Corporate Bonds for each of these periods.

The *Summary Statistics of Returns*, Table 2.1, presents Mei and Moses' (2002) summary findings, along with their results for various assets for the same sample period in comparison to Goetzmann (1993) and Pesando (1993). The Mei and Moses (2002) study reported real returns from these studies. The results of the comparison with these two studies and the Mei and Moses (2002) art returns are reported in of Table 2.1 *Summary Statistic of Returns*; it is important to note that Pesando's study included prints, not paintings. The Mei and Moses index was a momentous contribution to the art world, such that the New York auction house Sotheby's has maintained the index since its acquisition in 2016. Their website states "Sotheby's Mei Moses Indices are widely recognized to be the preeminent measure of the state of the art market. Leveraging over 60,000 repeat auction sales for the same object over time, Sotheby's is able to produce objective art market analysis to complement the world-class expertise of its specialist" (Sotheby's, 2019).

An increasing number of studies have questioned the viability of alternative investments including art and their investment performance compared to securities (Dimson & Spaenjers, 2015; Goetzmann, 1993; Mei & Moses, 2002; Pesando, 1993; Pesando & Shum, 1999). Based on the outcomes from prior literature, investment returns vary based on the index construction methodologies by the researcher, the method of measuring returns, and the type of art. Worthington and Higgs (2004) used monthly data from AMR to study art returns, calculating annual log returns. The study presented annual nominal arithmetic and geometric returns of financial and art returns in their descriptive statistics. Table 2.1 presents their summary arithmetic returns. These results contribute to understanding how the returns on art compare to traditional investments as shown in the table. The review of literature revealed the disparity in the extant literature when considering methodologies and the importance of consistency when exploring a variety of data to analyze art and financial returns. For example, Mei and Moses (2002) presented real returns with their data [now Sotheby's Mei Moses], while Worthington and Higgs (2004) reported nominal returns with data from AMR.

In order to compare the returns from the datasets, this research seeks to explore the risk and returns of three independent art indices datasets using arithmetic, nominal annual returns removing the methodology bias that may exist in specific methods utilized among various prior studies. Additionally, this study investigates three independent art datasets to explore if the results from any one index is an outlier compared to the market as a whole. This study aims to answer the research questions: How do risk and return for art assets differ and how do risk and return for art assets differ from other real and financial assets, when considering various indices, categories, and periods?

Table 2.1

Summary Statistics of Returns: Various Studies and Methodologies

Earlier Study on Index Constructed by AMR

Worthington & Higgs (2004)**		ART	Small* Stocks	Large* Stocks	Gov Bonds	Corp Bonds	T-Bills
1976–2001	Mean	0.030	0.179	0.140	0.098	0.096	0.065
	SD	0.101	0.153	0.132	0.117	0.105	0.026

Earlier Study on Index Created by Mei & Moses (2002)

Mei & Moses (2002)***		MMA***	S&P 500	Gov Bonds	Corp Bonds	T-Bills
1950–1999	Mean	0.082	0.089	0.019	0.022	0.013
	SD	0.213	0.161	0.095	0.092	0.023
1900–1999	Mean	0.052	0.067	0.014	0.020	0.011
	SD	0.355	0.198	0.086	0.084	0.049
1875–1999	Mean	0.049	0.066	0.020	0.029	0.018
	SD	0.428	0.087	0.080	0.080	0.048

Mei & Moses's (2002) Comparison of MMA*** Index with Earlier Studies

		Goetzmann****	MMA***	S&P 500	Gov bonds	Corp bonds	T-Bills
1900–1986	Mean	0.133	0.052	0.057	0.008	0.015	0.009
	SD	0.519	0.372	0.207	0.082	0.081	0.052
		Pesando*****	MMA***	S&P 500	Gov bonds	Corp bonds	T-Bills
1977–1992	Mean	0.015	0.078	0.088	0.051	0.056	0.024
	SD	—	0.211	0.115	0.133	0.129	0.028

Note: Table 2.1 adapted from Mei & Moses (2002)
* Large and Small Stocks used by Worthington & Higgs (2004) represent indices constructed by Ibbotson Assoc. from US markets.
** Worthington & Higgs (2004): AMR Index (ART) is for paintings; represent nominal, arithmetic, monthly annualized, log returns.
*** Mei & Moses (2002) created their own index (MMA) from repeat sales for several classes of art & represent real annual returns.
**** Goetzmann (1993) used price data from Reitlinger (1961) & Mayer (1987) on paintings; & represent real annual returns.
***** Pesando (1993) used repeat sales from modern prints & represent real annual returns.

2.3.5 Diversification Prospects

Although Mei and Moses (2002) indicate "that a diversified portfolio of artworks may play a more important role in portfolio diversification" (p. 1663), and art has implications for long-term investors, they did not empirically test it. Markowitz (1952) created the quantitative portfolio allocation model that has become a standard in Modern Portfolio Theory (MPT). MPT asserts that a portfolio is diversified when the expected

return is maximized for a given level of risk. If art assets are not highly correlated with other financial assets, the addition of that asset into the portfolio may create a diversification benefit. Art has been suggested as a good way to diversify investment portfolios when financial times are uncertain (Botha et al., 2016; Campbell, 2008).

While the majority of literature focuses on the returns of art, Worthington and Higgs (2004) researched risk, return, and diversification in major painting markets. They explored returns using AMR's datasets for eight subcategories of paintings, and one comprehensive all-art index (ART). Table 2.1 reports the results from Worthington and Higgs (2004) and Mei and Moses (2002) studies. Through construction of Markowitz mean-variance efficient portfolios, they examined diversification benefits in an art-asset portfolio, as well as art as a component in a financial portfolio.

Worthington and Higgs (2004) agreed with Flôres, Ginsburgh, & Jeanfils (1999) that if art is to be regarded as a valid addition to financial investments, then it would be reasonable to examine diversification prospects from this dimension. The results suggest that pricing differs considerably from financial markets, and that the art market contains unique challenges such as illiquidity, slow turn-over, relatively-indivisible assets, and high transaction costs at high risk. Additionally, the art market requires extensive knowledge and capital, and art assets are difficult to value (Worthington & Higgs, 2004). At the time of the Worthington and Higgs (2004) study, the global-art market was moving closer to the characteristics of the financial market, such as increased turnover, transparency in the media, and art advisory services. Today, there is more globalization within the art world as there are more opportunities for art purchases online, and the art

market has made strong contributions in implementing blockchain.[6] As technologies evolve, the global art market is capitalizing on them, increasing demand, transparency, and marketability. Wealthy investors consider art to be a neutral asset; if the market is utilizing the asset as an investment for appreciation, growth, wealth transfer, and securing loans, then it is reasonable to apply financial theory to art.

Worthington and Higgs (2004) found that painting returns were lower than traditional financial investments, while risk was higher. Additionally, diversification benefits were possible in some art-asset portfolios, providing possible useful information for collectors, dealers, art-funds, museums, and other investors who hold art. The study concluded that there were no diversification gains in financial portfolios due to the low returns and the high volatility, even though the correlations were low with traditional financial instruments and trends. According to Worthington and Higgs (2004), the returns in the art market presented in the study did not include the emotional return, that is "a substantial component" of holding art (p. 269).

Other studies focused on some of the challenges with studying art as an alternative investment (Charlin & Cifuentes, 2017; Spaenjers, Goetzmann, & Mamonova, 2015; Assaf, 2018). Charlin and Cifuentes (2017) investigated whether adding art-related assets to a portfolio contributes to its diversification. Their study focused on the error associated correlation estimates. Based on the fact that confidence intervals are wide, they stated their results were inconclusive. Spaenjers et al., (2015) recently studied the economics of aesthetics and record prices for art. The researchers purported that art price patterns mask the underlying variation both in time series and cross-section (Spaenjers et

[6] A digital database containing information that can be simultaneously used and shared within a large decentralized, publicly accessible network (Merriam-Webster.com).

al., 2015). The authors argued that to increase the economic understanding of aesthetics, quantifying the value of the emotional dividend is an important aspect of the pricing model, and must be considered in the sales and purchase of art.

The prospects of portfolio diversification in adding art to a financial portfolio, and diversification of art classifications within an art-asset portfolio is considered in this study. The research question seeks to answer: do investments in art allow for diversification benefits when added to financial portfolio? Additionally, do investments in art allow for diversification benefits in an art-asset portfolio?

2.3.6 Co-movements

Several studies have examined patterns of correlations between securities and international indices (e.g. Buyuksahin, Haigh & Robe, 2008; Baele, Bekaert & Inghelbrecht, 2010; Barberis, Shleifer & Wurgler, 2002; Vasiliki, 2017). The fundamental view of co-movements refers to the positive correlations between returns (Barberis et al., 2017). When investments do not have high correlations with securities, such as with real assets, these investments provide diversification benefits. Buyuksahin et al., (2008) used Standard and Poor's S&P 500 return data to proxy for the rate of return on equity investments. To identify possible changes in co-movements, the researchers ran their analyses on the entire sample period, and then focused on three sub-periods in order to tease out the underlying relationships. They found difference in the means and standard deviations in some periods.

Similar to the aforementioned studies in the extant financial literature, this research considers patterns of correlations between the stock market as proxied by the S&P 500, and the art market as proxied by three independent art indices, in tandem. The

research question seeks to answer: Do art market risk and return relationships differ from the securities market when considering indices from three independent art indices providers simultaneously?

2.3.7 Measurement of Art Investments

Previous studies have used different methodologies to explore the financial implications of art as an investment. To measure the investments of returns, art indices are compiled from prior sales prices. Researchers either compile their own index or use datasets compiled from art indices providers such as AP, AMR and SMM. Stein (1974) constructed an index from a sample of art sales and concluded that selection bias is an important consideration when interpreting the financial performance in researcher-created indices.

The two primary methods of creating an index is repeat-sales regression and hedonic pricing method (HPM). Though repeat-sales have been the predominant method of constructing art indices, several researchers have used hedonic pricing models allowing insight into the characteristics of artwork that determine price (Chanel et al., 1996; Renneboog & Spaenjers, 2013; Spaenjers et al., 2014). Mandel (2009) surveyed the index construction methodologies of several studies, and found research using the repeat-sales regression methodology (e.g., Anderson, 1974; Baumol, 1986; Frey & Pommerehne, 1989; Pesando, 1993; Goetzmann, 1993) was slightly more prevalent than the hedonic method (e.g., Anderson, 1974; Czujack, 1997; Chanel et al., 1996). Mandel's (2009) research of 13 previous studies concluded that art returns were relatively heterogeneous across and within periods, as well as index construction methodologies.

Comprehensive indices are now being created to track the art market on a global scale. Art investment research by Worthington and Higgs (2004) used an extensive set of indices constructed by AMR including eight categories of paintings. AMR's methodology of constructing the indices takes the central 80% of prices from auction sales, trimming the top and bottom 10% of prices (AMR, n.d.).

Prior studies have also calculated returns based on either premium prices of art sold at auction or hammer prices. Hammer prices are the sales price or winning bid of an asset at auction before the buyer's premium. The buyer's premium is the price paid by the buyer to the auction house, above and beyond the hammer price. Buyer's premiums are often a direct cost to the purchaser. Studies using hammer prices such as Korteweg et al., (2015), McAndrew and Thompson (2006), Renneboog and Spaenjers (2013) result in overestimation of reported returns. Studies by Anderson (1974) and Pesando (1993) used premium prices only, while Ashenfelter and Graddy (2003) presented both.

Consistent measurements are important when assessing the financial implications of investing in art. Lack of consistency of dataset methodologies, sample selection, and timing have contributed to these studies' diverse results. From the literature review, it is apparent that there have been mixed results when assessing the value of art as an investment. Additionally, as a passion asset, investors will continue to invest in art for emotional and social dividends.

However, in reviewing the body of research on art risk, return, and prospects of diversification, a clear determination on the viability of art as an investment compared to financial assets has yet to be determined. The differences are attributed to various factors including varying time frames studied, as well as the type of art and art indices

construction, resulting in sample selection biases and inconsistent methodologies. Several researchers have sought to create their own indices, increasing the risk of selection bias (e.g., Goetzmann et al., 2009; Mei & Moses, 2002,) while others have studied the financial implications of art from large datasets compiled by art indices providers (e.g., Worthington & Higgs, 2004). This study seeks to find whether three art indices are correlated by applying consistent analytical methods.

2.3.8 Tax Consequences

Frey and Eichenberger (1995) found that no studies consider tax implications of art collecting, even though in many countries investing in art is key to lowering or escaping tax burdens. They argue that it is difficult to compare tax implications internationally and over time due to varying tax rates. In Cadeo de Iturbide's (2015) foundational book on taxation for the global collector, over 100 countries' tax rates were compiled to serve as a guide for financial and legal advisors to help understand the regulatory, legal, and fiscal frameworks affecting artworks. As Cadeo de Iturbide writes, "works of art can be subject to customs duties, Value Added Tax (VAT), net worth tax, income and corporate tax, resale rights, capital gains tax and gift and inheritance tax" (Cadeo de Iturbide, 2015, pp. 11–12). Although this study does not take into consideration the net returns after tax, it is important to understand that the various countries' tax rules impact the effective rate of return of art as an investment.

2.3.9 Financial Implications

Previous studies have reported mixed results on the investment opportunities in art resulting from underlying art classifications and the index provider's methodologies. This study examines the risk, returns, and diversification prospects in the global art

market with three art independent providers' indices to gain insight into the worthiness and various financial aspects of art as an investment. It is possible that one reason for the large discrepancies in art returns in past research is attributable to the numerous means in measuring art. As identified in the literature review, there is also not a consensus on what constitutes art. In several of the studies, it appears art is defined only as paintings (e.g., Mei Moses, 2002; Worthington & Higgs, 2004). In other studies antiques, furniture, and collectibles were also considered art. The literature review also provided insight into the methodology of constructing an index. While some indices include auction repeat sales using proprietary algorithms, or hedonic price methodologies, some indices are concerned with smoothing to the central 80%, and others focus solely on repeated sales that hold a bonafide provenance.[7] Differentials in measurement of the underlying art assets will produce diverse return outcomes as implied from prior studies' results. In order to gain an understanding of the investment performance of the art market, and its relation to the financial market, it is important to analyze the co-movement of art indices in tandem. This study seeks to explore if the art market moves in sync with the financial markets.

2.4 Research Question

The extant literature has been inconclusive on art as a viable alternative investment, art asset returns, as well as the correlation of the art and the financial markets. The prior literature has shown that returns on art as an investment are highly variable. Higgs and Worthington (2005) found the financial crisis of 2008 was delayed in the art market and has fully recovered. While certain categories of art have shown

[7] Documentation of authenticity as well as history of ownership.

diversification benefits, other categories have not due to high correlation or excessive risk (Worthington & Higgs, 2004).

The research question this study aims to answer is: What are the financial implications of investing in art as a real asset? Specifically, this study researches the financial implications under the following dimensions:

1. Do art assets differ, in both risk and return, when considering various indices, categories, and periods?
2. Do risk and return for art assets differ from other real and financial assets, when considering various indices, categories, and periods?
3. Do investments in art allow for diversification benefits when added to a financial portfolio?
4. Do investments in art allow for diversification benefits in an art-asset portfolio?
5. Do art and financial market, risk and reward relationships differ when considering returns from three independent art indices providers, simultaneously?

2.5 Hypotheses

This research explores art returns and the relation to the financial market, considering the index and time period, and explores optimized financial portfolios and art-asset portfolios, using Markowitz (1952) mean-variance optimization models and efficient frontier (Markowitz, 1959) with three independent art indices providers (Artprice, Art Market Research, and Sotheby's Mei Moses) through an analysis of annualized nominal returns, and considers the co-movement between the art market and financial market. The five dimensions of financial implications of investing in art are articulated in the null and alternative hypotheses (see Figure 2.1).

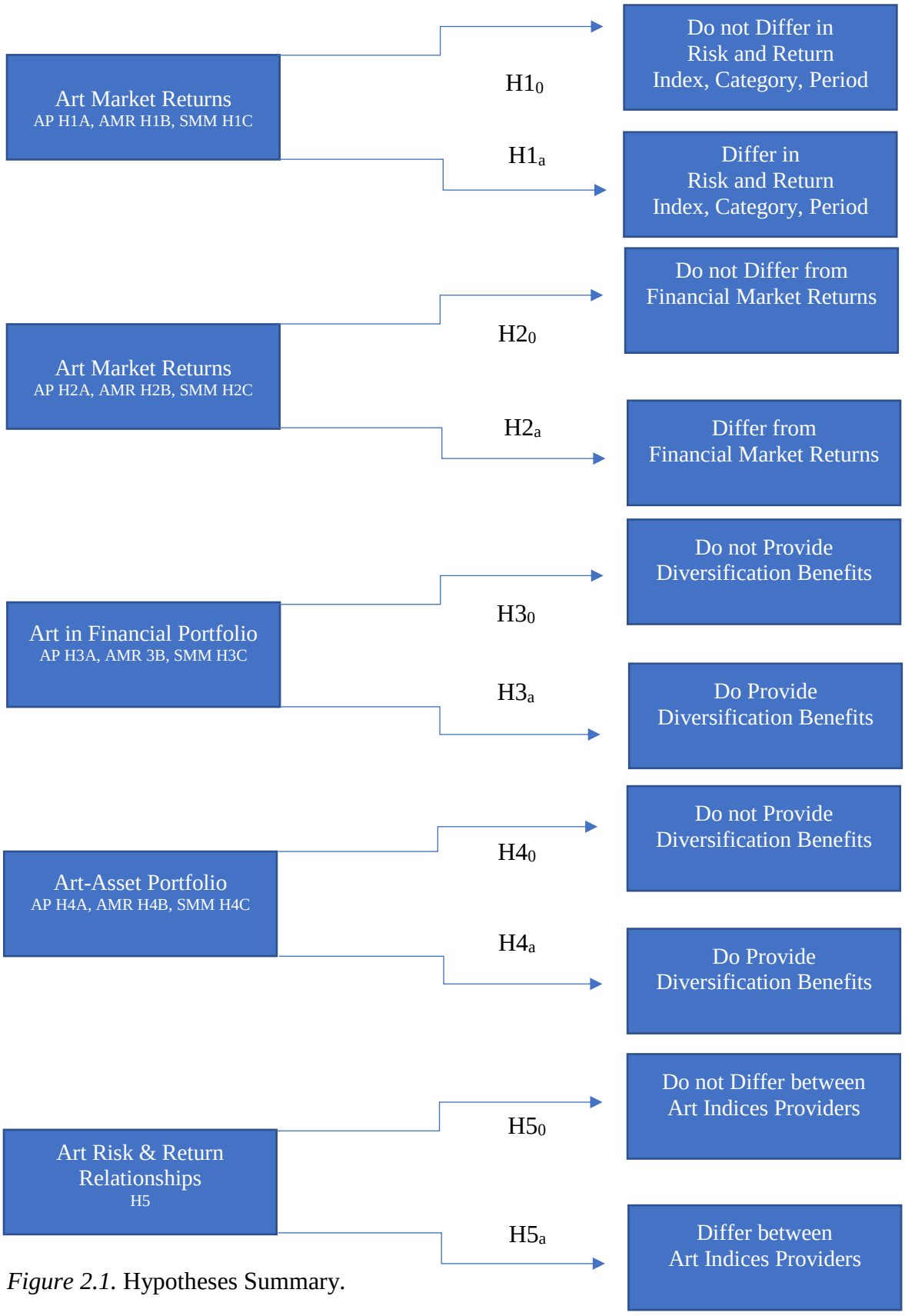

Figure 2.1. Hypotheses Summary.

2.6 Discussion

In this chapter, art was defined as an asset under several financial dimensions. This literature review then introduced the existing studies on portfolio theory's asset allocation strategies and diversification prospects for alternative investments. Following this overview was a discussion of prior literature's inconsistent results in the measurement of risk and return of art amid financial markets, and index construction methodology effects. These conflicting data formed the basis of this study and the development of hypotheses to investigate the financial implications of investing in the global art market.

Chapter Three describes the data and methodologies used to test these hypotheses. Chapters Four and Five provide the results for Hypotheses 1 and 2 respectively, exploring the nuances of risk and return including presenting descriptive statistics. Chapters Six and Seven provide results for Hypotheses 3 and 4 respectively, including the construction of mean-variance optimization and efficient frontier models. Chapter Eight explores Hypothesis 5 and present the results of comparing the art and financial market relationships between three independent art indices providers. Chapter Nine concludes with a discussion of the implications, contributions, and limitations of the study and recommendations for future research.

CHAPTER THREE: DATA AND METHODS

The main data sources used in this study came from art and financial data providers in the form of monthly, quarterly, and annual indices; monthly and quarterly indices are converted into continuously-compounded annual returns. Some financial returns were sourced from academic databases as identified in this chapter. The methods described in the following sections apply to the research and Hypotheses 1 through 5 as presented in Chapters Four through Eight.

3.1 Overview

The first section of this chapter outlines the sample and describes the data and timeframes to examine the risk, return, and portfolio diversification prospects of investing in the art market. The data from three art indices providers (Artprice, Art Market Research, and Sotheby's Mei Moses) are then introduced, followed by the method of collecting the securities data. The next section presents details of the art indices providers, and briefly explains the underlying methods of building the indices. The final section discusses the analytical methods and the research design used in this study.

3.2 Sample and Data Collection

This section explains the data used to examine the risk, returns, and portfolio diversification prospects of adding art to a financial portfolio using data from three art data organizations and securities measures. The sample for this study is composed of the price indices: (a) AP, (b) AMR, (c) SMM, (d) S&P 500, (e) Russel 2000, (f) U.S. Treasury Bonds, (g) Corporate Bonds, (h) T-Bills, and (i) Shiller S&P. The S&P 500, T-Bills and Government Bond returns were retrieved from NYU's Damodaran (2019)

website, the Russel 2000 price index from Yahoo Finance, and the Corporate Bonds index from Bloomberg terminals. The S&P price index data prior to 1928 was retrieved from Yale's Shiller (2019) website, to create an S&P extended dataset referred to henceforth as SPX. The datasets from the three art market data providers include one comprehensive art index and several subcategories of art indices. Artprice publicly publishes their indices, the AMR indices were purchased for this research, and the SMM indices were available through a research agreement with Sotheby's.

Prior studies have compared art returns to financial returns. Mei and Moses' (2002), Goetzmann's (1993), and Pesando's (1993) studies included annual returns of the S&P 500, Government and Corporate Bonds, and T-Bills, while Worthington and Higg's (2004) study included large-cap and small-cap stocks. In this study, the stock market return data consisted of U.S. equity securities. The U.S. equity market was proxied by both the S&P 500, for large-cap stocks, and the Russel 2000 (RUT 2K) for small-cap stocks. Worthington and Higgs' (2004) study reported Ibbotson Associates' data for large- and small-cap stocks as a proxy of the U.S. equities market for their analysis.

3.2.1 NYU: Damodaran

Consistent with previous studies, the annual financial returns of securities used in this study consist of the S&P 500, T-Bonds and T-Bills from 1928 forward (as available) and were procured from NYU's Dr. Aswath Damodaran's (2019) website.[8] The data provided consisted of calculated annual returns.

[8] Damodaran, A.,2019 NYU Stern page at: http://pages.stern.nyu.edu/~adamodar/

3.2.2 Open Source

The Russel 2000 was extracted from Yahoo Finance. The data represents an index measure of approximately 2,000 of the smallest-cap U.S. companies. It is considered a market-cap weighted index. The data are available from 1984 forward; therefore, this study only considered the Russel 2000 data in the period of 1998–2018. The monthly index was converted into simple returns and then annualized using the continuous compounding formula consistent with the method used to compute the art market returns.

3.2.3 Bloomberg

The Corporate Bond index was extracted from Bloomberg terminals using the Barclay's U.S. Corporate Index. However, the financial index data was limited with regard to available dates; therefore, this study only used data from the most recent 43 years 1976–2018. Simple nominal returns were calculated from the annual data.

3.2.4 Yale: Shiller

The S&P composite data from 1871–1927 were procured from Robert Shiller's (2019) website.[9] The data utilized in the study consisted of the raw annual prices. Simple nominal returns were calculated the same as the other indices and were consistent with the methodology used by Dr. Damodaran.

3.3 Art Index Data

The three art data organizations (referred to as indices providers for the purposes of this study) provided the samples of art indices used in this study. The overall indices sample covers a much broader time period of 1858–2018, with 1858 being the first year of compiled art prices by SMM. This study uses the SMM data to compare to the shorter

[9] Shiller, Robert., 2019 Yale page at: http://www.econ.yale.edu/~shiller/data.htm

periods available for AP (1998–2018) and AMR (1976–2018). The three indices were chosen because of their high quality and consistent use by government agencies (e.g., federal museums) and the media (e.g., the Wall Street Journal, Bloomberg, and Forbes) to report on the art market. The sample includes three comprehensive art indices and several subcategories of art depending on the characteristics available by each organization. The sample period of each index corresponds with the first date of that index provided, as listed below. The multiple dimensions of researching art assets through several independent indices aids in the ability of the researcher to tease out the trends in the art market. The indices providers consist of:

1. Artprice data for a 21-year period (1998–2018);
2. Art Market Research data for a 43-year period (1976–2018); data on classic car index for the 39-year period (1980–2018);
3. Sotheby's Mei Moses data for a 161-year period (1858–2018); subcategories of art for various time periods.

A discussion of the underlying art indices and the corresponding methodologies follows.

3.3.1 Dataset 1: Artprice Indices

The first set of indices used in this study comes from Artprice and consists of ten subcategories of various types of art and one comprehensive art market index, referred to as Global® Index (Global). The ten classifications are: Painting, Print, Sculpture, Photograph, Drawing, Old Masters, 19th Century Paintings, Modern Art, Post-War, and Contemporary. Artprice has developed a set of algorithms based on a sales dataset compiled from over 6,300 auction houses, excluding online auctions. The propriety algorithmic indices use repeated sales and hedonic regression. Artprice has compiled

their indices from 1998–2018; therefore, in this study the analysis of these indices is limited to the past 21 years. The indices are provided quarterly and were annualized, using continuous compounding for the analysis. This data are available online (Artprice, 2019).[10]

3.3.2 Dataset 2: Art Market Research Indices

The second set of indices was purchased from Art Market Research and consists of nine subcategories of art, and one comprehensive art market index.[11] The subcategories are: (a) paintings by Contemporary Masters (CM); (b) French Impressionist (FI) paintings; (c) Modern European (ME) paintings; (d) 19th Century European (NE) paintings; (e) paintings by Old Masters (OM); (f) Surrealist (SR) paintings; (g) 20th Century English (TE) paintings; (h) Modern U.S. Paintings (US); and (i) 19th Century French Sculpture (SC).

As an investment analyst, the founder of AMR originally collaborated with the London School of Economics to create indices for art, antiques, and collectible to devise smoothing and trimming mechanisms to eliminate distortions in art sales. The art markets are analyzed more frequently than other art indices and track monthly changes in the global market. The indices compiled by AMR use the average price method, and report the central 80 percent, removing outliers on both ends. Their methodology collects all world-wide sales each month, converts to U.S. dollars, and trims 10 percent to eliminate extreme values. Similar schools of art, art-movements, and periods are pooled together. Due to the seasonality of the auction market, to create a useful index on price movements, the dataset is smoothed by employing a 12-month moving average

[10] https://imgpublic.artprice.com/pdf/agi.xls
[11] AMR does not release their indices to the public. These indices were purchased for this research.

methodology (S. Duthy, Director of AMR, personal correspondence, April 17, 2019). Auction sale data for the month is added to the previous 11 months' data and averaged. The final dataset is therefore composed of a series of 12 monthly averages referred to as the Underlying Monetary Value (UMV). To compare datasets covering different market sectors, the UMV figures are rebased to the starting month in 1975 (AMR, 2019).

The AMR econometrics department has changed their methodology since Worthington and Higgs' (2004) study was published (S. Duthy, personal correspondence, April 20, 2019); at that time AMR used a group methodology.[12] This method calculated indices for artist components individually before aggregating to produce final figures. AMR's methodology currently uses pooling to construct their indices. This methodology combines all artists together to produce the final figures (AMR, 2019). The change in the method was retroactive to provide consistency in measuring outcomes (S. Duthy, personal correspondence, April 20, 2019), and results in a more robust analysis of the underlying performance of art. While it was originally intended to replicate the Worthington and Higgs (2004) study, the new methodology of constructing the AMR indices was used to provide an improved measure of the art market, and is an important contribution of this study.

3.3.3 Dataset 3: Sotheby's Mei Moses Indices

The data from SMM was obtained from Sotheby's econometrics department and represents the longest period dataset in this study; the comprehensive art index includes data from 1858 through 2018. The dataset also includes three subcategories of art: Old

[12] Sebastian Duthy, Managing Director of AMR, was contacted by the author of this study and confirmed a retroactive change in methodology from groupings to pooling. This is consistent with the results found by Grimmer in this research paper. More on AMR's methodology can be found at: http://www.artmarketresearch.com/methodology/

Masters & 19th Century (1897–2018); Impressionist & Modern (1930–2018); and Post War & Contemporary (1961–2018). A subset of this extensive dataset was used in the Mei and Moses (2002) foundational study.[13] The datasets were provided for this study for academic research purposes only.

The Mei & Moses index is the "preeminent measure in the art market, leveraging over 60,000 repeated auction sales" (Sotheby's, 2019). The SMM indices only cover artworks that have been sold more than once, from Sotheby's and Christie's, although the original sale could have been traced from any auction house. The repeat-sales regression method uses the purchase price and sales price to estimate the value of an art asset over a specified time. This methodology was used in several of the previous studies (e.g., Anderson, 1974; Baumol, 1986; Goetzmann, 1993; Pesando, 1993) and is prevalent in recent literature (Korteweg, et al., 2018). The resulting index is based on prices relative to the same art, controlling for quality, and is not subject to arbitrary specifications of a hedonic model (Mei & Moses, 2002). The method starts with continuously-compounded returns, then the natural log is taken of the purchase-price over the sale-price pair (Mei & Moses, 2002). The computation used by SMM is: "The assumption of continuous compounding rate of an art index plus an error term, as described below.[14]

Where: μ_t = average return in period *t*

$$r_{i,t} = \mu_t + \eta_{i,t}$$

Where P is the purchase and sales price pairs

And r_i is the logged price relative to asset i

[13] Mei and Moses's (2002) data covered the period of 1875–2001 and consisted of four categories of art.
[14] Direct quote of formula: See Mei Moses (2002) p. 6.

$$r_i = \ln\left(\frac{P_{i,s}}{P_{i,b}}\right) = \sum_{t=b_i+1}^{s_i} r_{i,t}$$

$$= \sum_{t=b_i+1}^{s_i} \mu_t + \sum_{t=b_i+1}^{s_i} \eta_{i,t}$$

$P_{i,b}$, and $P_{i,s}$, = purchase and sales price pairs, for asset *i* and bought and sold date" (Mei & Moses, 2002, p. 6)

The methodology used by Mei and Moses (2002) is based on the Case-Shiller (1987) Real Estate Index, allowing for an adjustment for a downward bias resulting from log price transformations (Mei & Moses, 2002) and is consistent with the methodology used by Goetzmann (1993). A drawback to the repeat sales regression (RSR) index is its construction from sales that are a subset of all transactions (Mei & Moses, 2002). The index is primarily an analysis of auction sales from the two largest auction houses (Sotheby's and Christies) and represents a sample of fine art market sales, although the original purchase is traced to other auction houses. See Table 3.1 for a summary of data sources for this study.

Table 3.1

Summary of Data Sources

Index Provider	Date	Summary	Indices	Sub-Indices
AP	1998–2018	10 sub-indices of art 1 all-art index Algorithmic propriety method using hedonic method on repeated sales.	GBL	Painting Print Sculpture Photograph Drawing Old Masters 19th Century Paintings Modern Art Post-War Contemporary
AMR	1976–2018	8 sub-indices–paintings 1 sub-index–sculpture 1 sub-index–collectible 1 all-art index Prices smoothed to the central 80%	ART	Contemporary Masters French Impressionist Modern Paintings 19th Century Old Masters Surreal 20th Century U.S. Paintings 19th Century Sculpture Classic Cars–traditional
SMM	Various 1858–2018	3 sub-indices of art 1 all-art index Repeated-sales regression	ALL	Post-War/Contemp. Impressionist/Modern Old Masters/19th Century
NYU Stern Dr. Damodaran's website	1928–2018	3 financial measures	S&P 500 T-Bills Gov bonds	
Bloomberg	1976–2018	1 financial measure	Corp bonds	
Yahoo Finance	1976–2018	1 financial measure	RUT 2K	
Yale Dr. Shiller website	1871–1927	1 financial measure	S&P Composite	

3.4 Analytical Methods

This study investigates risk-return relationships and portfolio theory using price data from three independent art index providers and five traditional financial measures to examine portfolio diversification benefit prospects, and to construct the mean-variance

efficient frontier. This section discusses the analytical methods used in this study, distinct from the internally-developed index provider's methodology. To empirically investigate the hypotheses all price indices are compiled into Excel and transformed into nominal returns. Monthly and quarterly returns are continuously compounded, and annualized, and arithmetic means are calculated.

3.4.1 Rate of Return and Risk

In order to examine if the risk and return for classifications of art assets differ in both risk and return, as well as when comparing art returns to other real and financial assets, when considering various indices, categories and time periods, the first measure is to transform all prices from the index series into returns:

$$R_{it} = (p_{it} - p_{it\text{-}1})/p_{it\text{-}1} \quad (1)$$

Where,

R_i = continuous compound returns at time *t* and

p_{it} = is the ending index price at time *t* and

$p_{it\text{-}1}$ = is the previous period ending index price.

Monthly and quarterly returns are annualized by calculating the compounded annual return.

$$\Pi = [(1+R_{Jan})(1+R_{Feb})...(1+R_{Dec})]-1 \quad (2)$$

The expected return is then calculated as the average of the annual arithmetic means.

$$\bar{R} = \frac{\sum \Pi_i}{n} = \text{Notation translated as: } \Pi = (\Pi_A + \Pi_B + \cdots \Pi_n)/n \quad (3)$$

Risk is the standard deviations of the expected returns. It measures the spread around the arithmetic mean of the returns and is represented as:

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(\Pi_i - \mu)^2}$$ = Notation translated as: σ = sqrt[Σ ($\Pi_i - \mu$)^2 / n] (4)

The results are analyzed to explore the risk and returns of the individual markets, and the coefficient of variation is calculated for analysis on the dispersion of the data point around the mean. The coefficient of variation metric represents the risk-to-reward:

$$\text{CV} = \frac{\sigma_i}{\mu_i}$$ = Notation translated as: = CV = Risk/ER (5)

The financial and art returns are compiled into spreadsheets, where the means and risk are analyzed.

3.4.2 Mean-Variance Model

Portfolio theory is applied to this research to explore the risk and return and asset allocation using Markowitz's (1952) mean-variance model to determine if there is a diversification benefit of adding art assets to a financial portfolio and allocating classifications of art in an art-asset portfolio, in order to minimize risk and maximize return. The model considers the rate of return on assets as random variables and chooses the asset allocation weight factors that optimize the return for a given level of acceptable risk. The variance of the rate of return of the asset is used in the formula to represent its volatility as shown in Formula 9 below.

Portfolio theory uses the mean-variance optimization model and is composed of several statistical measures to determine risk and return for a combination of assets that combine to make an investment portfolio (Markowitz, 1952). The first measure is to convert the index series into compound returns as done in formula (1) above. The statistical measure is to calculate the expected return of the portfolio with *n* assets given by 1,2, … n.

The following formula is used to calculate the expected return of the portfolio:

$$ER_p = \sum_{i=1}^{n} W_i \mu_i \quad \text{Notation translated as: } ER_P = W_A ER_A + W_B ER_B + \cdots W_n ER_n \tag{6}$$

Where,

ER_p = Expected return of the portfolio

i = Asset 1, 2, …n

μ_i = (i = 1, 2,… n) denotes the expected return (mean[15]) on asset i.

W = The weight of asset i

The assets are allocated in the portfolio based on proportion of the total, where the weights sum to 100%, given by the following constraints:

$$\sum_{i=1}^{n} W_i = 1 \quad \text{Notation translated as: } W_A + W_B + \ldots + W_n = 1 \tag{7}$$

And where the weights are greater than zero, given by the constraint:

$$W_1 \geq 0 \text{ for } i = 1, 2, \ldots, n. \quad \text{Notation translasted as: } W_{A,B,C} \geq 0 \tag{8}$$

Where,

W = The weight of asset i

The next statistical measure is the calculation of risk corresponding to the related return. This measure is the variance (σ_p^2) of the portfolio.

The variance of the portfolio formula used in this study:

$$\sigma_p^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} W_i W_j \sigma_{ij} \tag{9}$$

Notation is translated as (if constructing a three-asset model below):

$$VAR_P = W_A^2 VAR_A + W_B^2 VAR_B + W_C^2 VAR_C + 2W_A W_B COV_{A,B} + 2W_A W_C COV_{A,C} + 2W_B W_C COV_{B,C}$$

[15] Arithmetic annual means are used in the mean-variance model.

Where,

σ_p = is the portfolio standard deviation (volatility)

σ_{ij} = is the covariance of the periodic returns on two assets

The optimal set of assets is the set of the greatest expected portfolio returns for the minimum standard deviation whose weights sum to one and are positive. The measures of the mean-variance model together can be used to identify the maximization of growth and minimization of risk for a portfolio of assets. Markowitz's efficient portfolio model assumes that investors seek to find portfolios with the maximum expected return-risk tradeoff. To solve for an optimal portfolio is to maximize portfolio expected return while minimizing portfolio risk, by adjusting the designated weights of individual assets. The efficient set are the maximum returns for various levels of risk.

Maximize expected return of the portfolio at minimal risk formula:

$$\text{MAX ratio} = \frac{ER_p}{\sigma_p} \tag{10}$$

3.4.3 Portfolio Optimization Matrix Model

From the results of the aforementioned formulas, optimized portfolios and construction of the Efficient Frontier can be achieved through matrices. The quantum model created by Max Planck using matrix algebra was set up to create vectors of the factors to optimize the portfolio of asset returns. Excel is utilized to multiply the matrices to calculate the expected return, variance, and risk of a portfolio. Matrices are built from the array of weights, expected returns, and covariances of the individual assets. The formulas for the Matrices can be found in the Appendix.

3.4.3.1 Creation of four matrices. First, weights are assigned in a horizontal vector for assets *a* through *n* (Matrix 1). Second, a vertical vector is formed of all expected returns of each asset *a* through *n*, (Matrix 2). Third, the variances and covariances of the array of returns of all assets are calculated and form a vector with *n* rows and *n* columns, such that for assets *a*, *b*, and *n*. Fourth, the weights of the portfolio are transposed in a vertical vector.

Once the four matrices are created in Excel, they can be multiplied together using the matrix multiplication function to solve for the portfolio's expected returns, variance, and standard deviation, in order to then solve for the optimized portfolios and construct the efficient set. The five-step process follows:

3.4.3.2 Steps one to three: Expected return, variance and standard deviation. Steps one and two use the matrix multiplication function in Excel: the first step is to calculate the portfolio's expected return, and the second step is to calculate the portfolio variance. The weights of each asset (Matrix 1) are multiplied by each asset's expected return (Matrix 2) to calculate the expected return on the portfolio (Step 1 ERp: Matrix 1 x Matrix 2). The covariance matrix (Matrix 3) is multiplied by the transposed weight matrix (Matrix 4), and the resulting calculated matrix is then multiplied by the weight matrix (Matrix 1) to calculate the portfolio variance (Step 2 VARp: Matrix 1 x (Matrix 3 x Matrix 4). Taking the square root of the variance of the portfolio will result in the standard deviation of the portfolio as a whole (Step 3 STDp: Sqrt of VARp). The standard deviation is the risk of the portfolio. The resulting factors (portfolio expected return, portfolio standard deviation) are then used to find the optimal weights for the optimized portfolios through the Solver tool.

In investment theory, the objective is to lower the risk for a given amount of return. As risk increases, return also often increases; therefore, through diversification, an investor can reduce the overall risk of their investments through investment in assets that are not highly correlated with each other. The goal is to find an optimized portfolio of investments that reduce this risk with desirable returns. This is explored through asset allocation that takes into account the respective weights of the assets and their respective returns to find the maximum return for a target level of risk

3.4.3.3 Step four: Optimal portfolio selection. To achieve asset allocation through diversification prospects, the add-in Excel Solver Data-Analysis (Solver) tool was used to construct the optimal portfolio weights. This was accomplished by calculating the weights that optimize the expected returns of the portfolio.

Where,

Objective: Calculate the maximum expected return of the portfolio

Variables: Change the array of weight variable cells in Matrix 3

Subject to: Constraint that the weights must equal 1

Subject to: Constraint that the weights must be greater or equal to zero

Through this process, the Solver tool calculates the optimal portfolio of assets that will result in the maximum return with the lowest risk. With the aforementioned optimization techniques, minimum risk, maximum returns, and naïve portfolios were created. Additional constraints can be placed on the formula such as the desirable level of risk or return. Investors can choose between different levels of risk, calculating the asset

allocation that maximizes their return for a given level of risk. Assets with lower correlation may reduce the portfolio risk and increase the portfolio return.

3.4.3.4 Step five: The Efficient Frontier. With the data above, several scenarios of combinations between asset and weights are run, and plot on a graph to construct the efficient set of portfolios known as the Efficient Frontier. Maximum expected returns are calculated for incremental increases in risk through Solver. The Y axis represents the expected returns and X axis is the risk. Portfolio Expected Returns and Portfolio Risk are plotted on the graph to create an arc of the maximum returns for any given level of risk. The individual asset's risk and return are also plotted on the assets graph, along with a naïve portfolio (equally weighted), the minimum risk and maximum return portfolio, and the maximum return portfolio for the same level of risk as an equally-weighted portfolio. The Efficient Frontier reveals the benefits of diversification by investing in several assets. The individual asset's risk and return are compared to the optimal portfolios for each given level of risk and expected return to identify its position compared to the efficient set. The efficient set is the portfolios that generate the maximum expected returns for various levels of risk (Markowitz, 1959) as a result of the optimization between the expected returns, standard deviation, and covariances of a set of assets. The Efficient Frontier graphs are then used for analysis in relation to the individual assets, and where they fall within the efficient and inefficient sets. Points on the graphs that fall below the efficient frontier curve represent assets or portfolios of assets that are inferior to the efficient set of portfolios. The inefficient investments and portfolios either offer the same returns with more risk, or less return for the same risk. The Efficient Frontiers are

exhibited in Chapters Six through Eight where these results are presented according to each specific research questions.

3.4.4 Financial Portfolio Diversification

To empirically investigate if investments in art allow for diversification benefits in a financial-asset portfolio, the following steps were taken. The financial-asset portfolios were constructed in Excel and one comprehensive art index was added to analyze the risks and returns of the individual markets, as well as the coefficient of variance. To solve for the portfolio's expected return, variance, and standard deviation, portfolio selection and construction of the efficient set in steps one to five above were employed in order to explore the asset allocation prospection of adding art-assets to a portfolio of various financial assets. With the aforementioned optimization techniques, minimum risk, maximum return, naïve portfolios, and maximum return for same risk as naive portfolios were created. These portfolios and the efficient set of optimized portfolios were plotted to construct the Efficient Frontier graphs of financial-asset and multi-asset portfolios. The process was repeated for the comprehensive art index from each of the three indices providers: AP, AMR, and SMM. For AMR, a classic car index was added representing an additional alternative investment in a multi-asset financial portfolio. Efficient Frontier figures are depicted in chapters Six through Eight where the results are presented according to each specific research question.

3.4.5 Art Portfolio Diversification

Additionally, to empirically investigate if investments in art allow for diversification benefits in an art-asset portfolio, the following steps were taken. An art-asset portfolio was constructed in Excel from the various sub-indices of art and analyzed

to explore the risk and returns of the individual art markets, as well as the coefficient of variance. The same methodology used to analyze a financial portfolio above was applied to an art-asset portfolio to explore asset allocation prospection of investing in a basket of art assets. Through optimization techniques, minimum risk, maximum return, and naïve portfolios were created. Lastly, efficient frontiers were constructed on the art-asset portfolios. The process was repeated for all categories of art from each of the three indices providers indices: AP, AMR, and SMM.

3.4.6 Art Market and Stock Market Relationships

This research considered patterns of correlations between the stock market as proxied by the S&P 500, and the art market as proxied by three independent art indices, in tandem. Correlation matrices were created in Excel to investigate the extent the markets move in sync. Annual return data was used to track the co-movement. Additionally, the historic return correlations were calculated by decade from 1871 through 2018.

3.5 Research Design

The research design of this study is presented in Figure 3.1. The design depicts the five hypotheses, and where they fall within the four stages while exploring (a) the risk and return attributes of art as an investment, (b) risk and return attributes of art-assets compared to financial-assets, (c) diversification benefits of adding art as an investment in a multi-asset financial portfolio, (d) diversification benefits in an art-asset portfolio, and (e) co-movements of the art market proxied by three comprehensive indices with the financial market. Each dataset was compiled with data from three independent providers of art indices and financial data.

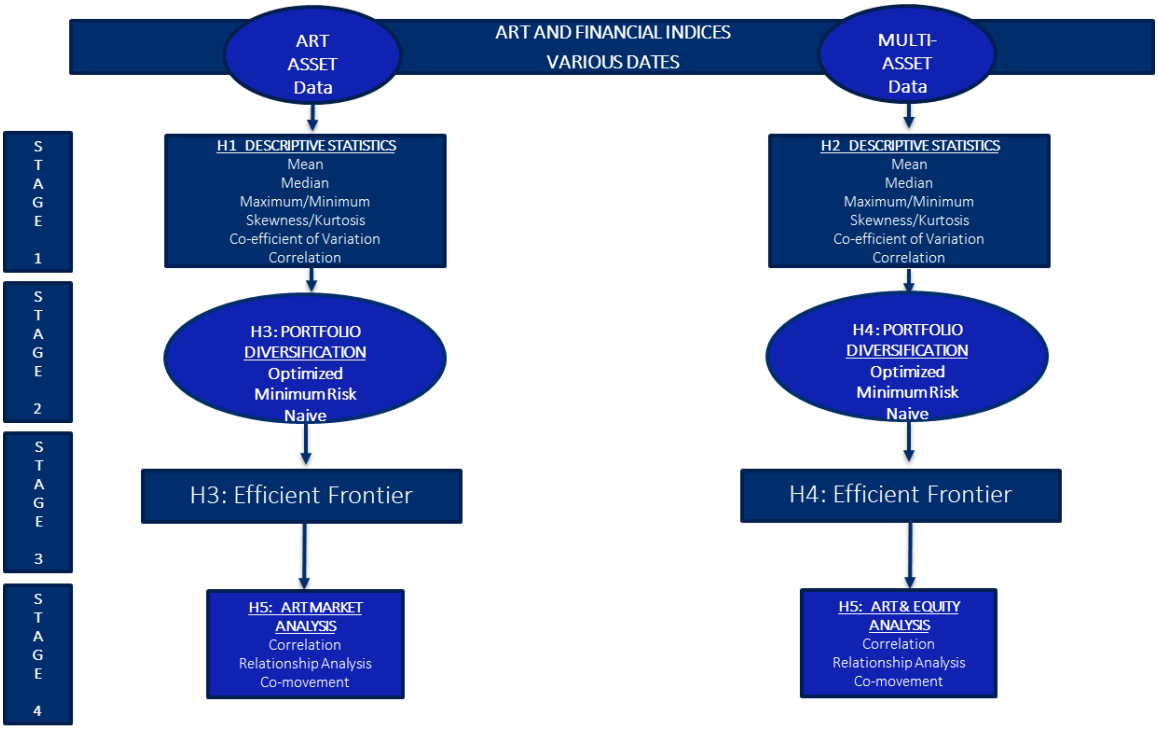

Figure 3.1. Research Design: Hypotheses 1–5.

The results of each hypothesis are organized by sub-research question and are presented in Chapters Four through Eight.

CHAPTER FOUR: RISK AND RETURN OF ART ASSETS

This chapter discusses the results and descriptive statistics on risk and return utilizing three independent providers' art indices. Frey and Pommerehne (1989) claim that investment in art is considered profitable for U.S. and European investors. While there has been a growing body of literature in recent years examining risk, and return for the global art market, there have been conflicting conclusions on art returns and viability of art as an investment.

4.1 Research Sub-Question One: Overview

This chapter explores research sub-question one. The first section introduces the first hypothesis. The second section presents the data model used in Chapter Four. The third section presents the findings, with a section for each of the three art indices providers. The final section provides a detailed discussion of the results and concludes the material on the given hypothesis.

4.2 Hypothesis

This study seeks to understand how risk and return interact in the realm of alternative investments and proposes to answer the research question: Do art assets differ both, in risk and return, when considering various indices, categories and periods? Therefore, this study posits:

- Proposition 1: Art market returns do not differ, both in risk and return when considering indices, categories, and periods.
    - $H1A_0$*:* Art market returns do not differ, both in risk and return, when considering AP's indices, categories, and periods.

- *$H1A_a$:* Art market returns differ, both in risk and return, when considering AP's indices, categories, and periods.
- *$H1B_0$:* Art market returns do not differ, both in risk and return, when considering AMR indices, categories, and periods.
- *$H1B_a$:* Art market returns differ, both in risk and return, when considering AMR indices, categories, and periods.
- *$H1C_0$:* Art market returns do not differ, both in return and risk, when considering SMM's indices, categories, and periods.
- *$H1C_a$:* Art market returns differ, both in risk and return, when considering SMM's indices, categories, and periods.

4.3 Model: Art Asset Risk and Return

In order to examine if art assets differ, in both risk and return, when comparing art returns to other real and financial assets, when considering various indices, categories and time periods, the first step is to transform all prices from the index series into annualized, nominal returns. See formulas (1) through (5) in Chapter Three for details applied in the analysis to follow. Figure 4.1 presents the data model for Hypothesis 1.

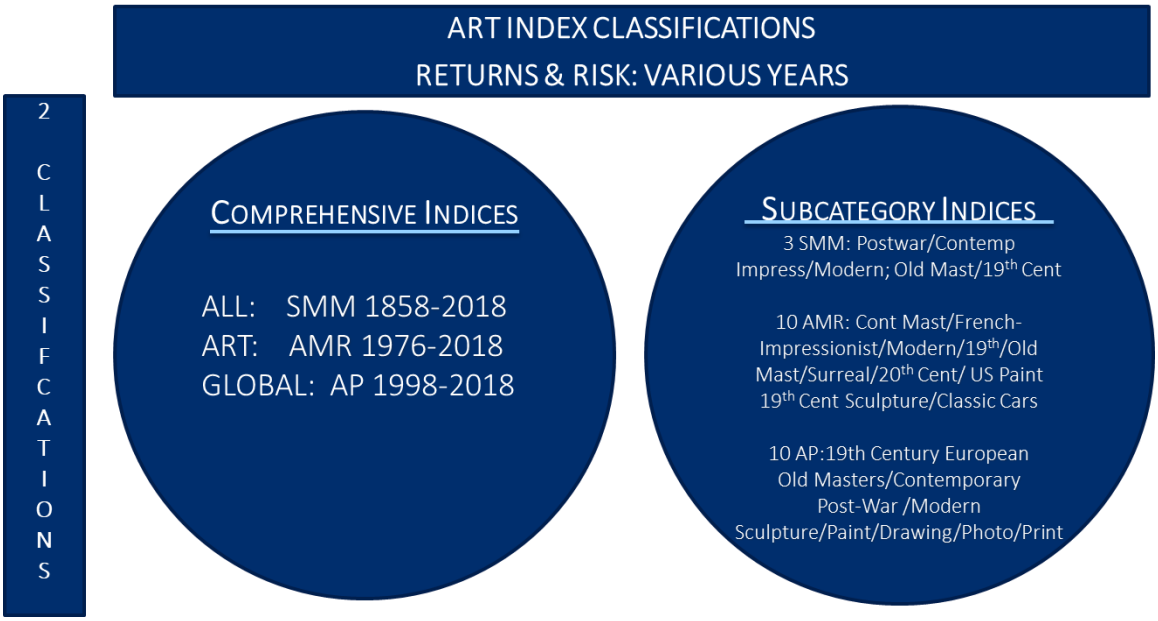

Figure 4.1. Model for H1: Art Risk and Return.

4.4 Results: Art Asset Risk and Return

This study explored three independent indices to study art as an investment. First, Artprice's indices with extensive datasets on art sales from all over the world were considered. Second, Art Market Research indices were explored; and included sculpture along with a traditional collectible, classic cars. Third, Sotheby's Mei Moses extensive repeat sales indices from 1858 to 2018 were examined. As described in the data section, the art indices providers apply different methodologies to construct their indices, with consistent methodology in computing annual, nominal, returns to reduce research bias in this study, the effects on the art market are explored. Through this analysis of the individual art groupings, some consistent art-market trends, both with prior studies and between these datasets, are revealed in this chapter to follow.

4.4.1 Artprice Indices: 1998–2018

In order to explore Hypothesis 1, Figure 4.2 presents a visualization of the Global art market returns and Figure 4.3 presents the returns of the ten subcategories of art and the Global art returns calculated from the Artprice dataset for the twenty-one year period 1998–2018. Table 4.1 presents descriptive statistics in order to investigate the art market.

Figure 4.2 shows that Artprice's Global index has had several years with negative returns, such as in 2000, 2008. 2011 and 2015. The 2008 negative return is consistent with the global credit crisis. Since 1998, this comprehensive art index also exposes the highest return year in art to be 2007, at almost a 30% return. The time series analysis reveals the art market has not returned to its 2007 state and has been on a downward trend since 1998.

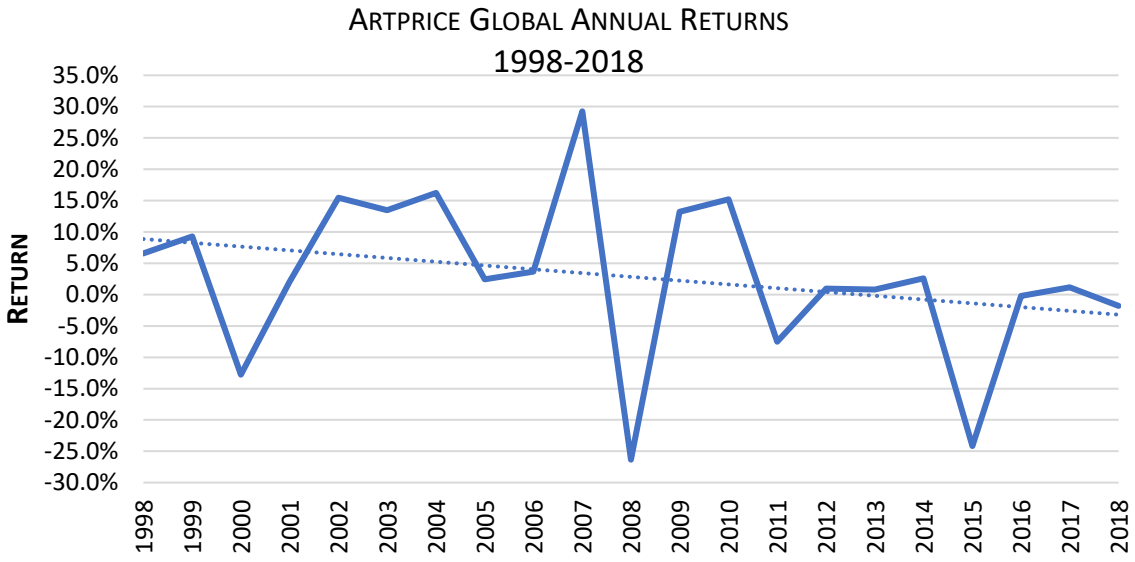

Figure 4.2. AP Global Annual Returns, 1998–2018.

Figure 4.3 reveals that the comprehensive Global (thick red line) art returns forms a somewhat central pattern in the overall art market, and underlines the rate of returns for the various subcategories of art. There are also several types of art that continually

outperform the Global art market and may provide better investment prospects. Specifically, Contemporary (4.64%), Drawings (4.11%), and Photos (3.23%) have all shown higher returns than the Global (2.84%) art market in Figure 4.3. Table 4.1 confirms this art market trend. The graph suggests that Contemporary artworks are on the rise; however, this may be followed by a period to self-correct, following the historical trends such as in 2004, 2007 and 2011. Contemporary Art had the second highest volatility of the art categories presented, with a SD of 16.73% (See Table 4.1).

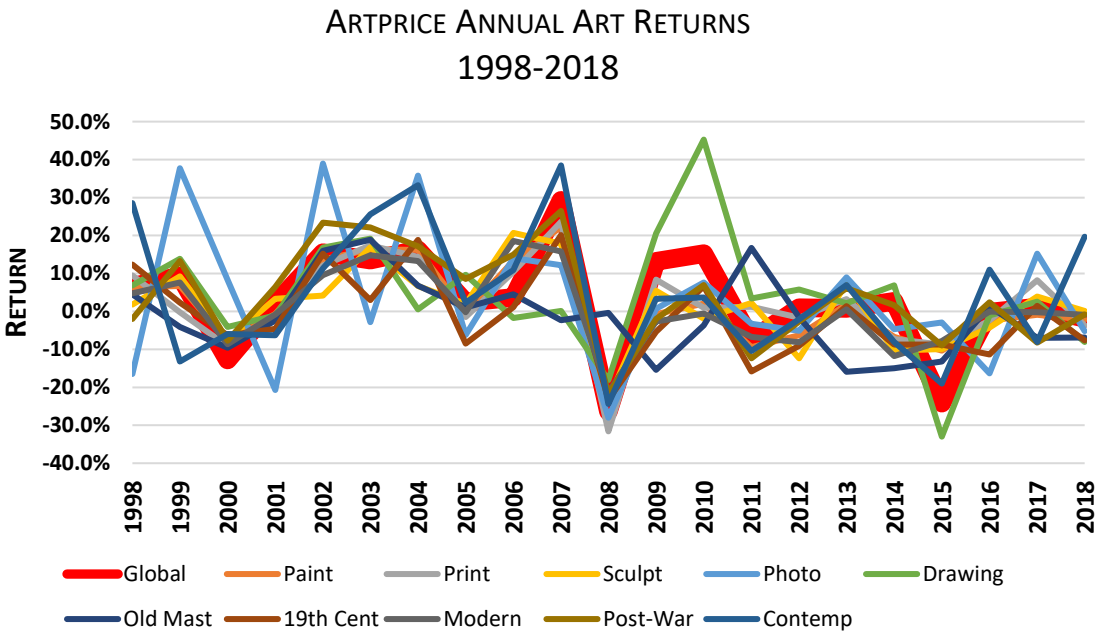

Figure 4.3. AP Annual Art Returns, 1998–2018.

Table 4.1 reports descriptive statistics for ten art markets and Artprice's comprehensive art market index (Global). Arithmetic means, standard deviations, coefficients of variation, geometric means, medians, maximums, minimums, skewness, kurtosis, and risk-adjusted returns are reported. Figure 4.3 reports the trends in annual returns, highlighting the highs and lows in the narrative to follow. The annual arithmetic returns from the 1998–2018 period range from -1.32% for Old Masters to 4.64% for

Contemporary Art. This is consistent with the trend in the Contemporary Art market that has resulted in several years of high growth in the last few years. Risk ranged from a low of 9.76% for Modern to 17.83% for photography. Risk was relatively low for Old Masters, 9.92%, in comparison to the overall art market. Global returns performed at 2.84% with a risk of 12.80% and represents the art market as a whole during this twenty-one-year period. Of the five classifications of art (Paintings, Print, Sculpture, Photo and Drawings), Drawings had the highest return (4.1%), and Paintings had the lowest returns (1.4%). However, during this time Paintings and Sculpture returns were relatively close—1.4% versus 1.5%, respectively.

The risk and return relationship was calculated and is presented in Table 4.1 with two measures. First, the Coefficient of Variation (CV) (risk divided by the mean return) measures the relationship of risk to return, in order to assess the volatility in the expected return of the art investment. Lower measures are more favorable investments. The lowest CV corresponds to Modern Art at 9.76, while the highest is 16.73, for Contemporary Art. Contemporary Art also has the lowest correlation with Old Masters, indicating that they are opposite spectrums of the trend.

Second, Table 4.1 reports the risk-adjusted return, calculated by subtracting the risk-free rate (T-bills) from the annualized return, divided by standard deviation, measuring the return relative to the risk. The results indicate several negative measures since the T-Bill rate is higher than the return of several art markets. Through the analysis of Artprice's ten subcategories and Global art markets, the results suggest that risk and return for art assets differ in both risk and return when considering various categories of art.

Table 4.1

Artprice Indices–Descriptive Statistics, 1998–2018

Selected description statistics for returns in ten art markets, one Global index; Artprice Indices: 1998–2018

	Paint	Print	Sculpt	Photo	Draw	Old Mast	19th Cent.	Mod.	Post-War	Cont.	Global
Central tendency, dispersion & shape											
Arithmetic	0.014	0.020	0.015	0.032	0.041	-0.013	-0.013	0.007	0.040	0.046	0.028
Std. Deviation	0.105	0.114	0.103	0.178	0.150	0.099	0.110	0.098	0.123	0.167	0.128
CV	7.730	5.762	6.785	5.528	3.644	-7.492	-8.580	13.585	3.102	3.606	4.514
Risk-Adjusted	-0.059	0.000	-0.044	0.070	0.143	-0.332	-0.296	-0.129	0.162	0.159	0.067
Geo. mean	0.008	0.013	0.010	0.017	0.030	-0.018	-0.019	0.002	0.032	0.033	0.020
Median	-0.006	0.010	0.022	-0.028	0.025	-0.023	-0.046	-0.002	0.024	0.034	0.024
Maximum	0.222	0.236	0.207	0.389	0.453	0.189	0.201	0.186	0.265	0.385	0.292
Minimum	-0.226	-0.316	-0.233	-0.280	-0.330	-0.159	-0.232	-0.213	-0.218	-0.244	-0.263
Skewness	0.046	-0.756	-0.269	0.526	0.224	0.448	0.313	-0.015	0.039	0.360	-0.504
Kurtosis	0.094	2.439	0.452	0.014	2.841	-0.248	-0.225	-0.070	-0.413	-0.531	0.877
Correlation											
Paint	1.000	—	—	—	—	—	—	—	—	—	—
Print	0.911	1.000	—	—	—	—	—	—	—	—	—
Sculpt	0.867	0.861	1.000	—	—	—	—	—	—	—	—
Photo	0.600	0.520	0.493	1.000	—	—	—	—	—	—	—
Drawing	0.400	0.427	0.334	0.297	1.000	—	—	—	—	—	—
Old Mast	0.390	0.354	0.319	0.126	0.216	1.000	—	—	—	—	—
19th Cent	0.888	0.815	0.645	0.656	0.380	0.229	1.000	—	—	—	—
Modern	0.966	0.874	0.915	0.576	0.310	0.439	0.796	1.000	—	—	—
Post-War	0.926	0.764	0.760	0.574	0.428	0.352	0.766	0.872	1.000	—	—
Contemp	0.812	0.775	0.621	0.235	0.262	0.345	0.741	0.753	0.684	1.000	—
Global Index®	0.864	0.848	0.708	0.504	0.691	0.242	0.799	0.755	0.829	0.733	1.000

Notes: Means, median, maximum and minimum are in annualized terms. Risk adjusted return = (ER - Rf)/SD
Global is AP's Global Index® of comprehensive art, compiled from all auction sales.
Correlation is Pearson correlation. Indices constructed by Artprice©

4.4.2 Art Market Research Indices: 1976–2018

The second dataset explored is provided by AMR from 1976 through 2018 on eight classes of paintings, one 19th Century French Sculpture, and one comprehensive art market index (ART). Figure 4.4 reports the trend of the ART annualized returns since

1976 and Figure 4.5 presents the subcategories of art and the ART returns. In order to explore how time periods affect art risk and return, Tables 4.2 and 4.3 present the descriptive statistics for the period 1976–2018 and 1998–2018, respectively.

Figure 4.4 reveals AMR's negative returns in the early 1990s, 2000s, and 2017. However, unlike AP, although the returns revealed a bear market, the AMR data did not report negative returns after the 2008 financial crisis. The figure also shows high year returns per the AMR art market to be 1999 and 2007—over 50% and 40%, respectively. The 2007 high is consistent with the high returns reported by AP, although AMR reports ten points higher than AP's 30% return. The comparison between these two indices suggests that 2007 brought in a substantial return for investors. Consistent with the AP's Global art returns during 1998–2018, there is a slight downward trend in returns during the 1976–2018 period by AMR's ALL returns.

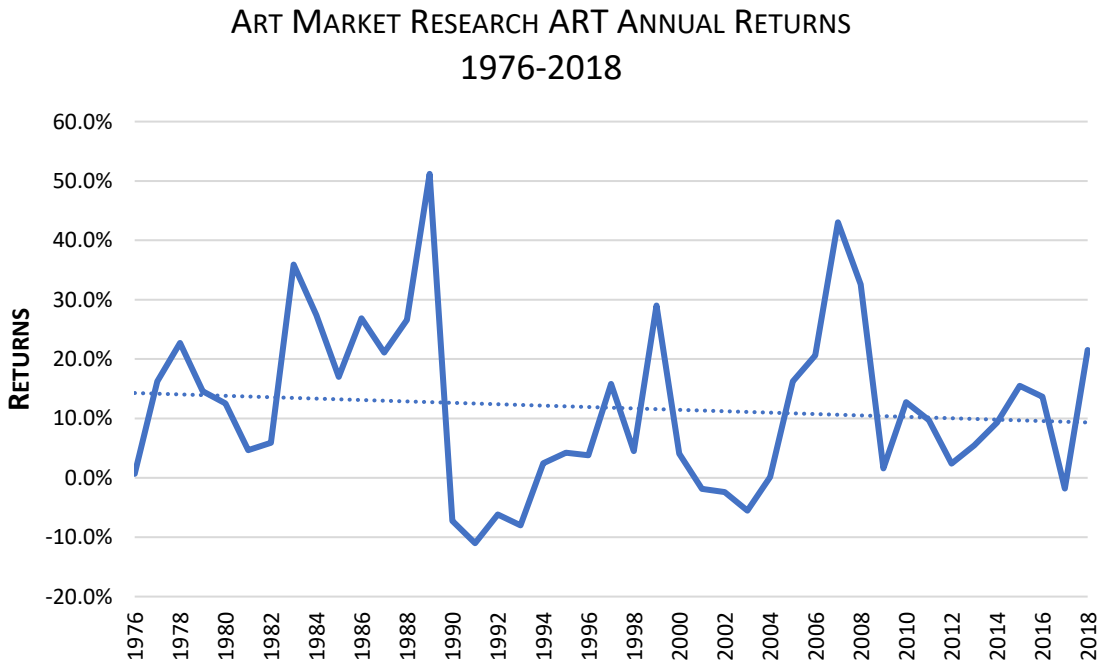

Figure 4.4. AMR ART Annual Returns, 1976–2018.

Figure 4.5 presents the annual returns of AMR's nine classifications of the art market and AMR's ART over the forty-three-year period. While many of the classifications and genres appear to trend together, 19th Century Sculpture has had the largest variability. Additionally, French Impressionist Art also had a high variability over this time period. Figure 4.5 depicts that the French Impressionist classification had been in a bear market for the past couple of years up until 2016; however, it is nearly matching the high return of just over 120.0% in the late 1980s before the art subcategory self-corrected in the early 1990s.

The thick red line presents the annual returns of the comprehensive art index in order to show how the subcategories of art differ from the art market as a whole. The dotted red line in the late 1980s reveals that French Impressionist Art appeared to mirror the art market as a whole. While many of the subcategories have similar trends to the art market index, it appears that several markets under-performed worse in the mid-80s and then flipped to over-perform in the 90s through 2005. These results suggest that not all categories of art will fare equally and understanding the trends within specific art categories affects the return on art investments and is an important finding in this study.

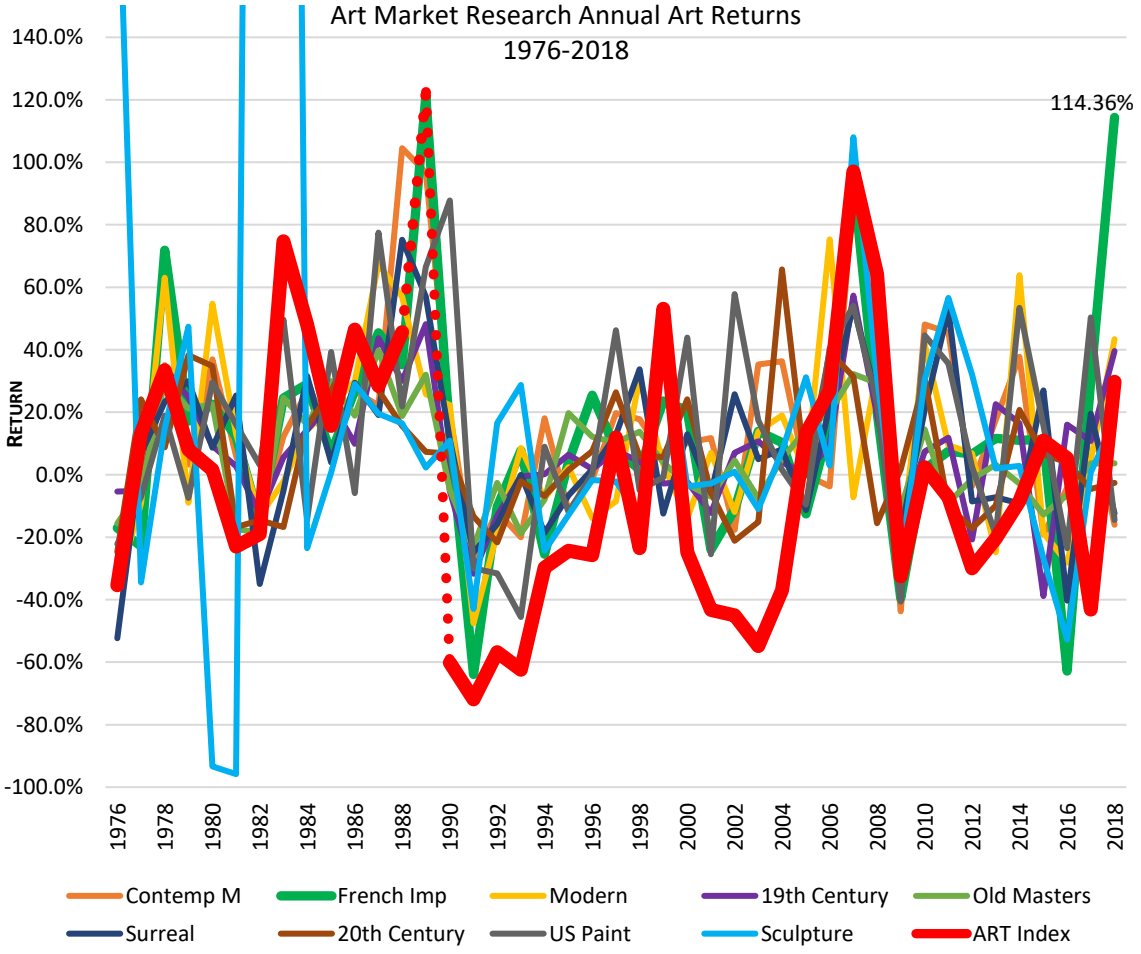

Figure 4.5. AMR Annual Art Returns, 1976–2018.

Table 4.2 reports descriptive statistics for nine art markets and AMR's comprehensive art market index (ART). Arithmetic means, standard deviations, coefficients of variation, geometric means, medians, maximums, minimums, skewness, kurtosis, and risk-adjusted returns are reported. Figure 4.5 reports the trends, highlighting the highs and lows in the narrative discussed in this section. The annual arithmetic returns for paintings from the 1976–2018 period range from 6.69% for 20th Century Paintings to 14.58% for Contemporary Masters Paintings. This is consistent with the trend in the Contemporary Art market as represented by Artprice that were also high compared to

other genres of art. It is important to note that the returns for Contemporary Art by Artprice from 1998–2018 were only 4.84% that may be a result of different types of Contemporary Art as well as the method of constructing the index, separate from the difference in time period; therefore, in the next section, this study will analyze AMR's indices against the 1998–2018 data range.

AMR reported the risk for paintings ranged from a low of 16.20% for Old Masters to 36.58% for French Impressionists. While Worthington and Higgs (2004) only investigated paintings, this study also added 19th Century Sculpture to expand the types of art explored from the art indices provider AMR. The return on 19th Century Sculpture between 1976–2018, is shown to be 79.84%, exceeding the return of all the genres of paintings, however at a risk of 376.3%. Art Market Research's ART returns performed at 11.81% with a risk of 13.97% and represented the art market as a whole during this forty-three-year period. See Table 4.3 for a comparison of AMR with AP's comprehensive art market returns for the same period of time (1998–2018).

The coefficient of variation (standard deviation divided by the arithmetic mean) was calculated as a measure of the risk-return relationship. This dispersion of the data series around the mean allows investors to determine how much volatility is assumed in comparison to the expected return. Lower measures are more favorable investments. The coefficient of variations (CV) for the art market under the AMR dataset for 1976–2018 is 1.18. Of the nine subcategories of art, Contemporary Masters has the lowest coefficient of variation of 2.14, followed by U.S. Paintings at 2.38; the highest CV was for Sculpture at 4.71.

Table 4.2 also reveals that most subcategories of art are not highly correlated with each other or the market as a whole. The highest correlation between subcategories are 19th Century European with French Impressionist at 0.7226, followed by Contemporary Master Paintings with Surrealist Paintings at 0.7185, and Old Masters with 19th Century European at 0.7124. Additionally, the comprehensive art market ART is most correlated with Old Masters at 0.7088. The remaining correlations are below 0.70. The correlations between the subcategories of art reveals that Sculpture is negatively correlated with all categories of paintings, except for U.S. paintings; that was non-correlated at 0.0046; and highly uncorrelated with the art market as a whole (ART) at 0.0369, thus providing insight into the benefits of diversifying across subcategories and types of art assets.

Table 4.2

Art Market Research Indices–Descriptive Statistics, 1976–2018

Selected description statistics for annual returns in nine art markets, one comprehensive (ART), Art Market Research Indices: 1976-2018

	CM	*FI*	*ME*	*NE*	*OM*	*SR*	*TE*	*US*	*SC*	*ART*
Central tendency, dispersion & shape										
Arithmetic	0.1458	0.1307	0.1022	0.0775	0.0628	0.0832	0.0697	0.1375	0.7984	0.1181
Standard deviation	0.3122	0.3658	0.2922	0.1931	0.1620	0.2596	0.2064	0.3279	3.7627	0.1397
Coefficient of Variance	2.1418	2.7982	2.8582	2.4926	2.5794	3.1199	2.9609	2.3842	4.7126	1.1835
Risk-adjusted return	0.3210	0.2328	0.1939	0.1652	0.1064	0.1450	0.1169	0.2805	0.2001	0.5189
Geometric mean	0.1064	0.0699	0.0640	0.0598	0.0504	0.0503	0.0506	0.0894	0.0430	0.1097
Median	0.1171	0.1127	0.0685	0.0699	0.0391	0.0812	0.0570	0.0895	0.0278	0.0970
Maximum	1.0451	1.2118	0.7532	0.5733	0.3979	0.7521	0.6571	0.8778	23.8920	0.5120
Minimum	-0.4373	-0.6393	-0.4754	-0.3883	-0.2304	-0.5233	-0.2473	-0.4553	-0.9582	-0.1101
Skewness	0.9826	0.8643	0.4623	0.2516	0.1368	0.1604	0.5841	0.2679	5.4930	0.6849
Kurtosis	1.5569	2.3867	-0.3462	0.7529	-0.9687	0.3333	-0.0632	-0.7443	34.2202	0.2851
Correlation										
CM	1.0000	—	—	—	—	—	—	—	—	—
FI	0.5692	1.0000	—	—	—	—	—	—	—	—
ME	0.4945	0.5104	1.0000	—	—	—	—	—	—	—
NE	0.6536	0.7226	0.5060	1.0000	—	—	—	—	—	—
OM	0.5424	0.5912	0.5507	0.7124	1.0000	—	—	—	—	—
SR	0.7185	0.5602	0.4633	0.4854	0.5150	1.0000	—	—	—	—
TE	0.3516	0.2417	0.4301	0.3230	0.4700	0.3735	1.0000	—	—	—
US	0.5262	0.4361	0.4509	0.4106	0.4503	0.4984	0.2465	1.0000	—	—
SC	-0.1344	-0.0716	-0.1486	-0.1343	-0.1604	-0.2735	-0.2147	0.0046	1.0000	—
ART	0.5702	0.6409	0.3603	0.6266	0.7088	0.4778	0.3170	0.3356	0.0369	1.0000

Notes: Means, median, maximum and minimum are in annualized terms. Eight Painting markets: CM = Contemporary Masters, FI = French Impressionist, ME = Modern European, NE = 19th Century European, OM = Old Masters, SR = Surrealist, TE = 20th Century English, US = Modern US Paintings; One Sculpture: SC = 19th Century Sculpture. ART is an comprehensive index, compiled from all art auction sales. Risk adjusted return is the ratio of standard deviation to return. Correlation is Pearson. Indices provided by AMR; extends Worthington & Higgs's (2004) study. Monthly data annualized.

In order to compare the returns from AMR with AP, Table 4.3 presents the descriptive statistics compiled from the AMR data for the period 1998–2018. The analysis reveals that the returns in art can vary widely depending on the methodology of the index measuring the art market and the sample used. As noted in the Chapter Three data section, AMR uses the central 80% to report their indices. It is possible that by removing the upper and lower 10% limits, the AMR returns present the average artwork return where extremes have been omitted. These trimming and smoothing mechanisms make it possible to eliminate seasonable and other possible distortions of returns, for

systematic analysis of the art markets (AMR, n.d.). The general results (see Table 4.3) present returns that exceed those of Artprice in general for the period 1998–2018 for similar categories. For example, AP's Old Masters' return from 1998–2018 is reported in Table 4.1 as -1.32% versus AMR's Old Masters' return from the same period in Table 4.3 is 4.16%, a 5.48% spread. Sample selection bias and the differences in the underlying index methodology may be two of the contributing factors to these variances.

The coefficient of variations for the art market under the AMR dataset for 1998–2018 is 1.14, and slightly less for the longer period of 1976–2018. Of the nine subcategories of art consistent with the 1976–2018 period, Contemporary had the lowest CV of 1.98, followed by U.S. Paintings, 2.08; however, during this time the highest CV was from 20th Century Art at 3.35, unlike Sculpture as reported during the longer period.

While AP's Old Masters reports a standard deviation of 9.92%, AMR's Old Master's standard deviation is also higher (at 12.30%), a 2.38% spread. It is possible that the removal of outliers from the data by AMR create a more average return and risk than Artprice due the central 80% methodology. Other differences in methodologies between these two art indices providers are likely to contribute to the variance in both returns and risks. Although the returns differ, both AP's and AMR's lowest category of returns were consistently Old Masters artworks. Therefore, these low rates of return results may validate that Old Master artworks are not as lucrative of an investment as other categories of art, consistent with Mei and Moses (2002) findings. Through the analysis of AMR's nine art categories and ART indices, the results support the alternative Hypothesis 1, risk and return for art assets differ both in risk and return when considering various indices, categories and periods.

Table 4.3

Art Market Research Indices–Descriptive Statistics, 1998–2018

Selected description statistics for annual returns in nine art markets, one comprehensive (ART), Art Market Research Indices: 1998-2018

	CM	*FI*	*ME*	*NE*	*OM*	*SR*	*TE*	*US*	*SC*	*ART*
Central tendency, dispersion & shape										
Arithmetic	0.1475	0.1170	0.1070	0.0689	0.0416	0.0858	0.0637	0.1436	0.1122	0.1098
Standard deviation	0.2924	0.3708	0.2802	0.1976	0.1230	0.2341	0.2133	0.2990	0.3352	0.1247
Coefficient of Variance	1.9818	3.1702	2.6189	2.8661	2.9543	2.7276	3.3479	2.0817	2.9861	1.1360
Risk-adjusted return	0.3488	0.1926	0.2192	0.1183	-0.0321	0.1720	0.0851	0.3280	0.1989	0.5149
Geometric mean	0.1098	0.0552	0.0734	0.0500	0.0347	0.0598	0.0443	0.1021	0.0632	0.1031
Median	0.1171	0.1100	0.0685	0.0745	0.0362	0.0812	0.0173	0.1573	0.0278	0.0930
Maximum	0.9089	1.1436	0.7532	0.5733	0.3217	0.5410	0.6571	0.5783	1.0797	0.4305
Minimum	-0.4373	-0.6280	-0.2815	-0.3883	-0.1271	-0.4032	-0.2114	-0.4062	-0.5281	-0.0555
Skewness	0.4442	0.9712	0.6544	0.2096	0.7543	0.1346	1.0598	-0.0734	0.8576	0.8996
Kurtosis	0.8808	2.9193	-0.0698	1.7408	0.0565	-0.2532	1.2155	-1.3177	2.1581	0.5338
Correlation										
CM	1.0000	—	—	—	—	—	—	—	—	—
FI	0.3725	1.0000	—	—	—	—	—	—	—	—
ME	0.2506	0.3174	1.0000	—	—	—	—	—	—	—
NE	0.5797	0.5849	0.2392	1.0000	—	—	—	—	—	—
OM	0.5003	0.4231	0.3871	0.5704	1.0000	—	—	—	—	—
SR	0.5421	0.3826	0.1725	0.2038	0.4161	1.0000	—	—	—	—
TE	0.3098	0.1498	0.3287	0.1299	0.2767	0.1423	1.0000	—	—	—
US	0.4997	0.3341	0.3322	0.2734	0.3342	0.6650	0.2103	1.0000	—	—
SC	0.6435	0.6007	0.1660	0.4743	0.5806	0.5009	0.1103	0.3842	1.0000	—
ART	0.3418	0.5014	0.1762	0.4716	0.6495	0.2201	0.2027	0.1470	0.6072	1.0000

Notes: Means, median, maximum and minimum are in annualized terms. Eight Painting markets: CM = Contemporary Masters, FI = French Impressionist, ME = Modern European, NE = 19th Century European, OM = Old Masters, SR = Surrealist, TE = 20th Century English, US = Modern US Paintings; One Sculpture: SC = 19th Century Sculpture. ART is an comprehensive index, compiled from all art auction sales. Risk adjusted return is the ratio of standard deviation to return. Correlation is Pearson. Indices provided by AMR; extends Worthington & Higgs's (2004) study. Monthly data annualized.

4.4.3 Sotheby's Mei Moses Indices: 1858–2018

The third set of indices explored is provided directly by the auction house Sotheby's, who now maintain the Mei and Moses art market data. The ALL index dates back to 1858, while the three subcategories of art indices present data from a variety of dates. In order to compare SMM returns with AP and AMR, this section first explores returns in art from the timeseries 1998–2018, the timeframe in which AP's indices were available (1998). Next, the SMM dataset is explored for the same years that AMR's indices started (1976). After the analysis of the 1976–2018 period, this study reviewed

the movement in art prices from SMM's ALL index from its earliest year (1858), for an in-depth investigation into the historical art market returns. The returns are further classified by decade in Chapter Eight, where they are compared to the financial markets, with their corresponding correlations (see Table 8.4).

4.4.3.1 Sotheby's Mei Moses 1998–2018. In this section, the Sotheby's Mei Moses dataset represents returns from 1998 through 2018 on one comprehensive all-art index (ALL) and three classes of paintings: Post-War & Contemporary, Impressionist & Modern, and Old Masters & 19th Century.

Table 4.4 presents the SMM's descriptive statistics from 1998–2018 for the four indices. Although the subcategories are not as granular as AP or AMR, the analysis to follow provides insight into the similar genres across the data providers. For this time frame, the ALL comprehensive index presents a return of 5.28% with a risk of 10.03%. The return is greater than AP's Global return for the same period of 2.84% (Table 4.1), and lower than AMR's ART return of 10.98% (Table 4.3). SMM's returns appear to fall between the two art market data providers. The coefficient of variation (standard deviation divided by the arithmetic mean) was calculated as a measure of the risk-return relationship. This dispersion of the data series around the mean allows investors to determine how much volatility is assumed in comparison to the expected return. Lower measures are more favorable investments. The coefficient of variation for the art market under the SMM dataset for 1998–2018 is 1.90. Of the three subcategories of art, Post-War & Contemporary has the lowest coefficient of variation of 1.43, followed by Impressionist & Modern, 1.68, and lastly Old Masters & 19th Century at 8.37. The Post-War & Contemporary provided the largest return of 10.46% with a risk of 14.91%, for

the most favorable risk/reward relationship. Impressionist & Modern came in second with return of 4.52% for a risk of 7.59%. Finally, the lowest risk/reward relationship was found to be the Old Masters & 19th Century Art with a low return of 1.40% and a relatively high risk of 11.71%. For a lower risk of 7.59% an investor would have been able to invest in Impressionist & Modern Art for about a 2.5 times higher return compared to Old Masters & 19th Century Art.

Table 4.4

Sotheby's Mei Moses Indices–Descriptive Statistics, 1998–2018

Selected description statistics for returns in three art markets, one ALL-Art, SMM Indices: 1998-2018

	Post-war & Contemporary	Impressionist & Modern	Old Masters & 19th Century	SMM ALL
Central tendency, dispersion & shape				
Arithmetic	0.1046	0.0452	0.0140	0.0528
Standard Deviation	0.1491	0.0759	0.1171	0.1003
Coefficient of Variation	1.4252	1.6791	8.3740	1.9016
Risk-adjusted return	0.3961	-0.0046	-0.2697	0.0718
Geometric mean	0.0932	0.0424	0.0066	0.0477
Median	0.1304	0.0516	0.0271	0.0657
Maximum	0.3343	0.1954	0.2166	0.1903
Minimum	-0.3421	-0.1384	-0.2841	-0.2273
Skewness	-0.9087	-0.3079	-0.8110	-0.7964
Kurtosis	2.4243	0.4769	0.9660	1.1880
Correlation				
Post-war & Contemporary	1.0000			
Impressionist & Modern	0.9114	1.0000		
Old Masters & 19th Century	0.6663	0.6517	1.0000	
SMM ALL Index	0.9140	0.8859	0.7843	1.0000

Notes: Means, median, maximum and minimum are in annualized terms.
SMM ALL is a comprehensive index, compiled from all art auction sales. Risk adjusted return = (ER - Rf)/SD
Correlation is Pearson correlation. All indices provided by Sotheby's.

4.4.3.2 Sotheby's Mei Moses 1976–2018. In this section, the Sotheby's Mei Moses dataset represents returns from 1976 through 2018 on one comprehensive all art

index (ALL). Figure 4.6 reports the trend of the annual returns of the ALL index with a downward slope in the returns of the art market since 1976. These findings also reveal that in the 1980s, 1990s, and in 2009 there were large losses in the art market as a whole, with the greatest variability taking place between the late 1980s and early 1990. The visual analysis of Figure 4.6 indicates that art is not producing gains at the pre-1990 rates. This trend may suggest that investors were attempting to hedge on the high inflation rates of the 1980s with art, but since then investors have not been as motivated to use art for such a strategy due to the tempered inflationary environment since the 1990s. The trendline over the period 1976–2018 suggests a steeper downward trend those shown by AP and AMR; however, all three indices support that the art market returns have generally declined over the years.

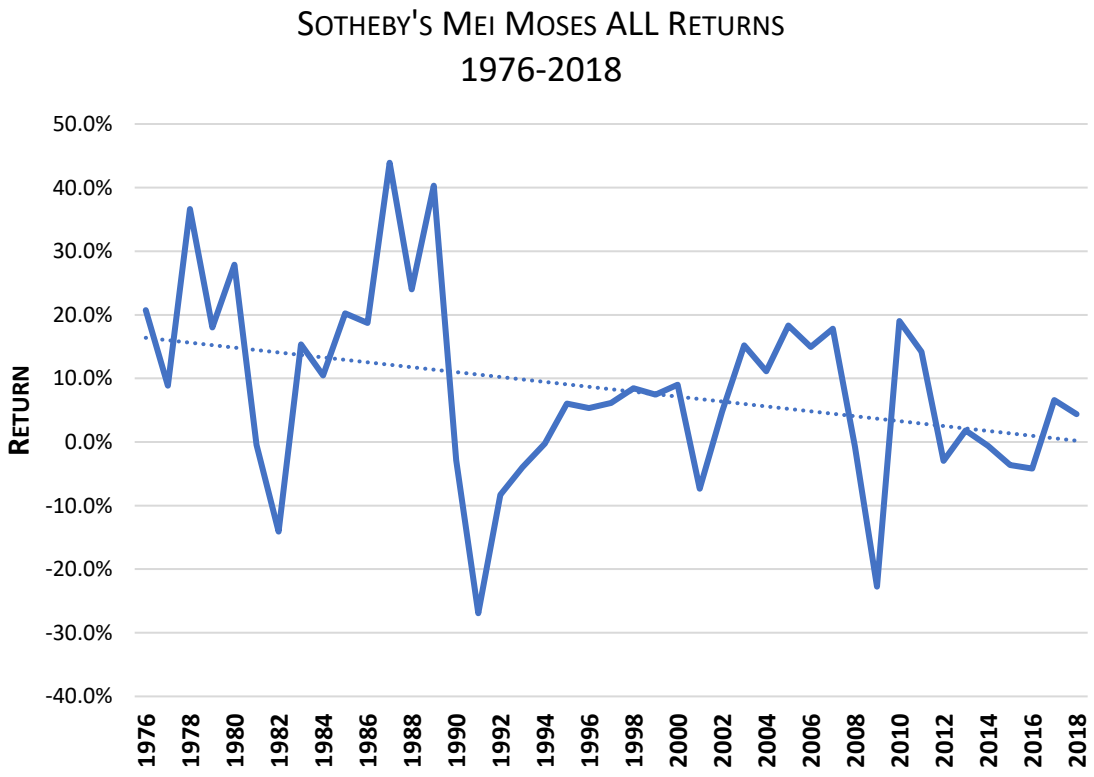

Figure 4.6. SMM ALL Annual Returns, 1976–2018.

In this section, the Sotheby's Mei Moses dataset represents returns from 1976 through 2018 on one comprehensive all art index (ALL) and three classes of paintings: Post-War & Contemporary, Impressionist & Modern, and Old Masters & 19th Century. A review of Figure 4.7 shows the SMM ALL art returns appear to be central to the subcategory returns of the art market, and although they trend together during some periods, they do not correlate consistently during the 43-year period. Post-War returns continuously outperform the overall market. Consistent with Mei and Moses (2002), the pattern of returns compared to Post-War & Contemporary provides evidence of the underperformance of the Old Masters & 19th Century subcategory during several periods, and is supported by the lower overall returns presented in Table 4.5. From the perspective of an investor, while common knowledge of a well-known masterpiece may appear attractive, according to the analysis, this category tends to underperform in the art market index. Contrary to common perception, the largest investment performances tend to come from artworks of lesser-known artists, as evidence suggests in the review of the Post-War & Contemporary in Figure 4.7, and identified in Table 4.5. Table 4.5 reports an approximate 5.0% greater spread in return of Post-War & Contemporary over Old Masters & 19th Century Art (11.69% return over 6.65% return, respectively).

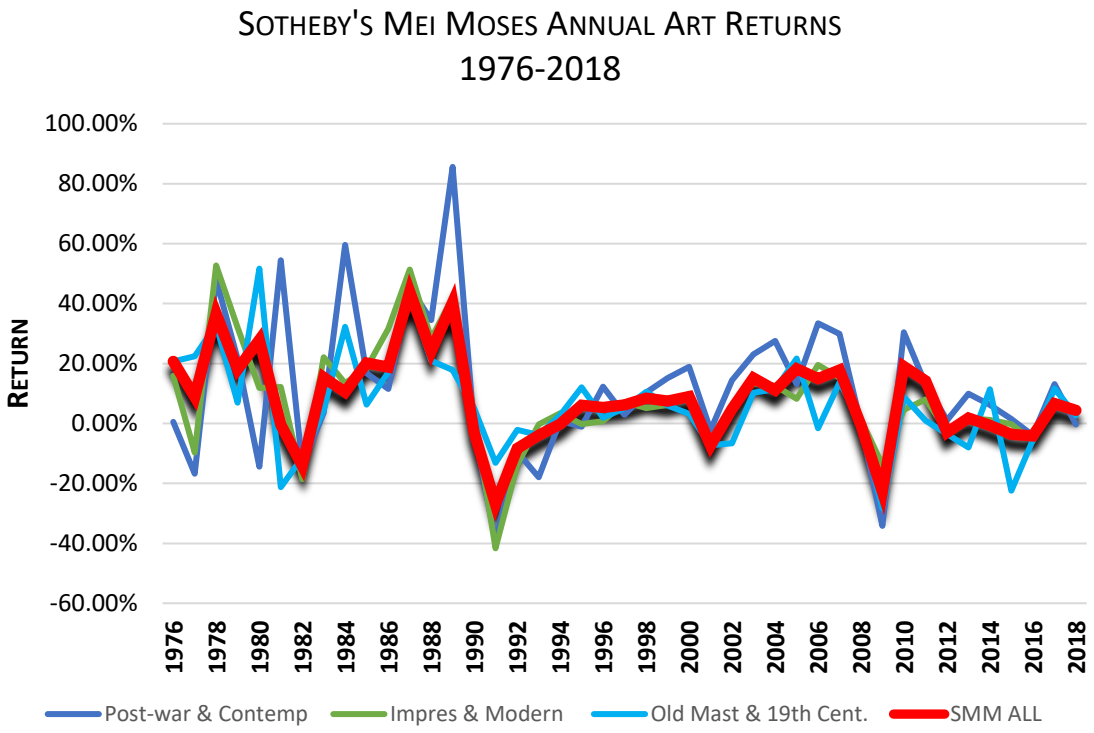

Figure 4.7. SMM Annual Art Returns, 1976–2018.

While Figure 4.7 shows the trends in annual returns, highlighting the highs and lows in this narrative, Table 4.5 reports descriptive statistics for three art markets and SMM's comprehensive art market index (ALL). The measures included the arithmetic means, standard deviations, coefficients of variation, geometric means, medians, maximums, minimums, skewness, kurtosis, and risk-adjusted returns.

The annual arithmetic returns from the 1976–2018 period range from 6.53% for Old Masters/19th Century to 11.69% for Post-War/Contemporary. This is consistent with the return trends in the Contemporary Art market reported by both AP and AMR. Risk ranged from a low of 15.53% for Old Masters & 19th Century to 23.72% for Post-War & Contemporary Art. ALL returns performed at 8.29% with a risk of 14.50% and represents the art market as a whole during this forty-three-year period. There is a high correlation

between Impressionist & Modern with the comprehensive art market ALL (0.9007). The coefficient of variation (standard deviation divided by the arithmetic mean) was calculated as a measure of the risk-return relationship. This dispersion of the data series around the mean allows investors to determine how much volatility is assumed in comparison to the expected return. Lower measures are more favorable investments. The coefficient of variation for the art market was 1.75. Of the three subcategories of art, Post-War & Contemporary had the lowest coefficient of variation of 2.03, followed by Impressionist & Modern, 2.06, and lastly Old Masters & 19th Century at 2.43. Though the 11.69% return on Post-War & Contemporary Art is attractive, the risk of 23.72% may not provide a favorable reward when accounting for the related risk relationship.

Table 4.5

Sotheby's Mei Moses Indices–Descriptive Statistics, 1976–2018

Selected description statistics for returns in three art markets, one ALL-Art, SMM Indices: 1976-2018

	Post-war & Contemporary	Impressionist & Modern	Old Masters & 19th Century	SMM ALL
Central tendency, dispersion & shape				
Arithmetic	0.1169	0.0829	0.0653	0.0829
Standard Deviation	0.2372	0.1716	0.1583	0.1450
Coefficient of Variation	2.0294	2.0695	2.4253	1.7492
Risk-adjusted return	0.3007	0.2178	0.1246	0.2575
Geometric mean	0.0922	0.0690	0.0536	0.0731
Median	0.1036	0.0619	0.0514	0.0743
Maximum	0.8560	0.5271	0.5166	0.4391
Minimum	-0.3923	-0.4166	-0.2841	-0.2693
Skewness	0.6572	0.2927	0.4476	0.1342
Kurtosis	1.4319	1.8798	1.0470	0.6771
Correlation				
Post-war & Contemporary	1.0000			
Impressionist & Modern	0.7653	1.0000		
Old Masters & 19th Century	0.3809	0.6000	1.0000	
SMM ALL Index	0.7060	0.9007	0.7866	1.0000

Notes: Means, median, maximum and minimum are in annualized terms.
SMM ALL is a comprehensive index, compiled from all art auction sales. Risk adjusted return = (ER - Rf)/SD
Correlation is Pearson correlation. All indices provided by Sotheby's.

4.4.3.3 Sotheby's Mei Moses Index 1858–2018. This section reviews Sotheby's Mei Moses returns from 1859 through 2018 on one comprehensive all art index (ALL). Sotheby's Mei Moses has compiled a comprehensive art index since 1858. Figure 4.8 presents the general increase in the index from 1858 to 2018. A holistic view of the market shows that art prices were relatively flat from 1858 through 1950, while the second half of the century shows a continued increase in prices through both bull and bear markets. There is a sharp dip in the SMM ALL index corresponding to the 2008 financial crisis (see Figures 4.8 and 4.9).

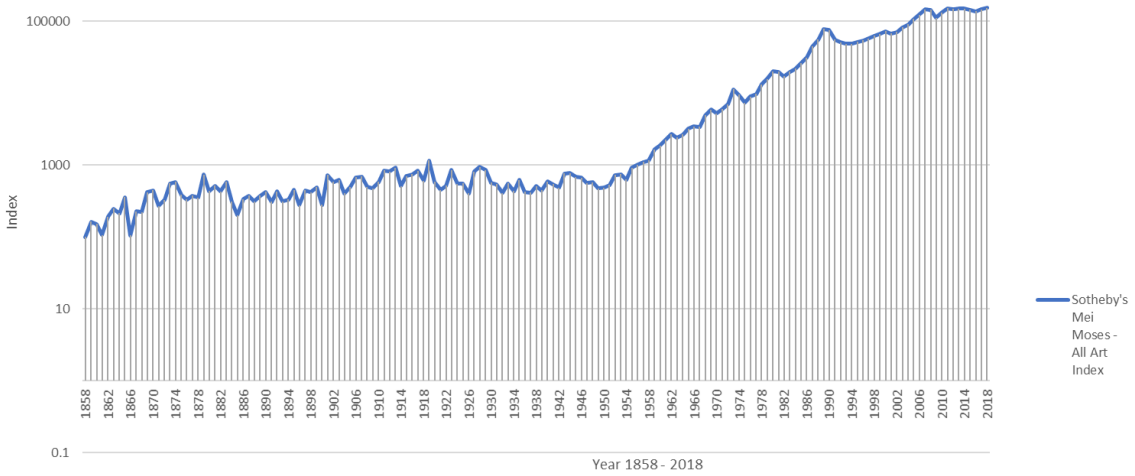

Figure 4.8. SMM Price Index, 1858–2018.

Figure 4.9 presents the price index from 1859 through 2018 compiled from SMM's extensive historical ALL index. A boom is depicted in the beginning of the twentieth century with a high return of 106%. It is noteworthy to mention that there was also a spike in art returns just prior to the Great Depression in the U.S., with art returns maxing out at approximately 100%. The large returns in the 19th century and the first part of 20th century start to taper off in the 1930s, with a spike in over a 40% return in the 1940s, 1970s, and 1980s. The art market volatility also appears to be the highest through the 1940s, with the market becoming more stable since the early 1990s. Art returns in the overall market have not exceeded 20% since the late 1980s (see Figure 4.9). Through the analysis of Sotheby's Mei Moses' art index, the art returns support the alternative Hypothesis 1; risk and return for art assets differ, both in risk and return, when considering various indices, categories and periods.

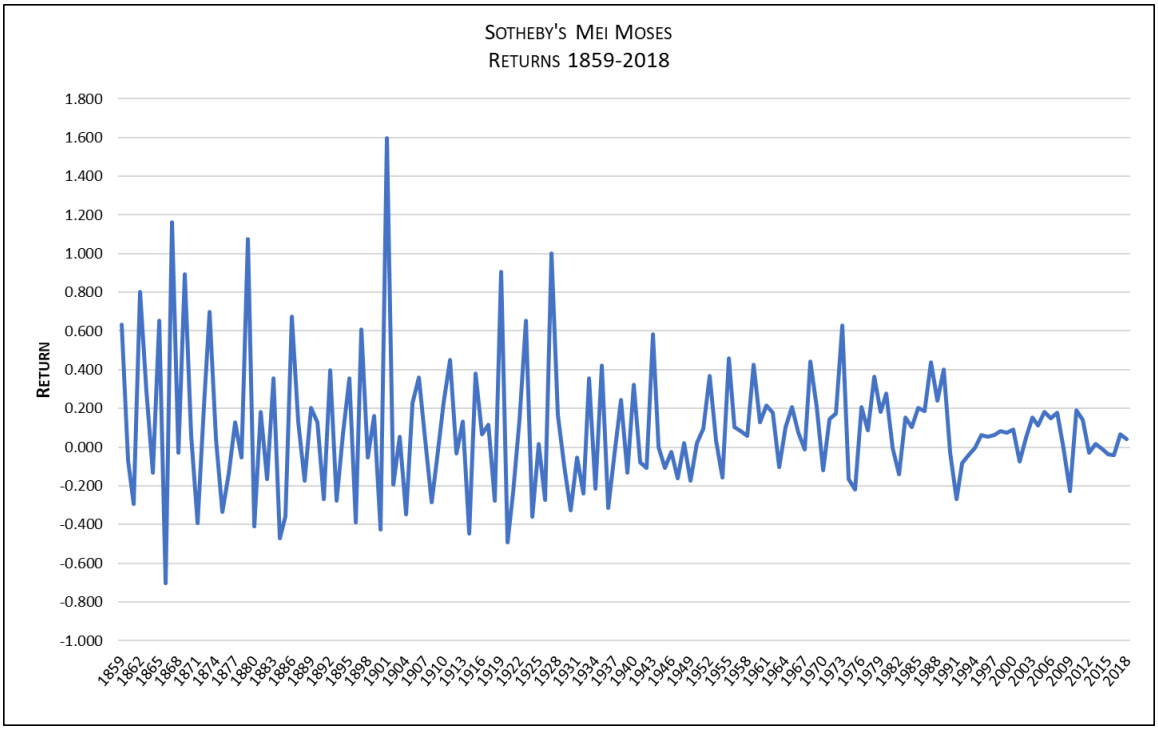

Figure 4.9. SMM ALL Annual Returns, 1859–2018.

4.5 Discussion

Through the analysis of three art indices providers, it appears that the return on art is complex. Each of the three art indices revealed a different return on the overall art market as well as subcategories and genres of artworks. This chapter provided useful information to stakeholders regarding return on art, and supports the need to understand how heterogeneity and trends that drive the demand for sub-classifications of art might contribute to the financial reward associated with investing in art.

This chapter explored the research sub-question one: “Do risk and return for art assets differ when considering various indices, categories, and periods?” Based upon the analysis of the three indices, the return and risk under each comprehensive art index varied. Additionally, the analysis suggests that different categories of art, including types, format and genres differed in return and volatility. These characteristics provided

additional insight into how some categories may be a better investment for high returns while other characteristics of art provide a more stable investment. Old Masters & 19th Century Art provides marginal returns as their supply is limited and it appears that their prices have peaked, resulting in lower future expected returns. While Post-War and Contemporary Art, while being more volatile, provides the largest returns to investors. However, similar to up-and-coming IPOs, the success is often dependent on many unknown and future factors. Artworks additionally require expert knowledge into the popularity of the artist that underlies the original artwork, making it difficult to measure new works as future investment opportunities.

One interesting result of the study was the change in phenomenon of the returns on Sculpture. AMR reported significant returns of 79.84% and risk of 376% (Table 4.2) of the 19th Century Sculptures, from 1976–2018. Similar to Old Master Paintings, these enormous masterpiece returns diminished in the later part of the century, as evident from the 1998–2018 analysis of AMR with reported returns of 11.22% (Table 4.3). It is likely—since that the majority of these sculptures were attributed to the preeminent French sculptor Auguste Rodin, who died in 1917—that the high returns may be a reflection of the artist's works being introduced into the art market in the early 1900s. Similar to modern day Contemporary artists, Rodin became popular later in his career, and even more so after his life; by the late 1990s the market prices for his works had absorbed the majority of the growth in the price of the artworks as museums now hold the majority of his works. This example provides insight into the variability of art as an investment, and the role of the category and how the period being measured may impact the financial return an investor would receive.

Based on the analysis above of the three art indices providers' risk and return for subcategories of art and the comprehensive art market indices, this evidence in this chapter supports a rejection of the Null Hypothesis 1 and concludes in favor of the Alternative Hypothesis that risk and return for art assets differ, both in risk and return, when considering various indices, categories and periods.

It is important when considering the above results to compare them to other asset classes. Chapter Five explores art assets against other asset classes, including equity, fixed income, and classic cars as another collectible. Similar to Chapter Four, the results from this analysis will be presented for each of the three art indices providers: Artprice (1998–2018); Art Market Research (1976–2018), and Sotheby's Mei Moses (Various years between 1858–2018).

CHAPTER FIVE: ART AND FINANCIAL RETURNS COMPARED

This chapter discusses the results and descriptive statistics on return and risk utilizing three independent providers' art indices and compares them to those of the financial markets. The return on real assets is often compared to the financial markets in hopes of finding alternative investments that may meet or possibly outperform the market. Art is a unique investment in that it appreciates over time and the supply is inherently limited, and yet art as an investment is not as commonplace as equities and bonds for conventional investors. In this chapter, the return and volatility of art with several financial assets are explored and the prospects of art as an investment with traditional investments were compared during several time intervals.

5.1 Research Sub-Question Two: Overview

This chapter explores research sub-question two: "Do risk and return for art assets differ from other real and financial assets, when considering various indices, categories, and periods?" The first section introduces the hypothesis. The second section introduces the model used to investigate the risk and return for both art and financial assets. The third section presents the findings. The final section provides a detailed discussion of the results and a conclusion on the given hypothesis.

5.2 Hypothesis

The second hypothesis seeks to understand how risk and return interact in the realm of alternative investments and proposes to answer the research question: Do risk and return for art assets differ from other real and financial assets, when considering various indices, categories, and periods? Therefore, this study posits:

- Proposition 2: Art market returns do not differ from financial returns, both in return and risk.
    - $H2A_0$: Art market returns do not differ from financial returns, both in risk and return when comparing AP's Indices to S&P 500, T-Bonds, Corp-Bonds, T-Bills, and Russel 2000.
    - $H2A_a$: Art market returns differ from financial returns, both in risk and return when comparing AP's Indices to S&P 500, T-Bonds, Corp-Bonds, T-Bills, and Russel 2000.
    - $H2B_0$: Art market returns do not differ from financial returns, both in risk and return when comparing AMR Indices to S&P 500, T-Bonds, Corp-Bonds, T-Bills, and Russel, 2000.
    - $H2B_a$: Art market returns differ from financial returns, both in risk and return when comparing AMR Indices to S&P 500, T-Bonds, Corp-Bonds, T-Bills, and Russel, 2000.
    - $H2C_0$: Art market returns do not differ from financial returns, both in risk and return when comparing SMM's Indices to S&P 500, T-Bonds, Corp-Bonds, T-Bills, and Russel 2000.
    - $H2C_a$: Art market returns differ from financial returns, both in risk and return when comparing SMM's Indices to S&P 500, T-Bonds, Corp-Bonds, T-Bills, and Russel 2000.

5.3 Model: Art and Financial Asset Risk and Return

Figure 5.1 presents the data model to compare the art market to financial market risk and returns in a multi-asset portfolio. The data show that data from one comprehensive art index is added to financial indices to create a portfolio of asset classes.

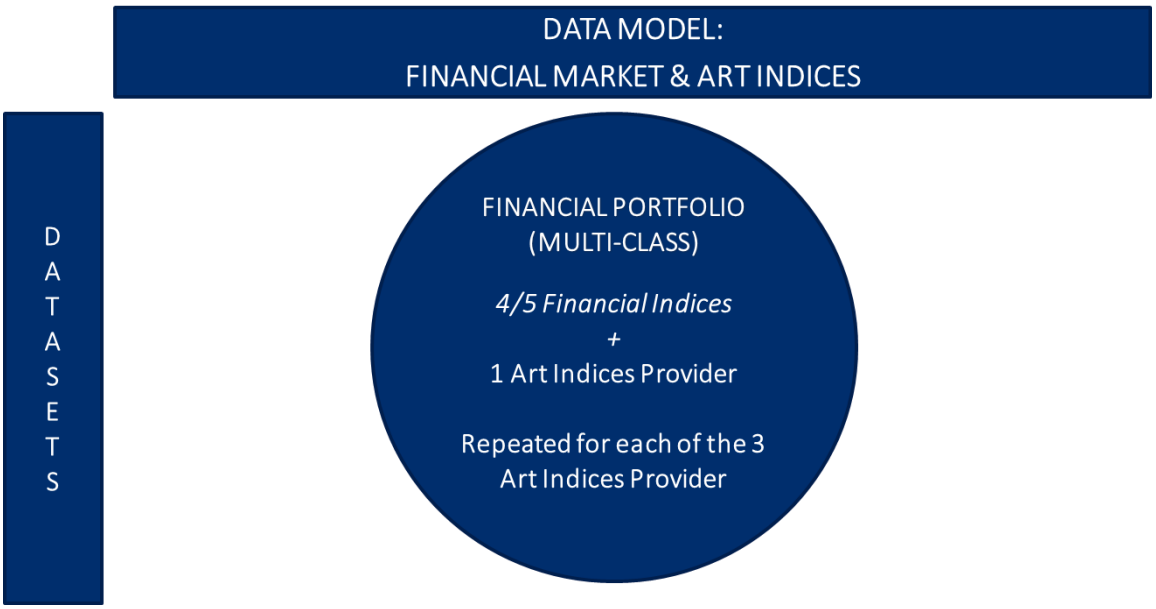

Figure 5.1. Model for H2: Art and Financial Risk and Return.

5.4 Results: Art and Financial Asset Risk and Return

The following presents key results for this study of the risk and return of art as compared to financial assets. This study explores three independent indices to compare the art market with various traditional investment classes. The financial classes consist of (a) treasury bills; (b) treasury bonds; (c) corporate bonds; (d) the S&P 500; and (e) the Russel 2000 (RUT2K for the 1998–2018 series only). First, Artprice's indices with extensive datasets on art sales from all over the world are considered. Second, Art Market Research indices are explored consistent with those in Worthington & Higgs (2004) and

extend the data to include sculpture along with a traditional collectible, classic cars. Third, Sotheby's Mei Moses extensive repeat sales indices are consistently examined. As described in the data section, the three art indices providers presented below apply different methodologies to construct their indices. The intent of this section is to investigate the art returns compared to other investment returns with consistent methodology in computing returns to reduce research bias in this study. Through this analysis of various asset classes, the comparison of investing in the art market versus traditional investment markets is examined.

5.4.1 Artprice Indices: 1998–2018

From Artprice's indices, trends in the art market were explored, as a means to differentiate the risk and returns of investing in art within classes of art, and among financial classes. In order to explore Hypothesis 2, Figure 5.2 presents a visualization of the ten sub-category art indices and the Global art index compiled by Artprice compared to the five financial index returns from the years 1998–2018. Based on the algorithms used to produce these indices over the twenty-one year period, it is apparent that returns of art differ depending upon classification. Consistent with Mei and Moses (2002), Old Masters underperformed compared to the other nine subcategories with a negative return of -1.32%. While none of the art subcategories exceeded the equity returns or Corporate or T-Bonds, five of the subcategories showed returns greater than those of the of T-Bill. Figure 5.2 shows the five subcategories were: Contemporary Masters 4.64%, Drawings 4.11%, Post-War 3.96%, Photography 3.23%, and Print 1.98%. These returns, along with the Global Art Index 2.84%, outperformed T-Bills at the cost of increased risk, ranging from 11.39% for Print to 17.83% for Photography, compared to the low level of risk of

T-Bonds 1.90%. For a return of 5.08% on T-Bonds with 8. 44% risk, art does not appear to be an attractive investment when factoring in the risk to reward ratio. Figure 5.2 provides a general trend for the highest returns when risk is not a consideration. Since the data include sales of several genres of art, the volatility between the classes of art are consistent with expectations, and contrasts with financial market returns.

The Global returns outperformed U.S. Treasury Bills, inconsistent with Mei & Moses (2002), they did not outperform other fixed income (Treasury and Corporate Bonds). This is reasonable, as the Artprice index considers several forms of art, and includes more auction houses around the world with greater amounts of lower priced pieces of art. This methodology is imperative when understanding the results, as the underlying assets are not made up of the same status of pieces that would be sold at Sotheby's or Christie's auction houses. This difference creates a limitation in the study of the return of art as an investment. Figure 5.2 provides a visual summary.

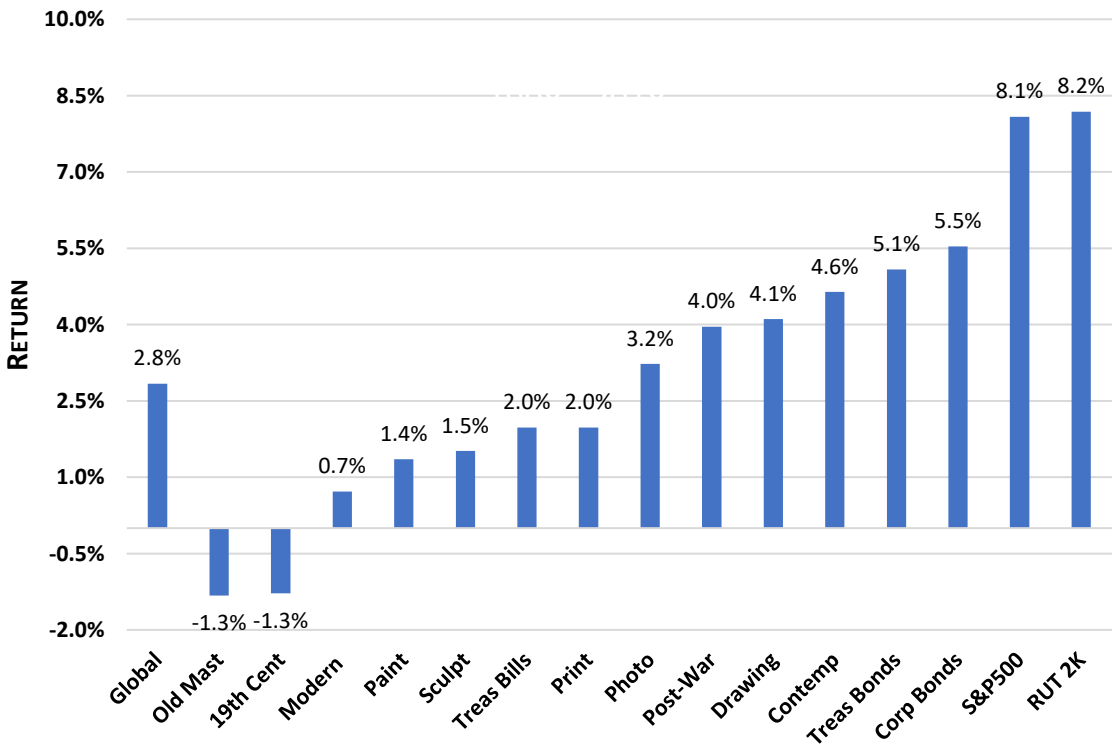

Figure 5.2. AP Art and Financial Returns, 1998–2018.

Table 5.1 summarizes the financial markets and correlation with the Global Index. Arithmetic means, standard deviations, coefficients of variation, geometric means, medians, maximums, minimums, skewness, kurtosis, and risk-adjusted returns are reported. Table 5.1 reports financial returns in relation to Artprice's Global Index. This comprehensive index outperforms the U.S. Treasury Bills by 0.087%, while the Global index risk of 12.80% was 10.9% points larger than the 1.9% risk of the T-Bill. Overall, the equity markets had the highest returns and the highest risks. Returns and risk of 8.09% and 17.06% (SD) for large stocks and, 8.18% and 20.64%(SD) for small stocks. The Global returns negatively correlates with U.S. Treasury Bonds at -0.2335 and has the lowest correlation with U.S. Treasury Bills at 0.1236. See Table 5.1 descriptive statistics for the summary of the financial markets as compared with Artprice's Global art market.

Table 5.1

Descriptive Statistics for Global and Financial Returns, 1998–2018

	S&P 500	T- Bond	Corp Bond	T- Bill	RUT 2K	Global
Central tendency, dispersion & shape						
Arithmetic	0.0809	0.0508	0.0554	0.0197	0.0818	0.0284
Standard Deviation	0.1706	0.0844	0.0545	0.0190	0.2064	0.1280
Coefficient of Variation	2.1104	1.6595	0.9848	0.9626	2.5213	4.5142
Risk-adjusted return	0.3582	0.3687	0.6535	0.0000	0.3010	0.0674
Geometric mean	0.0655	0.0474	0.0540	0.0196	0.0613	0.0199
Median	0.1177	0.0297	0.0642	0.0139	0.0745	0.0242
Maximum	0.3215	0.2010	0.1868	0.0576	0.5605	0.2925
Minimum	-0.3655	-0.1112	-0.0494	0.0003	-0.3782	-0.2634
Skewness	-0.8550	-0.1075	-0.0085	0.5924	0.0693	-0.5040
Kurtosis	0.7552	-0.5172	0.3226	-1.1013	0.6135	0.8767
Correlation						
S&P 500	1.0000	—	—	—	—	—
U.S. Treasury Bonds	-0.6270	1.0000	—	—	—	—
Corporate Bond	0.2410	0.0477	1.0000	—	—	—
U.S. Treasury Bills	-0.1557	0.2130	-0.1219	1.0000	—	—
Russel 2000	0.7913	-0.6365	0.3544	-0.2725	1.0000	—
AP Global Index	0.4415	-0.2335	0.4294	0.1236	0.3853	1.0000

5.4.2 Art Market Research Indices: 1976–2018

The second dataset explored is provided by AMR from 1976 through 2018 on eight classes of paintings, one 19th Century French Sculpture and one comprehensive art index, ART. In this section, Figure 5.3 shows the returns for the entire period that the AMR indices cover (1976–2018). Figure 5.4 follows with an analysis to compare the AMR returns to Artprice's returns from 1998–2018.

5.4.2.1 Art Market Research Indices: 1976–2018. From AMR's indices, trends in the art market were explored as a means to differentiate the risks and returns of investing in art within classes of art, and among financial classes. In order to explore

Hypothesis 2, Figure 5.3 presents a visualization of the ten subcategory art indices and the ART index compiled by AMR compared to financial returns from the years 1976–2018. Based on the methodology used to produce these indices over the forty-three years, it is apparent that returns of art differ depending upon classification. For example, returns for French Impressionist art (13.07%), U.S. Paintings (13.75%), Contemporary Masters (14.58%), and 19th Century French Sculpture (79.8%) all exceeded equity returns of 12.33%. Three of the subcategories of art and the comprehensive ART index dominated the returns of Government Bonds (at 7.48%), ART (11.81%), and the subcategory of Modern Art (10.22%), followed by Surreal Art (8.32%), and 19th Century European Art (7.75%). Since the data include sales of several genres of art, the variability of returns between the classes of art are consistent with expectations, and in contrast with financial markets.

ART outperformed U.S. Treasury Bills and T-Bonds, consistent with Mei & Moses (2002). The ART index outperformed all financial returns except for equity securities, but did not outperform four of the subcategories of art—French Impressionists, U.S. Paintings, Contemporary Masters and 19th Century Sculpture all dominated over the art market, represented as ART.

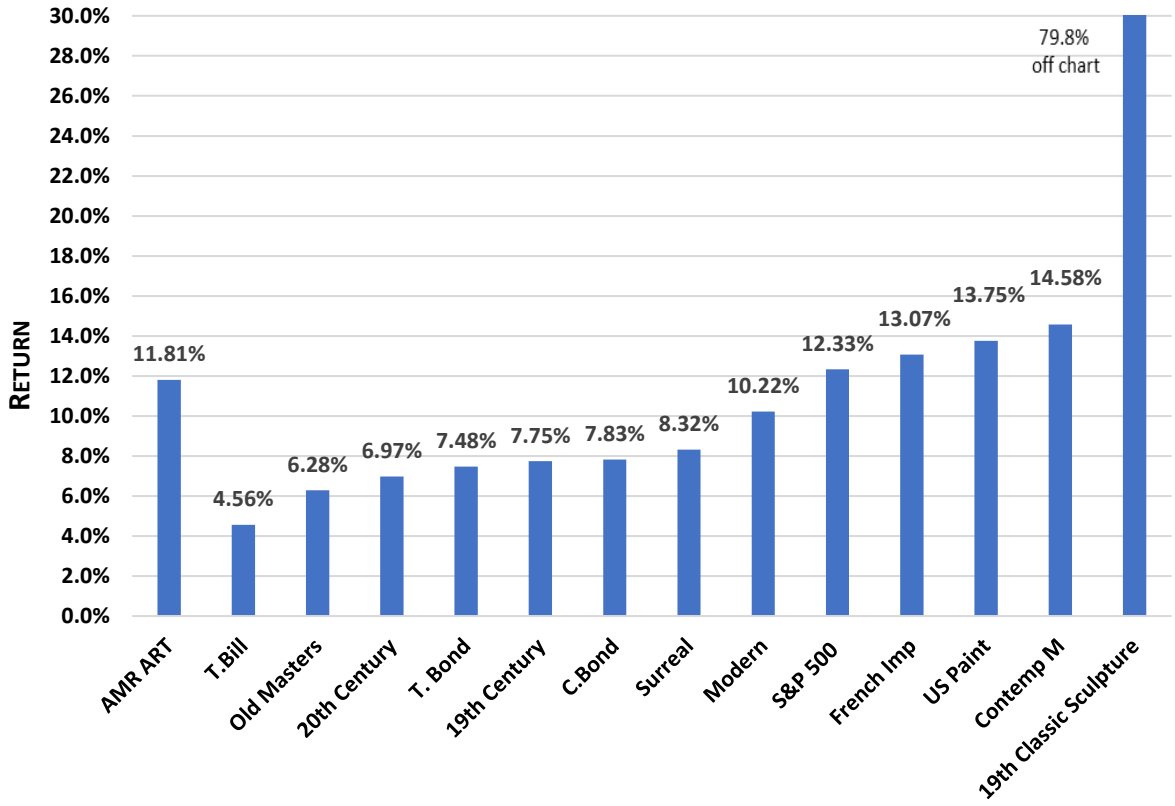

Figure 5.3. AMR Art and Financial Returns, 1976–2018.

The results in Table 5.2 represent the selected descriptive statistics for the Financial and AMR ART indices from 1976–2018. During this time, the standard deviation was 13.97% on the 11.81% ART returns. The S&P 500 not only had higher returns of 12.33% but also had a higher risk of 15.72%, 1.75% more than the risk on ART.

Table 5.2

Descriptive Statistics for ART and Financial Returns, 1976–2018

Selected Descriptive Statistics for ART & Financial Indices: 1976–2018					
	S&P 500	Treas Bond	Corp Bond	Treas Bill	AMR ART
Central tendency, dispersion & shape					
Arithmetic	0.1233	0.0748	0.0783	0.0456	0.1181
Standard Deviation	0.1572	0.0985	0.1036	0.0347	0.1397
Coefficient of Variation	1.2752	1.3174	1.3234	0.7607	1.1835
Risk-adjusted return	0.7842	0.7591	0.7556	1.3146	0.8450
Geometric mean	0.1110	0.0703	0.0737	0.0450	0.1097
Median	0.1482	0.0624	0.0705	0.0468	0.0970
Maximum	0.3720	0.3281	0.4447	0.1430	0.5120
Minimum	-0.3655	-0.1112	-0.1084	0.0003	-0.1101
Skewness	-0.7823	0.3231	1.5361	0.6079	0.6849
Kurtosis	0.8498	-0.1425	3.9070	0.1163	0.2851
Correlation					
S&P 500	1.0000	—	—	—	—
US Treasury Bond	-0.0205	1.0000	—	—	—
Corporate Bond	0.3650	0.5627	1.0000	—	—
US Treasury Bill	0.1370	0.2566	0.2081	1.0000	—
AMR Art Index	-0.0246	0.0404	-0.1537	0.2399	1.0000

Note: Risk adjusted return is the ratio of standard deviation to return. Correlation is Pearson.
Art data provided by AMR, consistent with 'Worthington & Higgs', (2004) study.
ART is a comprehensive index, compiled from all art auction sales.

5.4.2.2 Art Market Research Indices: 1998–2018. While it is evident in Figure 5.3 that 19th Century Classic Sculpture outperformed the other art categories with a return of 79.8% between 1976–2018, when the returns were measured between 1998 through 2018, the results were drastically different, showing a negative 2.2% return (see Figure 5.4) or an 81.6% spread. This insight is important in answering the research question: what are the financial implications of investing in the global art market? It is clear

through this analysis that timing and trend is important and that there are other important factors that may influence the returns of investing in art. Additionally, AMR compiles an index on the classic car market for this most recent period of 1998–2018. This study also includes AMR's classic car returns to identify where art returns fall in comparison to other investments for the same time period. All categories of art except Modern Paintings (ME) and Sculpture (SC) outperformed T-Bills, T-Bonds, Corporate Bonds, and returns on Classic Cars. 19th Century Paintings performed equally with Classic Cars from 1998–2018. Five subcategories and the comprehensive ART market outperformed the 8.1% return of the S&P 500. The top return consisted of U.S. Paintings (US) at 46.3% followed by Twentieth Century Paintings (TE) at 26.4%, Contemporary Modern Paintings (CM) 14.8%, Surreal (SR) at 12.7%, the ART market as a whole at 11.0%, and Old Masters (OM) at 10.3%.

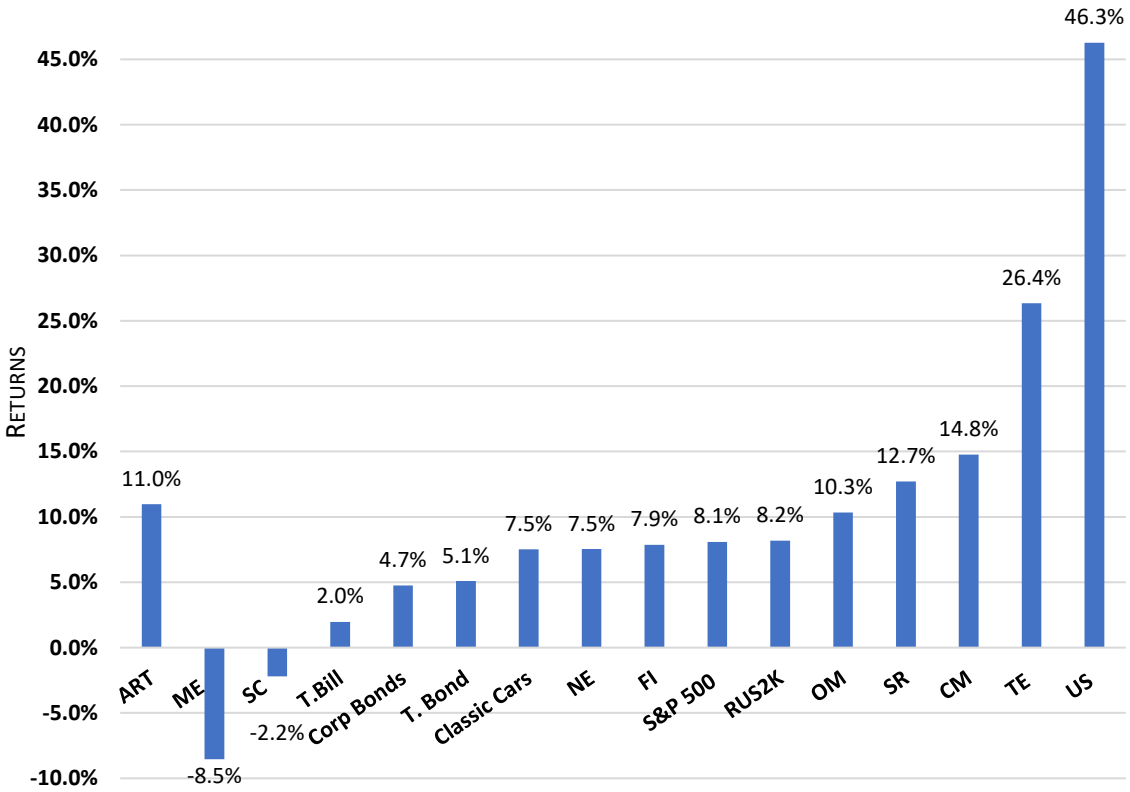

Figure 5.4. AMR, Art, Class Car, and Financial Returns, 1998–2018.

Table 5.3 reports the annual returns for ART at 10.98% with a standard deviation of 12.47%, from 1998–2018. For the same period, the S&P 500 reported returns of 8.09% with a standard deviation of 17.06%. This finding suggests that during this twenty-one-year period, an investor who invested in ART would have found ART to be less volatile while producing high returns for accepting a lower level of risk. Although Corporate Bonds and T-Bills both show a CV of less than one during this period, the ART CV of 1.14 supports ART having a favorable risk-return trade-off.

Table 5.3

Descriptive Statistics for ART and Financial Returns, 1998–2018

Selected Descriptive Statistics for ART & Financial Indices: 1998–2018

	S&P 500	T-Bond	Corp Bond	T-Bill	RUT 2K	AMR ART
Central tendency, dispersion & shape						
Arithmetic	0.0809	0.0508	0.0554	0.0197	0.0818	0.1098
Standard Deviation	0.1706	0.0844	0.0545	0.0190	0.2064	0.1247
Coefficient of Variation	2.1104	1.6595	0.9848	0.9626	2.5213	1.1360
Risk-adjusted return	0.2068	0.0626	0.1797	-1.3595	0.3010	0.5149
Geometric mean	0.0655	0.0474	0.0540	0.0196	0.0613	0.1031
Median	0.1177	0.0297	0.0642	0.0139	0.0745	0.0930
Maximum	0.3215	0.2010	0.1868	0.0576	0.5605	0.4305
Minimum	-0.3655	-0.1112	-0.0494	0.0003	-0.3782	-0.0555
Skewness	-0.8550	-0.1075	-0.0085	0.5924	0.0693	0.8996
Kurtosis	0.7552	-0.5172	0.3226	-1.1013	0.6135	0.5338
Correlation						
S&P 500	1.0000	—	—	—	—	—
US Treasury Bond	-0.6270	1.0000	—	—	—	—
Corporate Bond	0.2410	0.0477	1.0000	—	—	—
US Treasury Bill	-0.1557	0.2130	-0.1219	1.0000	—	—
Russel 2000	0.7913	-0.6365	0.3544	-0.2725	1.0000	
AMR Art Index	-0.2594	0.0831	-0.6154	0.3272	-0.3896	1.0000

Risk adjusted return is the ratio of standard deviation to return. Correlation is Pearson correlation.
All data provided by Art Market Research, consistent with 'Worthington & Higgs', (2004) study.
ART is a comprehensive index, compiled from all art auction sales.

5.4.3 Sotheby's Mei Moses Indices: 1858–2018

The third set of indices explored is provided directly by the auction house Sotheby's; they now maintain the Mei and Moses (2002) art market data. In order to compare the returns between the art and financial markets, this study first calculates the returns for the same time period as the AP's data are available, followed by an analysis for the same time frame AMR's data are available for SMM's three subcategories of art

and their comprehensive ALL art market. The SMM data are this analyzed for the period 1928–2018 to compare the art market to the S&P 500 since its inception. Finally, this paper explores the art market nominal returns from 1858 against the SPX from 1871 using Shiller (2015) data as a proxy for the stock market.

5.4.3.1 Sotheby's Mei Moses Indices 1998–2018. This section investigates the performance of art under the SMM indices for the period of 1998–2018. During these 21 years SMM'S Post-War & Contemporary subcategory outperformed the S&P 500, Russel 2000, the Corporate and Treasury Bond market and T-Bills (see Figure 5.6).

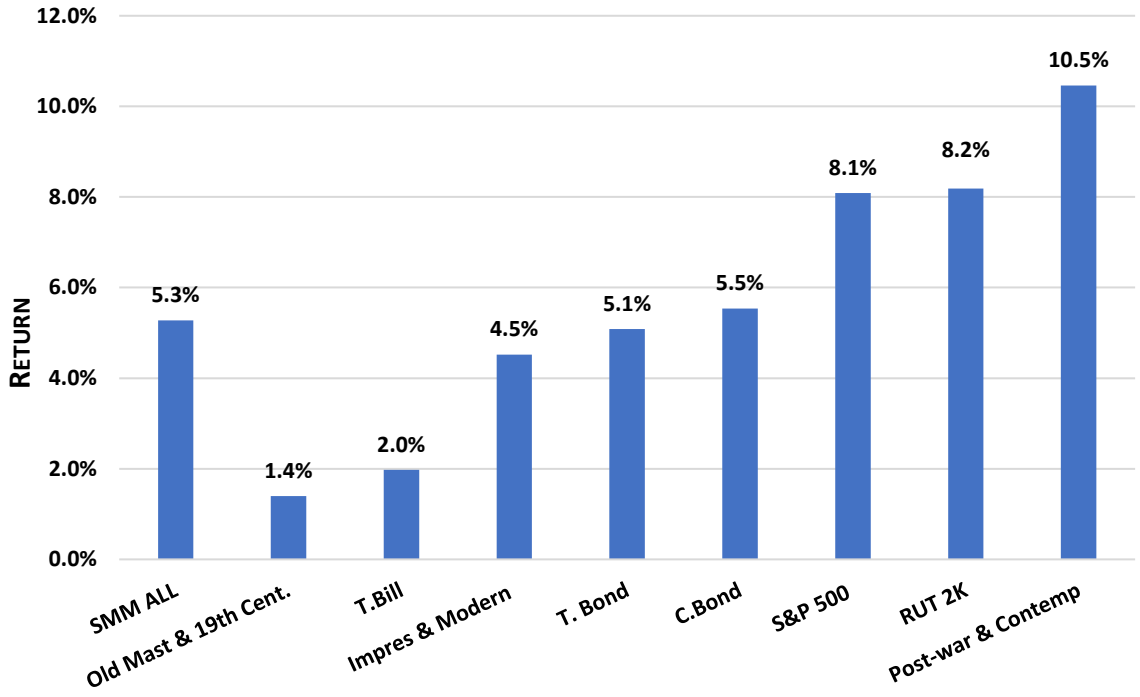

Figure 5.5. SMM Art and Financial Returns, 1998–2018.

Table 5.4 shows the descriptive statistics for SMM ALL from 1998–2018 as compared with the financial markets. Although the annual return for ALL (5.29%) was less than the

S&P 500 (8.09), the CV was slightly more favorable for ALL (1.90) versus the S&P of 2.11.

Table 5.4

Descriptive Statistics for ALL and Financial Returns, 1998–2018

Selected Descriptive Statistics for ALL & Financial Indices: 1998–2018

	S&P 500	T-Bond	Corp Bond	T-Bill	SMM ALL
Central tendency, dispersion & shape					
Arithmetic	0.0809	0.0508	0.0554	0.0197	0.0528
Standard Deviation	0.1706	0.0844	0.0545	0.0190	0.1003
Coefficient of Variation	2.1104	1.6595	0.9848	0.9626	1.9016
Risk-adjusted return	0.2068	0.0626	0.1797	-1.3595	0.0718
Geometric mean	0.0655	0.0474	0.0540	0.0196	0.0477
Median	0.1177	0.0297	0.0642	0.0139	0.0657
Maximum	0.3215	0.2010	0.1868	0.0576	0.1903
Minimum	-0.3655	-0.1112	-0.0494	0.0003	-0.2273
Skewness	-0.8550	-0.1075	-0.0085	0.5924	-0.7964
Kurtosis	0.7552	-0.5172	0.3226	-1.1013	1.1880
Correlation					
S&P 500	1.0000	—	—	—	—
US Treasury Bond	-0.6270	1.0000	—	—	—
Corporate Bond	0.2410	0.0477	1.0000	—	—
US Treasury Bill	-0.1557	0.2130	-0.1219	1.0000	—
SMM All Index	0.0525	0.3418	-0.2635	0.3487	1.0000

5.4.3.2 Sotheby's Mei Moses Indices 1976–2018. Figure 5.6 depicts three subcategories of art from 1976–2018 as compiled by Sotheby's Mei Moses. During this time, the highest returns were from the S&P 500 at 12.33%, however, Post-War & Contemporary Art had the second highest return at 11.69%. During this time, SMM reports the Impressionist & Modern Art market as well as the SMM ALL art market

exceeded the financial classes of investments, including Corporate and Treasury Bonds and T-Bills. Old Masters & 19th Century Art was the only category that underperformed the Corporate and Treasury Bond market, but still out-performed T-Bills.

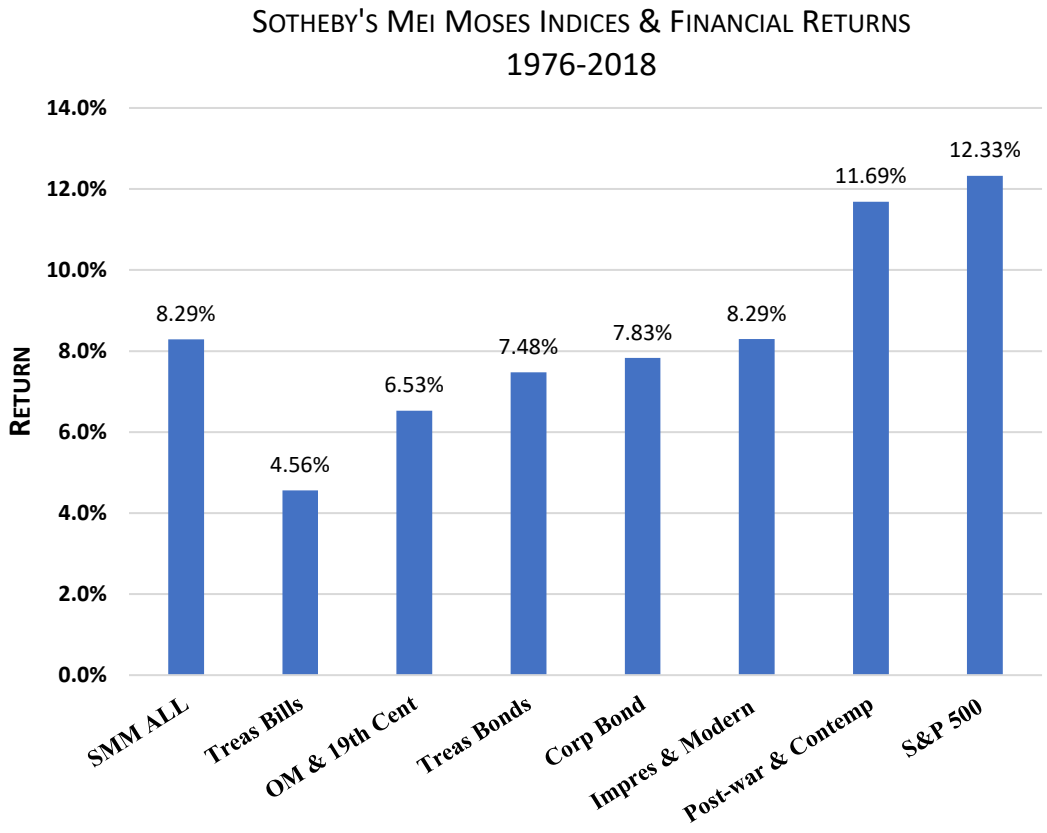

Figure 5.6. SMM Art and Financial Returns, 1976–2018.

Table 5.5 shows that the ALL risk-return tradeoff is not as favorable as the other financial returns presented. Although the returns exceeded Treasury and Corporate Bonds, and T-Bills, SMM's ALL return was not as favorable as the S&P 500 during this time.

Table 5.5

Descriptive Statistics for ALL and Financial Returns, 1976–2018

Selected Descriptive Statistics for SMM ALL & Financial Indices: 1976–2018

	S&P 500	Treas Bond	Corp Bond	Treas Bill	SMM ALL
Central tendency, dispersion & shape					
Arithmetic	0.1233	0.0748	0.0783	0.0456	0.0829
Standard Deviation	0.1572	0.0985	0.1036	0.0347	0.1450
Coefficient of Variation	1.2752	1.3174	1.3234	0.7607	1.7492
Risk-adjusted return	0.4943	0.2964	0.3158	0.0000	0.2575
Geometric mean	0.1110	0.0703	0.0737	0.0450	0.0731
Median	0.1482	0.0624	0.0705	0.0468	0.0743
Maximum	0.3720	0.3281	0.4447	0.1430	0.4391
Minimum	-0.3655	-0.1112	-0.1084	0.0003	-0.2693
Skewness	-0.7823	0.3231	1.5361	0.6079	0.1342
Kurtosis	0.8498	-0.1425	3.9070	0.1163	0.6771
Correlation					
S&P 500	1.0000	—	—	—	—
US Treasury Bond	-0.0205	1.0000	—	—	—
Corporate Bond	0.3650	0.5627	1.0000	—	—
US Treasury Bill	0.1370	0.2566	0.2081	1.0000	—
SMM All Index	0.1265	-0.0326	-0.3070	0.2643	1.0000

5.4.3.3 Sotheby's Mei Moses Indices 1928–2018. While Sotheby's Mei Moses's comprehensive art index ALL includes data from 1858, the S&P 500 returns were only readily available starting in 1928 from the NYU resource, and therefore are presented below during this more recent time series. To explore the long-term performance of art assets, Figure 5.7 presents the art market compared to the S&P 500's historic average return and risk from 1928 through 2018. The findings indicate that since 1928 (the year from which stock market data is readily available), the risk during this time series is

approximately equal. However, the S&P 500 would have provided an investor an 11.36% return, a 3.69% increase over 7.67% for art.

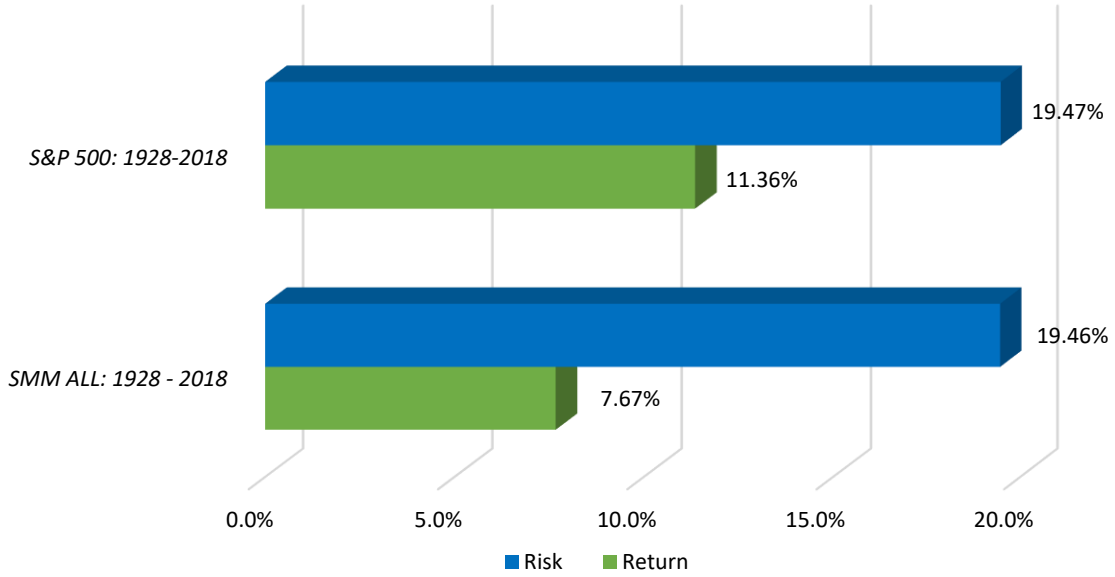

Figure 5.7. SMM ALL and S&P 500 Returns, 1928–2018.

5.4.3.4 Sotheby's Mei Moses Indices 1871–2018. Additionally, equity market data compiled by Shiller (2019) represents S&P composite prices from 1871–1927 and is included in this study to extend the S&P 500 returns for this longer time series. The resulting dataset, SPX (S&P Extended returns) is used in the following analysis to

compare the financial and art markets historically. Figure 5.8 presents art market returns compared to the SPX from 1871 through 2018.

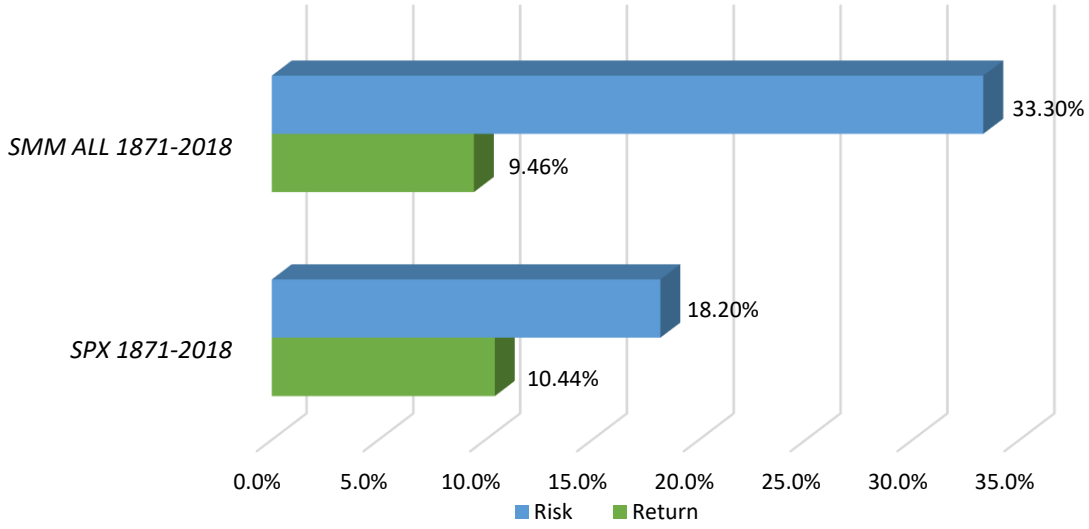

Figure 5.8. SMM ALL and SPX Returns, 1871–2018.

The historical returns for Sotheby's Mei Moses indices are presented in Figure 5.9 for various time series applicable to several art categories. Historically, from 1871, the SPX has produced returns of approximately 10.44%, compared to historic art returns from 1858–2018 of 9.46%. Since 1897, Old Masters and 19th Century Art has provided investors a 10.41% return—very close to the historical financial returns. Both Impressionist/Modern & Post-War/Contemporary Art have outperformed the equity market with returns of 13.09% and 15.46%, respectively.

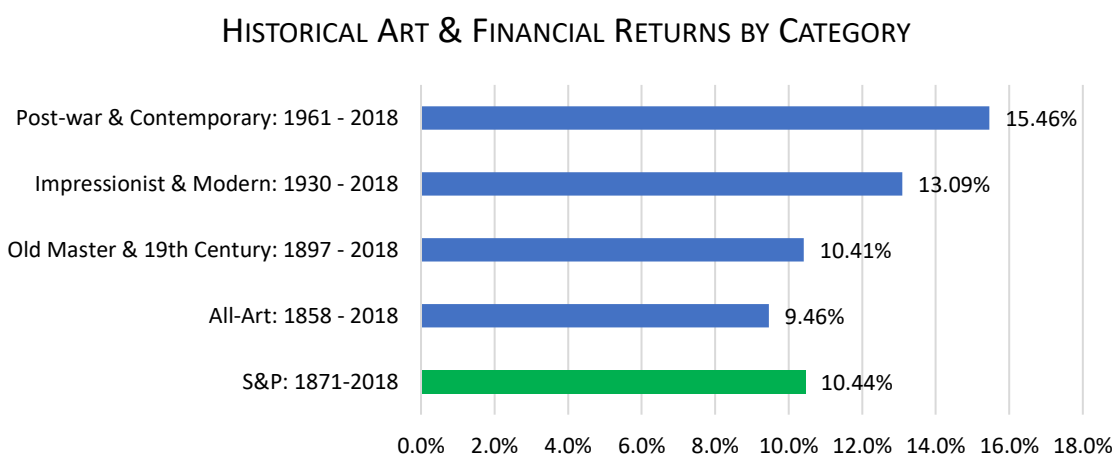

Figure 5.9. SMM Art and SPX Returns, Various Dates.

This study also compared the art market risk and returns for the same period of financial returns available, 1871–2018. Figure 5.10 shows that during this time, the SPX outperformed the art market by approximately 1%, with 15% less risk than art over the 148-year period. However, several caveats should be mentioned. The art market is based on the world art markets and may not represent the strongest art categories. In contrast to the art market, the SPX represents returns of the top companies in the U.S. equity market. As shown in Figure 5.8, the art market was more volatile during the 19th century, contributing to the risk of 33.30% depicted in Figure 5.10.

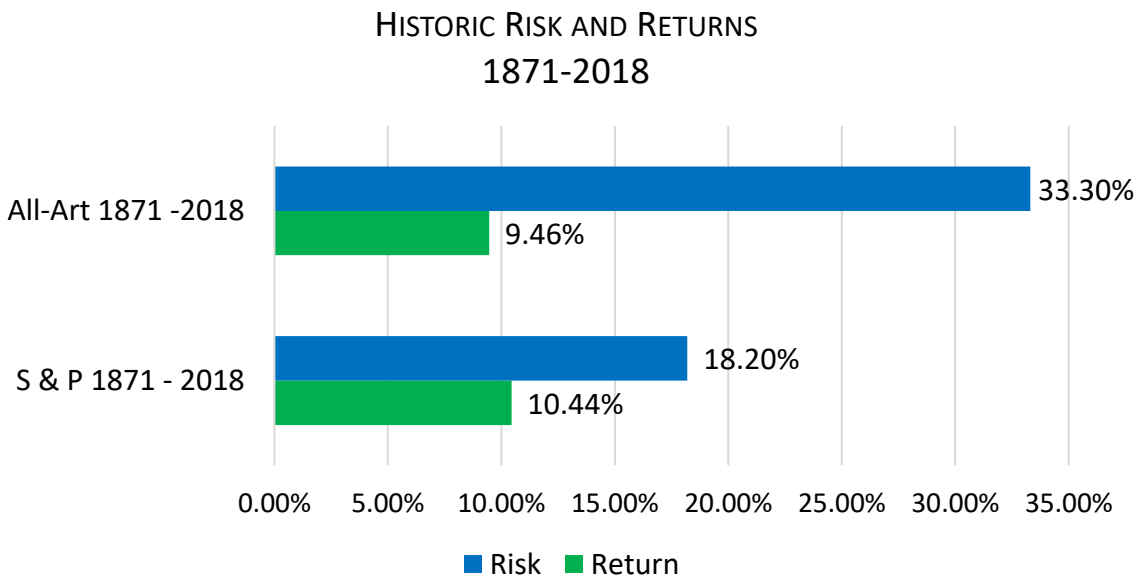

Figure 5.10. SMM ALL and SPX Risk and Return, 1871–2018.

5.5 Discussion

This chapter explored research sub-question two: "Do risk and return for art assets differ from other real and financial assets, when considering various indices, categories, and periods?" The above analysis provides evidence that depending on which indices provider, category, and time series was examined, risk and return of art assets differ from other real and financial assets. Historically, risk has been higher under all three providers than the financial markets, and returns can be either higher or lower than the financial markets depending on time periods. Through the analysis, the various subcategories of art are also an important factor in the risk and return in the art market.

Additionally, it is important to understand if the low correlations between the art and financial markets identified in this chapter provide diversification benefits. Chapter Six explores investing in several types of financial assets and adding art as an alternative

investment in order to mitigate the associated risk of a financial portfolio while increasing return.

CHAPTER SIX: DIVERSIFICATION OF FINANCIAL PORTFOLIO WITH ART

Markowitz (1952) introduced his new model for portfolio selection as the Expected Return–Variance of Returns (E-V) Rule. This rule states that the Expected Return on the portfolio as a whole is a weighted sum of random variables where the investor can choose the weights (Markowitz, 1959). The E-V rule states that the investor should desire to select a portfolio that gives rise to efficient Expected Return (ER) and Variance (V) combinations. Efficient in this case refers to having the minimum V for given ER or more and maximum ER for given V or less (Markowitz, 1952). Markowitz (1959) determined that the investor, once informed what E-V combinations were attainable, could find the portfolio that gave the desired combination. Markowitz's Modern Portfolio Theory assumes that given two portfolios with the same mean, investors will select the one with the least risk. However, although the theory assumes that investors are risk adverse, each investor will accept different levels of risk/reward combinations.

When applied, the rule takes diversification into consideration, the relationship of the securities with each other, and the weights of the returns and variances. Per Markowitz (1952), the objective is to avoid investing in assets with high covariances. Variance is a well-known measure of dispersion around the expected return. Portfolio return is the proportion-weighted combination of the allocated assets, with the portfolio's volatility as a function of the correlation of all asset pairs. Markowitz defined efficient portfolios as those in which the efficient curve begins at the attainable point with minimum variance, maximizing the expected return for each level of risk though the application of the mean-variance optimization formula. Since the correlation across asset

classes is often low, mean-variance analysis is a powerful tool in asset allocation to identify the risk reduction benefits of art as an asset class through diversification. In this section, Markowitz's portfolio theory and mean-variance optimization formula is applied to add art assets to a financial portfolio and explored diversification prospects though the construction the Efficient Frontier in order to gain an understanding of the implications of art as an investment.

6.1 Research Sub-Question Three: Overview

This chapter explores research sub-question three: "Do investments in art allow for diversification benefits when added to a financial portfolio?" The first section introduces the hypothesis. The next section presents the model used for portfolio selection and optimization under Markowitz's (1952) mean-variance optimization formula. The third section outlines the steps for solving asset allocation analysis through matrices for three independent art indices providers. The fourth section presents the efficient frontiers constructed and detailed analysis of the results for each indices provider. The final section provides a discussion of the results.

6.2 Hypothesis

While several studies have constructed indices for a segment of the art market such as modern prints (Pesando, 1993), Polish art (Potocki & Rogozinska, 2015), and Renoir paintings (Charlin & Cifuentes, 2016), art index providers have tracked main auction house sales by genres, time periods, and the art market as a whole. Of these providers, Campbell (2008) found some of the most widely-quoted art market performance indicators are Art Market Research and Sotheby's Mei Moses. Recent studies have also used the comprehensive indices from Artprice (Jureviciene &

Savicenko, 2012). Each of these providers prepare a comprehensive index of the art market as a whole, with slightly different methodologies for repeated sales and different time periods. Some studies found low correlation between art and financial assets. A low correlation between art and financial would indicate that there are diversification benefits in investing in art.

Worthington and Higgs (2004) found little benefit by adding art to a financial portfolio; however, they used only one art index (AMR) to evaluate diversification prospects. This study evaluates diversification benefits of adding art to a financial portfolio from three widely-quoted indices (AP, AMR, SMM). The third hypothesis proposes to answer the research question: Do investments in art allow for diversification benefits when added to a financial portfolio? Therefore, this study posits:

- Proposition 3: Investing in art does not provide diversification benefits in financial asset portfolios.
    - $H3A_0$: Investing in art does not provide diversification benefits in financial asset portfolios for the twenty-one-year period 1998–2018, when measuring art returns with AP's Global Index.
    - $H3A_a$: Investing in art does provide diversification benefits in financial asset portfolios for the twenty-one-year period 1998–2018, when measuring art returns with AP's Global Index.
    - $H3B_0$: Investing in art does not provide diversification benefits in financial asset portfolios for the forty-three-year period 1976–2018, when measuring art returns with AMR's ART Index.

- *$H3B_a$:* Investing in art provides diversification benefits in financial asset portfolios for the forty-three-year period 1976–2018, when measuring art returns with AMR's ART Index.
- *$H3C_0$:* Investing in art does not provide diversification benefits in financial asset portfolios for the periods 1928–2018 and 1976–2018, when measuring art returns with SMM's ALL Index.
- *$H3C_a$:* Investing in art provides diversification benefits in financial asset portfolios for the periods 1928–2018 and 1976–2018, when measuring art returns with SMM's ALL Index.

6.3 Model: Diversification of Financial Portfolio

In order to explore diversification prospects of adding art assets to a financial asset investment portfolio, datasets were built to replicate a financial portfolio consisting of several financial assets. Five financial assets from 1998–2018 compose the portfolio, including: (a) U.S. Treasury Bills, (b) U.S. Treasury Bonds, (d) S&P 500, (e) Corporate Bonds, and (f) Russel 2,000. For the period 1976–2018, only four of these financial measures were available: (a) U.S. Treasury Bills, (b) U.S. Treasury Bonds, (d) S&P 500, and (e) Corporate Bonds. One comprehensive art index was then added to the resulting financial dataset. Figure 6.1 presents the data model.

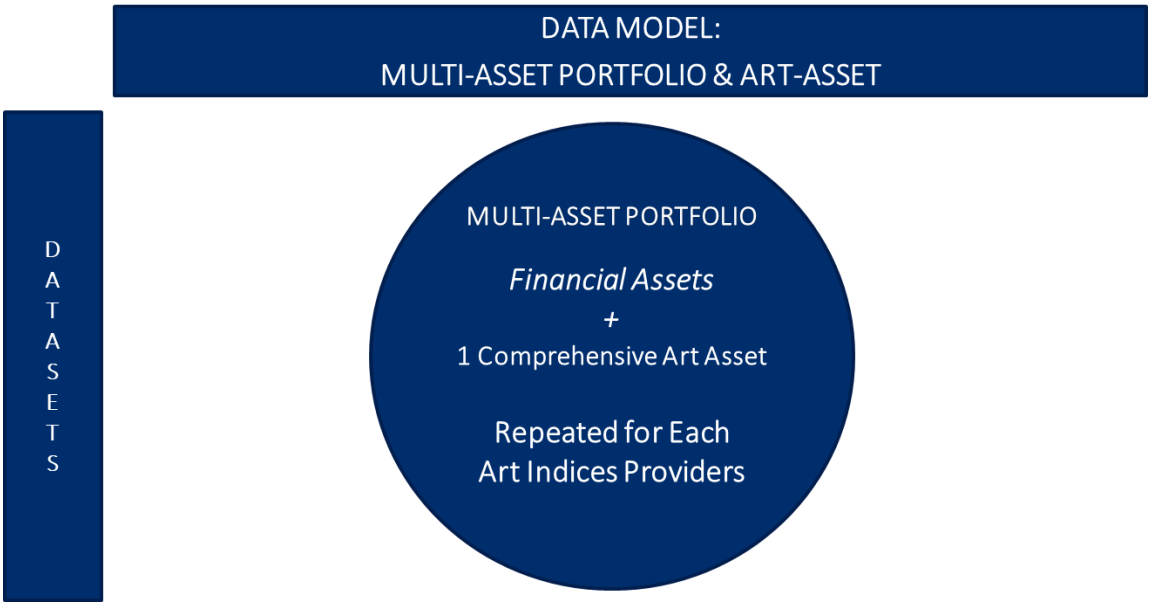

Figure 6.1. Model for H3: Diversification of Financial Portfolio with Art.

6.3.1 Financial Portfolio Diversification

To empirically investigate if investments in art allow for diversification benefits when added to a financial portfolio the following steps are taken. First, a portfolio is compiled of financial indices and then an art index is added. Second, correlation matrices are created in Excel and analyzed to determine the degree in which the financial and art assets move in relation to each other. Third, Markowitz's (1952) mean-variance model is then followed for this analysis and utilizing optimization techniques, minimum risk, maximum return, and naïve portfolios are created. Finally, an efficient frontier is constructed. This process is performed from the dimension of the three comprehensive art indices (Global by AP, ART by AMR, ALL by SMM) in order to explore hypotheses 3A, 3B and 3C.

6.4 Results: Financial Portfolio Diversification

Portfolio theory is applied to Hypothesis 3 to explore the risk and return and asset allocation using Markowitz's (1952) mean-variance model to determine if there is a diversification benefit of adding art assets to a financial portfolio, in order to minimize risk and maximize return. Chapter Three describes the methodology in equations 6 through 10. The model includes using matrices to identify a portfolio of financial assets that maximize returns at each given level of risk, given in Matrices 1 through 4. See Chapter Three for the details of these models, matrices, and the construction methods of the Efficient Frontier for the basis of the analysis that follows.

6.4.1 AP: Efficient Frontier-Financial Portfolio

In this section, the first efficient frontier constructed is depicted in Figure 6.2. Table 6.1 presents the correlation between the financial returns and Artprice's Global returns from 1998–2018. The Global returns are negatively correlated with Treasury bonds and correlated below 0.45 for all other financial returns. The low and negative correlations would suggest diversification benefits by adding art to a financial portfolio. Artprice's Global Index is presented alongside debt and equity instruments that include the S&P 500, T-Bonds, T-Bills, Corporate Bonds and the Russel 2000 (see Figure 6.2).

Table 6.1

Correlation Table for Financial and AP Global Returns, 1998–2018

Correlation Table of financial market returns and ArtPrice Global®Index Returns: 1998 - 2018

	S&P 500	Treas Bond	Corp Bond	Treas Bill	RUT 2K	Global®
Correlation						
S&P500	1.0000	—	—	—	—	—
US Treasury Bonds	-0.6270	1.0000	—	—	—	—
Corporate Bond	0.2410	0.0477	1.0000	—	—	—
US Treasure Bills	-0.1557	0.2130	-0.1219	1.0000	—	—
RUT 2K	0.7913	-0.6365	0.3544	-0.2725	1.0000	—
AP Global® Index	0.4415	-0.2335	0.4294	0.1236	0.3853	1.0000

Artprice's Global Index® and is comprehensive, compiled from all art auction sales. RUT 2K is Russel 2000 represents small cap equities. Correlation is Pearson correlation.

Figure 6.2 presents a financial portfolio and adds the comprehensive art-asset (Global) providing several benefits. The efficient frontier reveals that an optimized portfolio with the same level of risk as a naïve portfolio would increase the return from 5.28% to 6.78%. Additionally, the visual presentation clearly presents the high risk of Global (12.8%) to the low return of only 2.84%.

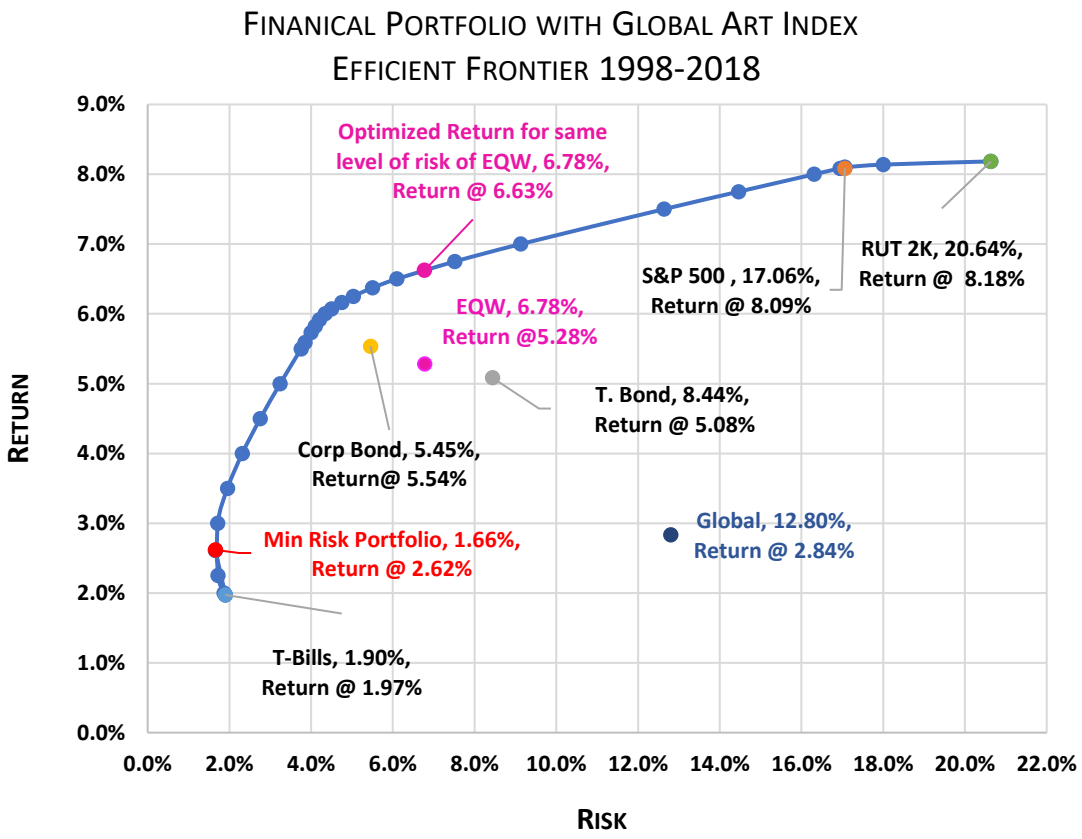

Figure 6.2. AP Financial Portfolio with Global Efficient Frontier, 1998–2018.

6.4.2 AMR: Efficient Frontier-Financial Portfolio

In this section, the second efficient frontier constructed is depicted in Figure 6.3. Table 6.2 presents the correlation between the financial returns and AMR's ART returns from 1976–2018. Although the AMR risk and return of the ART comprehensive art-index is similar to that of the S&P 500, the ART returns are negatively correlated with Corporate Bonds (-0.153) and the S&P 500 (-0.025) and correlated below 0.24 for all other financial returns. The low and negative correlations would suggest diversification benefits by adding art to a financial portfolio. Table 6.2 presents the correlations with financial returns.

Table 6.2

Correlation Table for Financial and AMR ART Returns, 1976–2018

	S&P 500	Treasury Bond	Corporate Bond	Treasury Bill	ART
Correlation					
S&P 500	1.0000	—	—	—	—
U.S. Treasury Bond	-0.0205	1.0000	—	—	—
Corporate Bond	0.3650	0.5627	1.0000	—	—
U.S. Treasury Bill	0.1370	0.2566	0.2081	1.0000	—
AMR Art Index	-0.0246	0.0404	-0.1537	0.2399	1.0000

Note: Correlation is Pearson correlation. Art index provided by Art Market Research, consistent with Worthington & Higgs', (2004) study. ART is a comprehensive index, compiled from all art auction sales.

Figure 6.3 presents a financial portfolio, and adds ART providing several benefits. The efficient frontier reveals that an optimized portfolio with the same level of risk as a naïve portfolio results in a slightly higher return. It is apparent that the AMR ART return is only slightly less, for a slightly lower risk (see Figure 6.3).

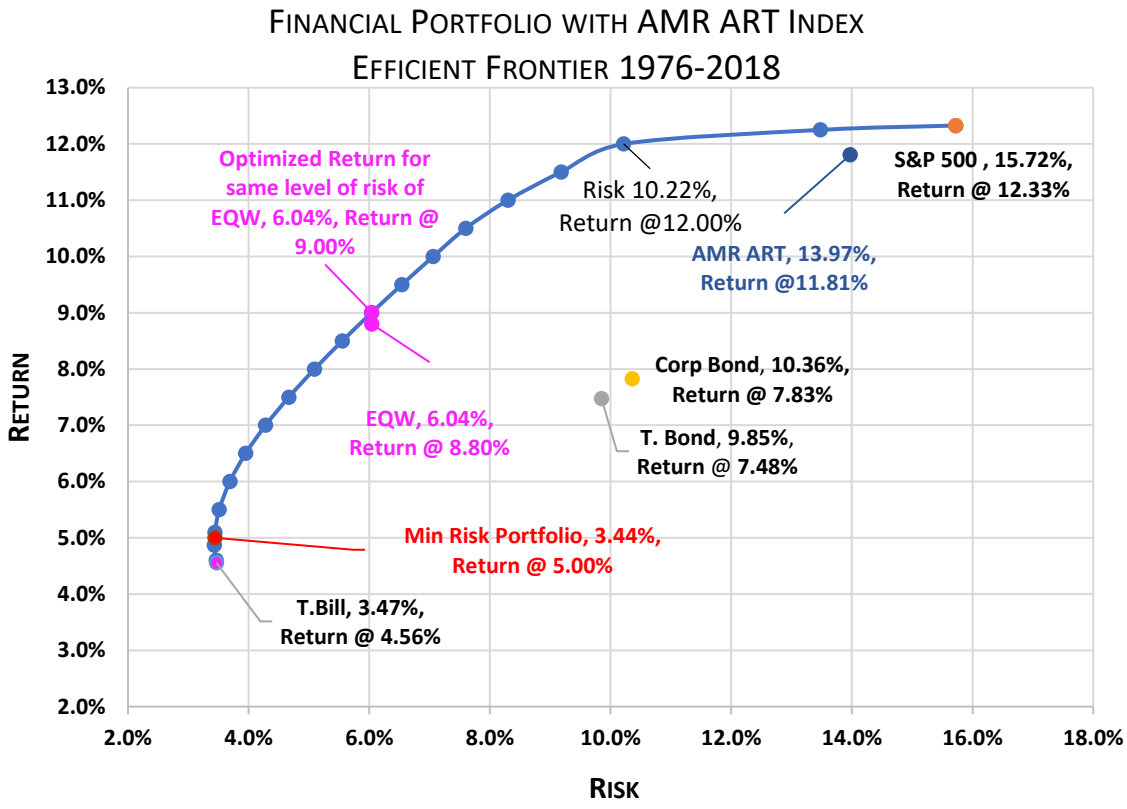

Figure 6.3. AMR Financial Portfolio with ART Efficient Frontier, 1976–2018.

6.4.3 SMM: Efficient Frontier-Financial Portfolio

In this section, the third Efficient Frontier constructed is depicted in Figure 6.4. Table 6.3 presents the correlation between the financial returns and SMM's ALL returns from 1976–2018. The ALL returns are negatively correlated with Treasury (-0.0326) and Corporate Bonds (-0.3070) and have low correlation with the S&P 500 (0.1265) and Treasury Bills (0.2643). Art's low correlation and negative correlations with financial assets would suggest diversification benefits by adding art to a financial portfolio. Table 6.3 presents the correlations with financial returns.

Table 6.3

Correlation Table for Financial and SMM ALL Returns, 1976–2018

	S&P 500	Treasury Bond	Corporate Bond	Treasury Bill	SMM ALL
S&P 500	1.0000	—	—	—	—
Treasury Bond	-0.0205	1.0000	—	—	—
Corporate Bond	0.3650	0.5627	1.0000	—	—
Treasury Bill	0.1370	0.2566	0.2081	1.0000	—
SMM ALL	0.1265	-0.0326	-0.3070	0.2643	1.0000

In the financial portfolio, Sotheby's ALL return is presented alongside debt and equity instruments that include the S&P 500, T-Bonds, T-Bills, and Corporate Bonds. The Efficient Frontier reveals that an equally weighted portfolio with a return of 8.10% is similar to an optimized portfolio of 8.12%, a 0.02% increase (see Figure 6.4). Additionally, a diversified portfolio with art would provide a portfolio return above 10.38% for the same level of risk (9.85%) than investing in a Treasury Bond alone with a return of 7.48%. The portfolio selection would include weights in the following asset classes: 57.49% S&P 500, 28.28% T-Bond, and 14.23% SMM ALL. Diversification with these asset classes shows that adding art investments would provide a 2.9% portfolio return increase.

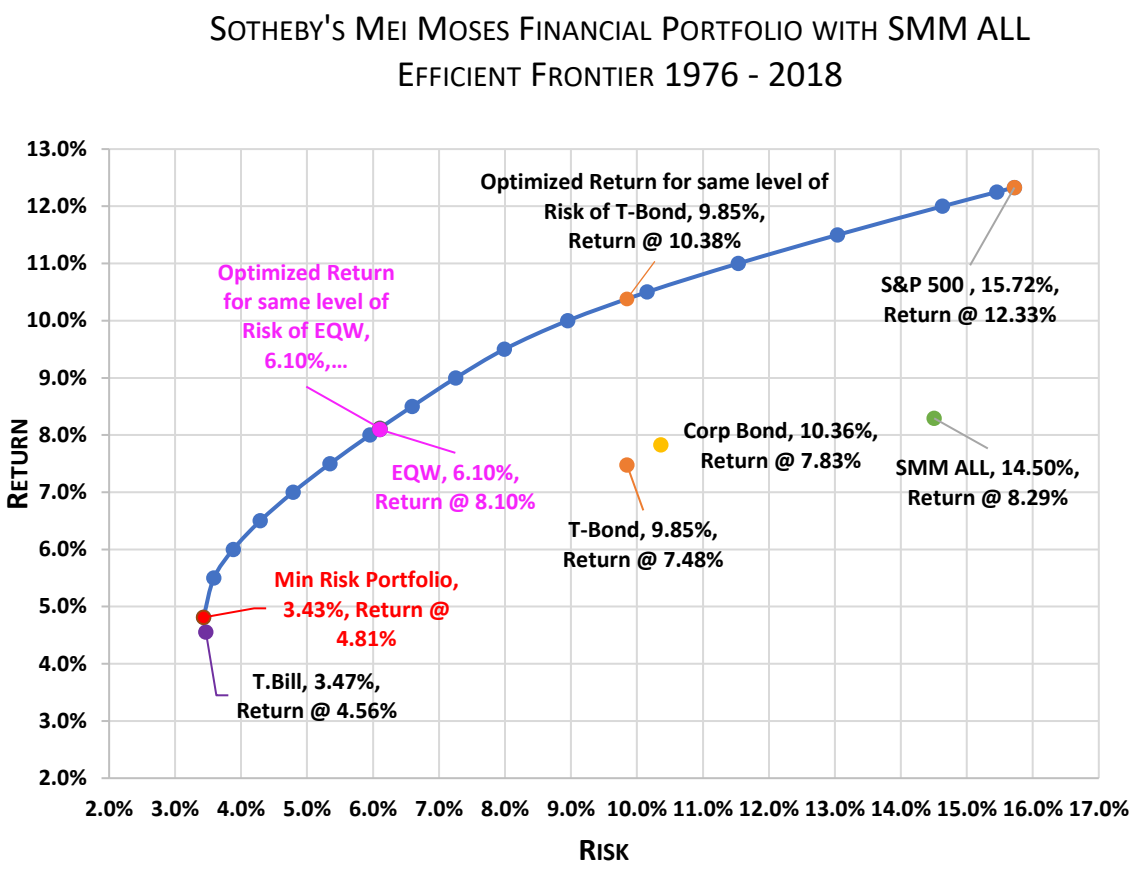

Figure 6.4. SMM Financial Portfolio with ALL Efficient Frontier, 1976–2018.

6.4.4: Efficient Frontier-Financial and Multi-Asset Comparison

Figure 6.5 overlays a financial-asset only portfolio over the SMM multi-asset portfolio. One finding shown is that adding art to a financial portfolio reduces the overall risk for lower return portfolios. However, for portfolios with higher risk, the weights of the financial assets have similar impact in the financial portfolio as they do in the SMM multi-asset portfolio. The Efficient Frontier reveals that at a 7.0% return, the SMM efficient set has a risk of 4.79%, while a financial portfolio without SMM ART has a risk of 5.02%, an approximate 0.23% higher risk. It is also evident that by adding ART to a financial portfolio, an investor will to accept a risk of 9.85% for T-Bond and would have

a slightly higher return than the efficient set of a financial portfolio, as seen in the figure where the plot is just above the curve with a 10.38% return. It is also clear that the minimum risk portfolio with ART would result in a return of 4.81% and risk of 3.43%, versus 4.56% and 3.47% respectively for a portfolio without ART. Therefore, the graphical representation suggests that adding art to a financial portfolio does provide diversification benefits.

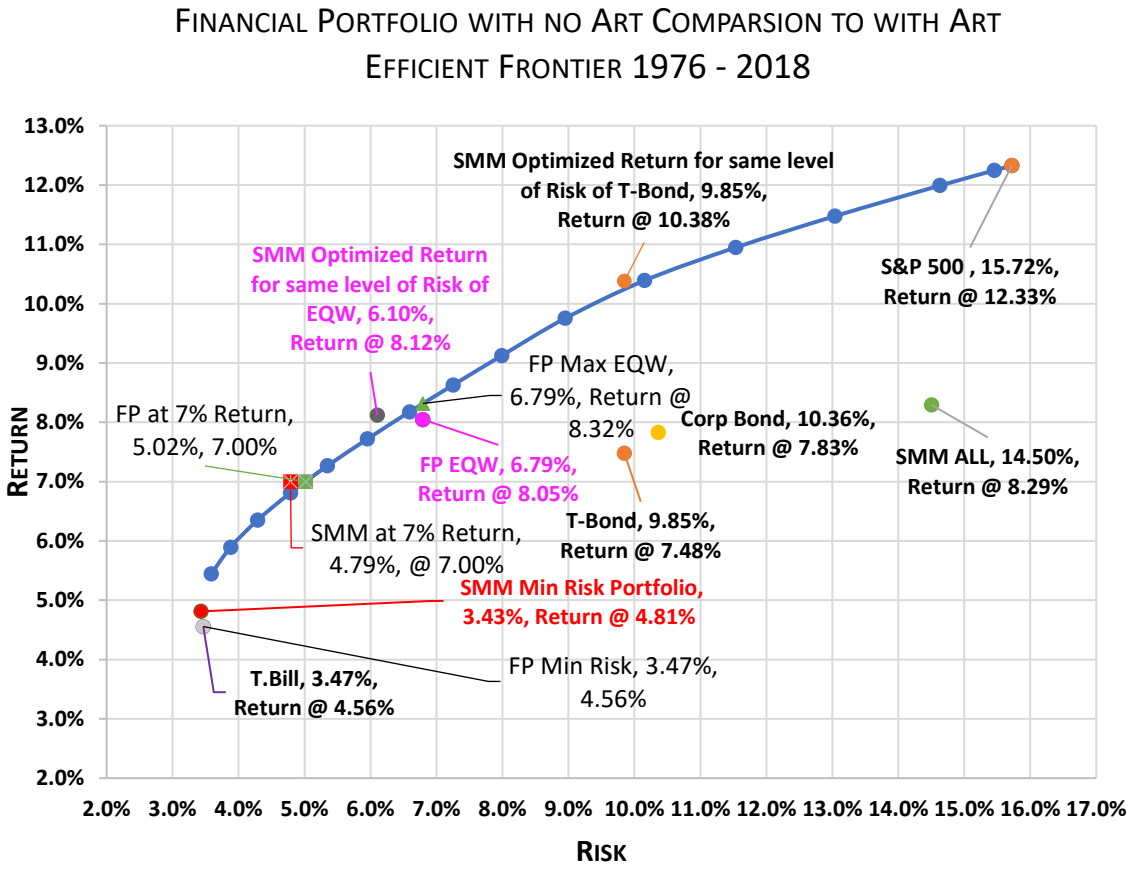

Figure 6.5. Financial Portfolio without ALL Efficient Frontier, 1976–2018.

6.5 Discussion

This chapter explored research sub-question three: "Do investments in art allow for diversification benefits when added to a financial portfolio?" The correlation between

financial assets and the art market varied depending upon the art indices provider. The indices with lower correlation provided more diversification benefits than indices with mediocre correlations. AMR had a negative correlation with the S&P 500 and minimal correlations with all other financial assets presented, providing more benefit in a diversified portfolio than in those using Artprice's Global or Sotheby's Mei Moses ALL art index. Similarly, SMM's had low correlation with the S&P 500 and Treasury Bills, with negative correlations with the Corporate and Treasury Bonds, providing strong diversification benefits to a financial portfolio. Even with the high levels of volatility in the art market, the results from the analysis would suggest that adding art to a multi-asset investment portfolio would mitigate some investment risk. This study suggests that investments in art do allow for diversification benefits when added to a financial portfolio. The implication from these results is that an investor would find it beneficial to add art to their financial portfolio because the risk/return tradeoff would result in a favorable wealth management strategy.

Additionally, it is important to understand if the correlations between subcategories of art provide diversification benefits. Chapter Seven explores investing in several types of art categories in order to mitigate the associated risk in investing in art-asset portfolio, while increasing return.

CHAPTER SEVEN: DIVERSIFICATION OF ART-ASSET PORTFOLIO

In this chapter, as in Chapter Six, Markowitz's portfolio theory and mean-variance optimization formula is applied to an art-asset portfolio and diversification prospects are explored though the construction of the Efficient Frontier, in order to gain an understanding of investing in the art market.

7.1 Research Sub-Question Four: Overview

This chapter explores research sub-question four: "Do investments in art allow for diversification benefits in an art-asset portfolio?" The first section introduces the hypothesis. The next section presents the model used for portfolio selection and optimization under Markowitz's (1952) mean-variance optimization formula. The final section presents the efficient frontiers constructed and detailed analysis of the results.

7.2 Hypothesis

Museums, pension plans, investors, art investment funds, and others who hold various art collections may be interested in how to diversify their art portfolios. Understanding the correlation between art types such as Old Masters and Impressionists is important if it reduces the overall risk of the art-asset portfolio. This study seeks to understand if diversification strategies are applicable to entities that hold a collection of art and proposes to answer the research question: Do investments in art allow for diversification benefits in an art-asset portfolio? Therefore, this study posits:

- Proposition 4: There are not diversification benefits in art-asset portfolios.
    - *$H4A_0$:* There are not diversification benefits in art-asset portfolios for the twenty-one-year period 1998–2018, when measuring art returns with AP Indices.

- *$H4A_a$:* There are diversification benefits in art-asset portfolios for the twenty-one-year period 1998–2018, when measuring art returns with AP Indices.
- *$H4B_0$:* There are not diversification benefits in art-asset portfolios for the forty-three-year period 1976–2018, when measuring art returns with AMR Indices.
- *H4Ba:* There are diversification benefits in art-asset portfolios for the forty-three-year period 1976–2018, when measuring art returns with AMR Indices.
- *$H4C_0$:* There are not diversification benefits in art-asset portfolios for the forty-three-year period 1976–2018, when measuring art returns with SMM Indices.
- *$H4C_a$:* There are diversification benefits in art-asset portfolios for forty-three-year period 1976–2018, when measuring art returns with SMM Indices.

7.3 Model: Diversification of Art-Asset Portfolio

In order to explore diversification prospects of art in an art asset investment portfolio, datasets were built to replicate an art-asset portfolio consisting of several categories of art and one comprehensive art index. Figure 7.1 presents the data model.

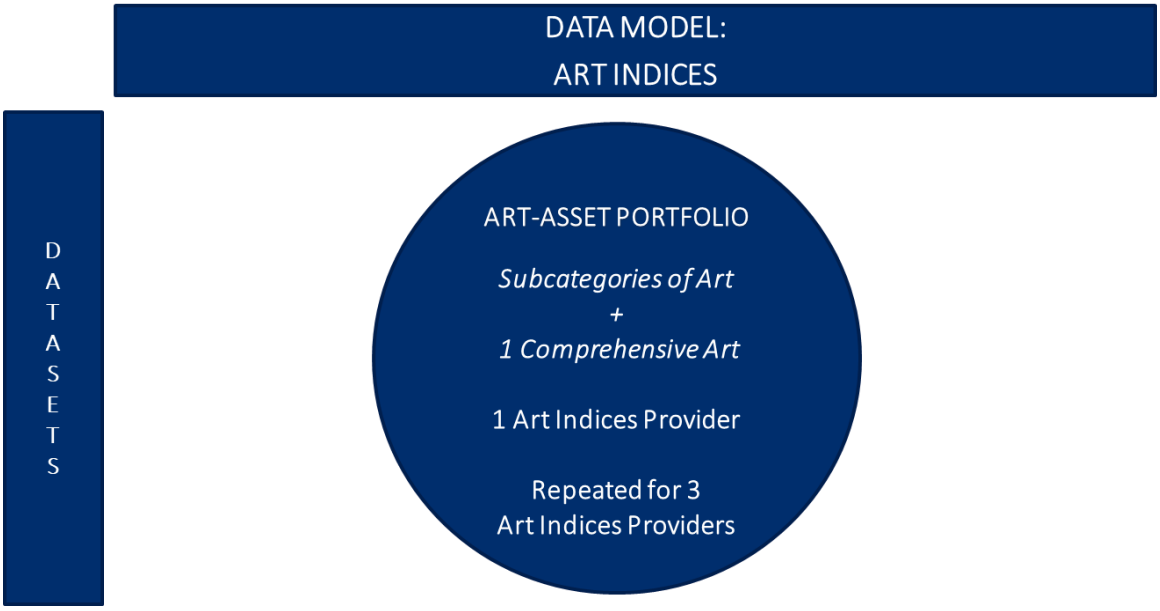

Figure 7.1. Model for H4: Diversification of Art-Asset Portfolio.

7.3.1 Art-Asset Portfolio Diversification

Additionally, to empirically investigate if investments in art allow for diversification benefits in an art-asset portfolio, the following steps are taken. An art-asset portfolio is constructed in Excel from the various subcategories of art and is analyzed to explore the risk and return of the individual markets, as well as the coefficient of variance. The same methodology used to analyze a financial portfolio above will be applied to an art-asset portfolio to explore asset allocation prospection of investing in a basket of art assets. Third, Markowitz's (1952) mean-variance model is then followed. Through optimization techniques, minimum risk, maximum return, naïve and maximum return at same level risk of equally weighted portfolios are created. Lastly, Efficient Frontiers are constructed on the art-asset portfolios. The process is repeated for

all categories of art from each of the three indices providers indices: AP, AMR, and SMM to explore Hypotheses 4A, 4B, and 4C

7.4 Results: Art-Asset Portfolio Diversification

Portfolio theory is applied to hypothesis four to determine if there is a diversification benefit of diversifying in various categories of art in an art-asset financial portfolio, in order to minimize risk and maximize return. Markowitz's mean-variance model presented in Chapter Three was the methodology used in this chapter for diversification in an art-asset portfolio. Matrices 1 through 4 (see the Appendix) and the Efficient Frontier presented in Chapter Three are also used to test Hypothesis 4. See Chapter Three for the details of these models, matrices, and the construction methods for the basis of this analysis.

7.4.1 AP: Efficient Frontier–Art-Asset Portfolio

This section follows Markowitz's portfolio theory to construct the Efficient Frontier for a portfolio created from art-assets. The art-asset portfolio below is constructed from ten categories and classifications of art-asset returns compiled from Artprice's indices (see Figure 7.2). First, Table 7.1 presents the correlation between AP's categories of art from 1998–2018. Returns with the lowest correlations include Old Masters with Photos (0.1262), Old Masters with Drawing (0.2161), and Old Masters with 19th Century (0.2289). Low correlations would suggest diversification benefits exist and would reduce the overall risk of an art-asset portfolio. Investors, collectors and art fund managers would be wise to diversify art categories between art-assets that were not highly correlated in order to mitigate risk in investing in the art market.

Table 7.1

Correlation Table for AP's Art Market Returns, 1998–2018

	Paint	*Print*	*Sculpture*	*Photo*	*Drawing*	*Old Mast*	*19th Cent*	*Modern*	*Post-War*	*Contemp*
Paint	1.0000									
Print	0.9112	1.0000								
Sculpture	0.8666	0.8605	1.0000							
Photo	0.5999	0.5198	0.4930	1.0000						
Drawing	0.3996	0.4266	0.3345	0.2974	1.0000					
Old Mast	0.3896	0.3541	0.3189	0.1262	0.2161	1.0000				
19th Century	0.8875	0.8148	0.6450	0.6562	0.3805	0.2289	1.0000			
Modern	0.9660	0.8740	0.9154	0.5758	0.3099	0.4390	0.7961	1.0000		
Post-War	0.9265	0.7638	0.7603	0.5736	0.4284	0.3517	0.7656	0.8721	1.0000	
Contemporary	0.8119	0.7750	0.6212	0.2348	0.2616	0.3449	0.7411	0.7532	0.6840	1.0000

The Efficient Frontier reveals that there are diversification benefits in investing in a variety of art classifications in an art-asset portfolio. As depicted in Figure 7.2, the optimized return of 2.92% is greater than the 1.89% return for the same level of risk of 9.68%, as an equally-weighted portfolio. Additionally, the AP return for Old Masters, during the period 1998 to 2018 indicates a 1.23% negative return, with a 9.92% risk. For the same level of risk, an approximate 3% return—or a 4% increase in return—would be achievable through diversification, then by only investing in Old Masters.

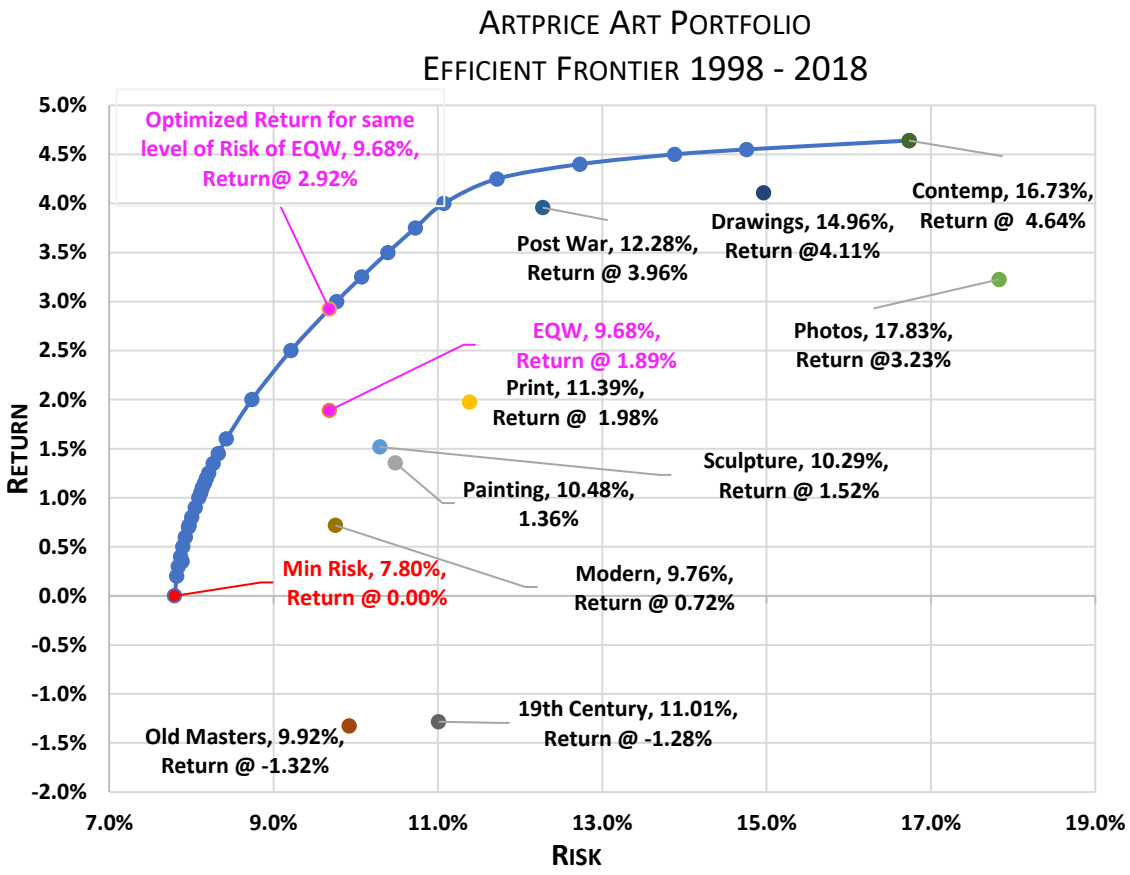

Figure 7.2. AP Art-Asset Portfolio Efficient Frontier, 1998–2018.

7.4.2 AMR: Efficient Frontier–Art-Asset Portfolio

In this section, the second Efficient Frontier constructed is depicted in Figure 7.3. Table 7.2 presents the correlation between categories of AMR's art returns from 1976–2018. The low correlations would suggest diversification benefits by allocating various subcategories of art to an art-asset portfolio. Table 7.2 presents the correlations with various art subcategories of returns.

Table 7.2

Correlation Table for AMR's Art Market Returns, 1976–2018

	CM	*FI*	*ME*	*NE*	*OM*	*SR*	*TE*	*US*	*SC*
CM	1.0000								
FI	0.5692	1.0000							
ME	0.4945	0.5104	1.0000						
NE	0.6536	0.7226	0.5060	1.0000					
OM	0.5424	0.5912	0.5507	0.7124	1.0000				
SR	0.7185	0.5602	0.4633	0.4854	0.5150	1.0000			
TE	0.3516	0.2417	0.4301	0.3230	0.4700	0.3735	1.0000		
US	0.5262	0.4361	0.4509	0.4106	0.4503	0.4984	0.2465	1.0000	
SC	-0.1344	-0.0716	-0.1486	-0.1343	-0.1604	-0.2735	-0.2147	0.0046	1.0000

Correlation is Pearson correlation. Art indices provided by Art Market Research.

The Efficient Frontier reveals that there are diversification benefits in allocating art asset classifications in an art-asset portfolio, with an equally-weighted portfolio under-performing an optimized portfolio by almost 3.0%, with a 42.4% level of risk (see Figure 7.3).

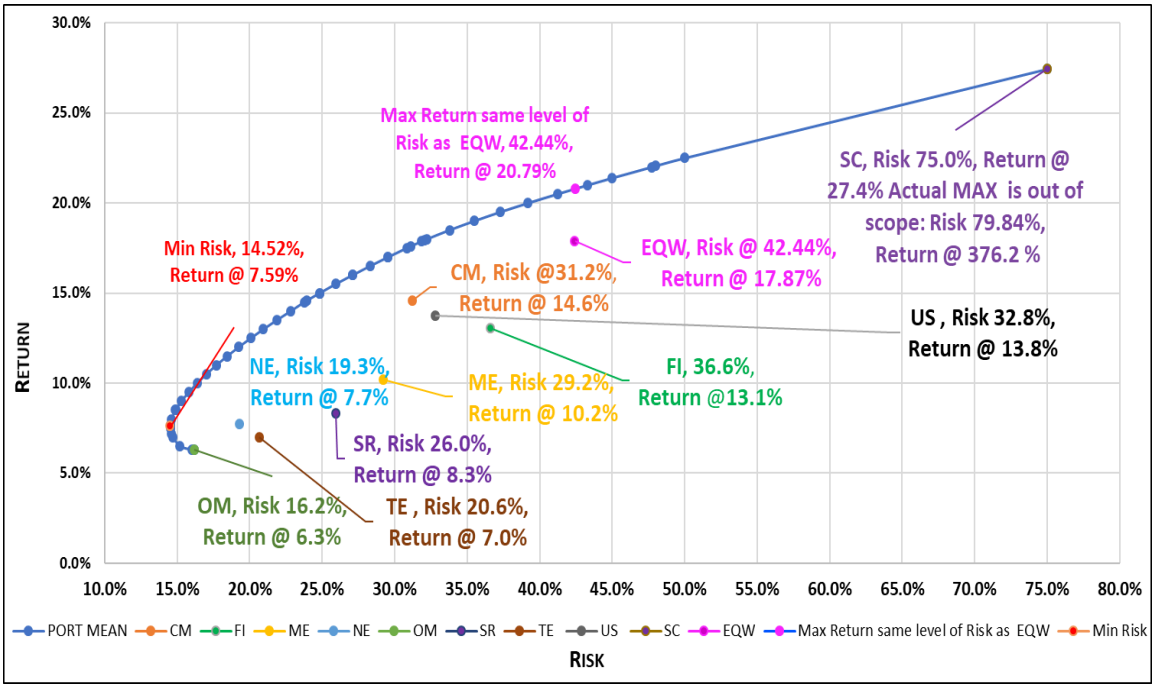

Figure 7.3. AMR Art-Asset Portfolio Efficient Frontier, 1976–2018.

7.4.3 SMM: Efficient Frontier–Art-Asset Portfolio

In this section, the third Efficient Frontier constructed is depicted in Figure 7.4. Table 7.3 presents the correlation between categories of SMM's art returns from 1976–2018. The low correlations would suggest diversification benefits by allocating various subcategories of art to an art-asset portfolio. Table 7.3 presents the correlations with various art subcategories of returns.

Table 7.3

Correlation Table for SMM's Art Market Returns, 1976–2018

	Post-war & Contemporary	*Impressionist & Modern*	*Old Masters & 19th Century*
Post-war/Contemp	1.0000		
Impress/Modern	0.7653	1.0000	
Old Mast/19th Cent.	0.3809	0.6000	1.0000

The art-asset portfolio below reveals that there are diversification benefits in diversifying art classifications, with an equally weighted portfolio with a return of 8.84 under-performing an optimized portfolio return of 8.88% at a 16.4% risk (see Figure 7.4).

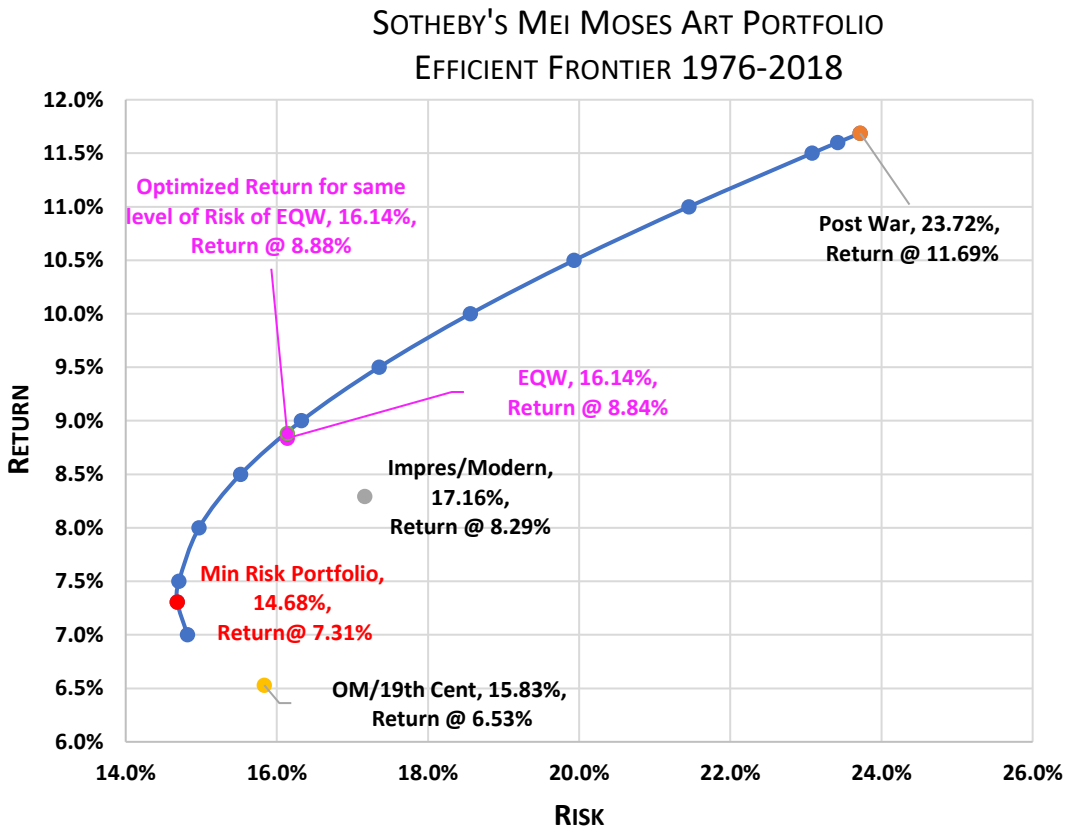

Figure 7.4. SMM Art-Asset Portfolio Efficient Frontier, 1976–2018.

7.5 Discussion

This chapter explored research sub-question four: "Do investments in art allow for diversification benefits in an all art portfolio?" The correlation between various subcategories of art assets and the art market varied depending upon the art indices provider. The indices with lower correlation provided more diversification benefits than indices with mediocre correlations. This research would suggest that diversifying the art collection of an art investment portfolio would mitigate some investment risk. This study suggested that investments in various categories of art allow for diversification benefits in an art-asset portfolio.

Additionally, it is important to understand the correlations and co-movements between the art market and financial market. Chapter Eight explores how the three art market indices returns move in conjunction with each other and the financial markets.

CHAPTER EIGHT: ART INDICES CORRELATIONS

This study investigates the relationship, or lack thereof, between investments in art and equity markets. Art market returns will be proxied by three independent art indices (Artprice, Art Market Research, and Sotheby's Mei Moses), and the S&P 500 will proxy the U.S. equity market. To identify the possible relationships in the co-movements between the return series, the analysis focuses on the correlation between art returns with financial returns, as well as art return relationships among the art indices providers.

8.1 Research Sub-Question Five: Overview

This chapter explores research sub-question five: "Do art and financial market risk and return relationships differ when considering indices from three independent art indices providers, simultaneously?" The first section introduces the hypotheses. The next section presents the methods used. The results are presented in section three. A detailed analysis on these results are presented in section four.

8.2 Hypotheses

This is the first study known to consider the impact of analyzing three independent comprehensive art indices simultaneously to gain additional insight into the relationship between the financial markets and the art investment field. This study sought to answer: Do art and financial market risk and return relationships differ when considering comprehensive art indices from three independent indices providers, simultaneously? Therefore, this study posited:

- Proposition 5: Comprehensive art indices' risk and return relationships will not differ between art indices providers when compared simultaneously.

- $H5A_0$: The risk and return relationships will not differ between three comprehensive art indices when compared simultaneously for the twenty-one-year period 1998–2018.
- $H5A_a$: The risk and return relationships will differ between three comprehensive art indices when compared simultaneously for the twenty-one-year period 1998–2018.
- $H5B_0$: The risk and return relationships will not differ between three comprehensive art indices when compared simultaneously to the S&P 500 for the twenty-one-year period 1998–2018.
- $H5B_a$: The risk and return relationships will differ between three comprehensive art indices when compared simultaneously to the S&P 500 for the twenty-one-year period 1998–2018.

Additionally, this study repeated Hypothesis 5, utilizing the returns from SMM and the S&P 500, extended with Shiller's S&P data from 1871–1927, henceforward referred to as SPX (S&P extended).[16] The historical return relationships are explored to identify if the longer time series are the same or different than the time series studied in Hypothesis 5 from 1998–2018. To provide additional insight and robustness, the relationships are also stratified by decade. The analysis sought to determine if the risk, returns relationships, correlation, and co-movements between the SMM art indices compared to the SPX differed for the period and subperiods during 1871–2018.

[16] SPX is the acronym used by the author of this paper to represent the S&P 500 extended for Shiller's data from 1871 through 1927. SPX stands for S&P Extended.

8.3 Model: Comparison of Comprehensive Art Indices Providers

Investment performance of art returns based on an art index has rarely been studied in the academic literature, even though art returns have varied depending on the study. Throughout this research, it has been apparent that there are different conclusions regarding the art market depending on the index provider analyzed. By researching the AP, AMR, and SMM indices compared to the S&P 500 simultaneously, this study explores trends in the market revealed by examining art as an asset (see Figure 8.1). In order to examine if the art index provider impacts art returns, a correlation analysis trend analysis is performed to compare the three art indices on the rate of return of art assets. The dataset for art returns consisted of AP's returns of the Global index, the AMR returns of the ART index, and Sotheby's art returns of the ALL index. Together, these three art indices were compared with each other. The annualized art indices from 1998–2018 were used to assess the relationships, including correlations, co-movements, and comparative analysis. The S&P 500 returns serve as a proxy for a portfolio of equity securities. The equity security portfolio movement is compared to the three idependent art indices that proxy for a portfolio of art asset investments.

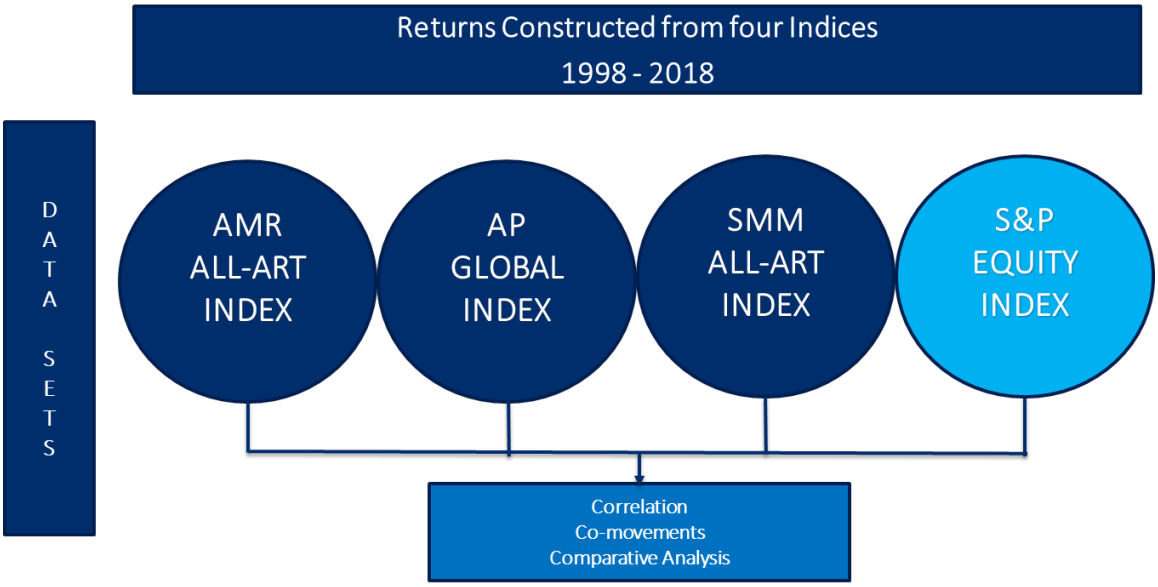

Figure 8.1. Model for H5: Co-movement of Art Market.

8.4 Results: Art and Financial Market Relationships

Sub-question five explored the return relationships and diversification prospects of art from data from three independent art indices providers compared to the financial markets. Each art indices provider measures the art market through a variety of categories of art as well as a comprehensive all-inclusive art index for the global marketplace. The results from Chapters Four through Seven suggest that measurement, selection bias, categories, and time periods all have implications for art as an investment. Due to these differences in samples, categories, and time periods, the following analysis sought to explore the overarching relationships between the art and financial markets.

8.4.1 Art and S&P 500 Returns

Figure 8.2 presents a comparison of the comprehensive all-art indices with the S&P 500 from 1998–2018. By comparing the three indices simultaneously with the S&P 500, it became evident that while some years appear to indicate a general trend consistent

with the financial markets, some years reveal contrasting trends. The analysis also reveals that the 2008 global financial crisis affected the global art market under all three indices: Artprice appeared to reflect market sentiment at nearly the same time as the financial markets' downturn in 2008, while SMM and AMR saw a delayed effect in 2009. This is consistent with the correlation table (Table 8.1) that reveals AP's market index is the most correlated of the three indices with the S&P 500 at 0.44, while AMR is negatively correlated with the S&P 500 (-0.26) and SMM with a very low correlation at 0.052 to the financial market. However, the AMR and SMM indices also have a low correlation with each other (0.25).

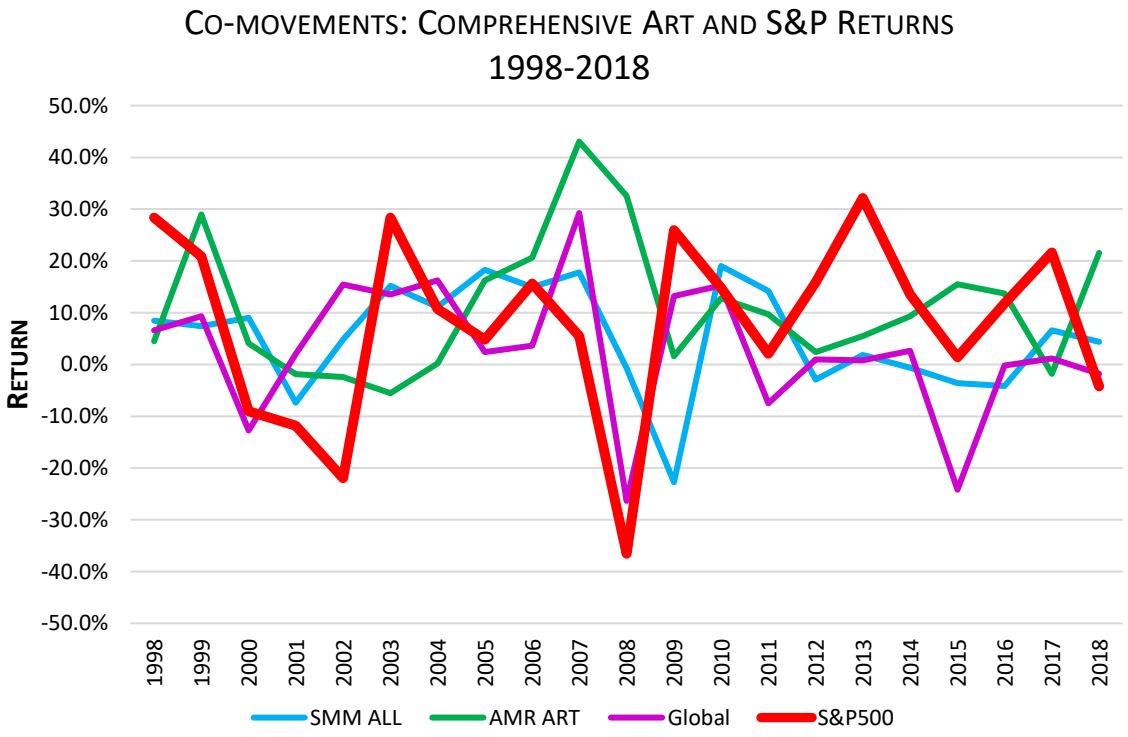

Figure 8.2. Co-movements: Art and S&P 500 Returns, 1998–2018.

Table 8.1 presents the correlation of the comprehensive art indices with each other and to the financial markets. The correlations of the three art indices reveal that although they all measure the art market, they are not highly correlated with each other. AP is negatively correlated with AMR (-0.07) and has low correlation with SMM (0.28). The results of the correlation analysis suggest that there is no statistically-significant correlation between the three art returns (Global, ART, and ALL) provided by leading art indices providers (AP, AMR, and SMM, respectively). It can there be concluded that for the relationship between the three art markets, this research fails to reject the Null Hypothesis 5A.

Additionally, there was not a significant relationship between AMR ART and SMM ALL and the S&P 500, $p > 0.10$, and therefore, there is inconclusive evidence about the association between the art and financial market measures; this research fails to reject the Null Hypothesis 5B. However, there was a significant positive relationship between AP Global and the S& P 500 between 1998–2018, $p < 0.05$ and therefore, the evidence supports a rejection of the Null Hypothesis 5B, in support of the Alternative Hypothesis 5B. Upon the review of Figure 8.2, it appears that there may be a slight pattern to the four markets that may be identifiable through future research.

Table 8.1

Correlations of Comprehensive Art and Financial Markets, 1998–2018

	AP	*AMR*	*SMM*	*S&P 500*	*T-Bill*	*T-Bond*	*RUT 2K*	*Corp Bonds*	*Classic Cars*
AP	1.00								
AMR	-0.07	1.00							
SMM	0.28	0.25	1.00						
S&P 500	0.44**	-0.26	0.05	1.00					
T Bills	0.12	0.33	0.35	-0.16	1.00				
T Bonds	-0.23	0.08	0.34	-0.63***	0.21	1.00			
RUT 2K	0.39*	-0.39*	0.03	0.79***	-0.27	-0.64***	1.00		
Corp Bonds	0.43**	-0.62***	-0.26	0.24	-0.12	0.05	0.35	1.00	
Classic Cars	-0.02	0.41*	0.17	0.10	-0.44**	0.03	-0.07	-0.44	1.00

Note: One, two, or three stars indicate the correlation is statistically significant at the 10%, 5% or 1% level, respectively.

Table 8.2 summarizes the three comprehensive indices mean and standard deviation measures against five asset classes similar to the summary statistics reported by Mei and Moses in their 2002 study. From the 1998–2018 time series, AMR presented the highest return of 10.98% with a risk of 12.47%, and coefficient of variation (CV) of 1.14. The second highest return compiled was derived from SMM at 5.20% with a risk of 10.0%, and CV of 1.90. The smallest return is from Artprice's global index with a mere return of 2.80%, risk of 12.80%, and CV of 12.8. AMR provided the best overall return with the lowest CV. Additionally, it outperformed the stock market, classic cars, fixed securities and T-Bills. Under AMR, the art market overperforms other investments, and would provide a rewarding return for the relative risk. If an investor considered the SMM returns, art as an investment would fall short of all other investment choices, only outperforming Government Bonds and T-Bills. Lastly, if an investor received returns similar to AP's Global art index, the mean return would only fair better than T-Bills.

For the time series 1976–2018 a similar picture of art returns emerges. AMR presented the highest return of 11.80% with a risk of 14.0%, and CV of 1.15. SMM reported return at 8.29% with a risk of 14.50%, and CV of 2.07. Artprice does not have data available for these years, and thus its means and standard deviation are not reported. Additionally, AMR & SMM both outperformed Government and Corporate bonds, and T-Bills.

Table 8.2

Summary Statistics of Various Asset Classes of Returns, Various Dates

Grimmer*		SMM	AMR	AP	S&P 500[1]	RUT 2K[2]	Classic cars	LT Gov bonds	T-Bills
1998–2018	Mean	0.0520	0.1098	0.0280	0.0809	0.0818	0.0751	0.0508	0.0197
	SD	0.1000	0.1247	0.1280	0.1706	0.2064	0.0869	0.0844	0.0190
		SMM	AMR	AP	S&P 500[1]	RUT 2K[2]	Corp bonds	LT Gov bonds	T-Bills
1976–2018	Mean	0.0829	0.1180	—	0.1233	—	0.0783	0.0748	0.0456
	SD	0.1450	0.1400	—	0.1572	—	0.1036	0.0985	0.0347

Note: *Grimmer includes Sotheby's Mei Moses Index (SMM) annual, AMR Index (AMR) monthly continuous annualized, and Artprice's Global Index (AP) quarterly continuous annualized; represent nominal, arithmetic returns.
[1] S&P 500 index represents large stocks. [2] RUT 2K (Russel 2000) index represents small stocks

8.4.2 Highest to Lowest Return and Risk

Table 8.3 summarizes the returns from highest to lowest for two time frames. The first panel presents the most recent twenty-one-year period from 1998–2018. This period includes the Artprice Global index. The table lists the means and then the standard deviations (SD) from highest to lowest. The listing indicates that the order of risk does not necessarily coordinate with the level of return. AMR's all art index has the highest return for this period at 11.0% with a relatively low risk of 12.5%, while AP reports a return on the global art index of a mere 2.8%, for a similar risk of 12.8%. SMM's all art

index return is approximately in the middle reporting a 5.3% return and corresponding 10.0% risk.

The analysis also indicated that investors who are willing to take on significant risk in equities, such as small stocks (20.6% risk) with a return of 8.2% and large stocks (17.1% risk) with a return of 8.1% may have increased their returns had they invested in art that mimicked those of AMR's return (11.5%) but would have fallen short if the returns were similar to those of SMM (5.3%) or AP (2.8%). For the longer period 1976–2018, higher returns were more indicative of taking on higher risk. AMR (return of 11.8%) reports a 3.5% higher return than SMM (return of 8.3%) for a 0.5% lower risk of 14.0%. The AMR return of 11.8% was close to the S&P 500 returns at 12.3% during this period and was slightly less risky by at 14.0% compared to the S&P 500 12.5% (see Table 8.3).

Table 8.3

Return and Risk from Highest to Lowest, 1998–2018

Indices with Highest Returns & Highest Risk

Highest to Lowest Return 1998–2018			**Highest to Lowest Risk 1998–2018**		
	Mean Return	Standard Deviation		Standard Deviation	Mean Return
AMR	11.0%	12.5%	RUT 2K	20.6%	8.2%
RUT 2K	8.2%	20.6%	S&P 500	17.1%	8.1%
S&P 500	8.1%	17.1%	AP	12.8%	2.8%
Classic Cars	7.5%	8.7%	AMR	12.5%	11.0%
SMM	5.3%	10.0%	SMM	10.0%	5.3%
T-Bonds	5.1%	8.4%	Classic Cars	8.7%	7.5%
AP	2.8%	12.8%	T-Bonds	8.4%	5.1%
T-Bills	2.0%	1.9%	T-Bills	1.9%	2.0%
Highest to Lowest Return 1976–2018			**Highest to Lowest Risk 1976–2018**		
	Mean Return	Standard Deviation		Standard Deviation	Mean Return
S&P 500	12.3%	15.7%	S&P 500	15.7%	12.3%
AMR	11.8%	14.0%	SMM	14.5%	8.3%
SMM	8.3%	14.5%	AMR	14.0%	11.8%
Corp Bonds	7.8%	10.4%	Corp Bonds	10.4%	7.8%
T-Bonds	7.5%	9.9%	T-Bonds	9.9%	7.5%
T-Bills	4.6%	3.5%	T-Bills	3.5%	4.6%

Figures 8.3 through 8.6 provide additional insight into the inconclusive results of art as an investment. Figure 8.3 presents art as an investment leader per AMR, as a mediocre investment per SMM, and as having lower investment potential per the AP index. The graph represents returns from highest to lowest in order to visualize the relationship between return and corresponding risk. For the period 1998–2018, AMR presented the highest return in art at 11.0%, followed by SMM's reported art return of

5.2%. AP reported the smallest art return during the last twenty-one-year period at 2.8%. The lower AP index returns are especially interesting because Artprice has acknowledged that their new proprietary index may better represent the financial industry's demand for a reliable bench market of investment quality art (Artprice, 2019). Their new "blue-chip" index, Artprice100®, is producing larger and likely more representative returns designed for financiers and investors because it ignores volatile artists (Artprice, 2020). This statement implies that the methodologies used by AMR and SMM may produce a more accurate depiction of art as an investment.

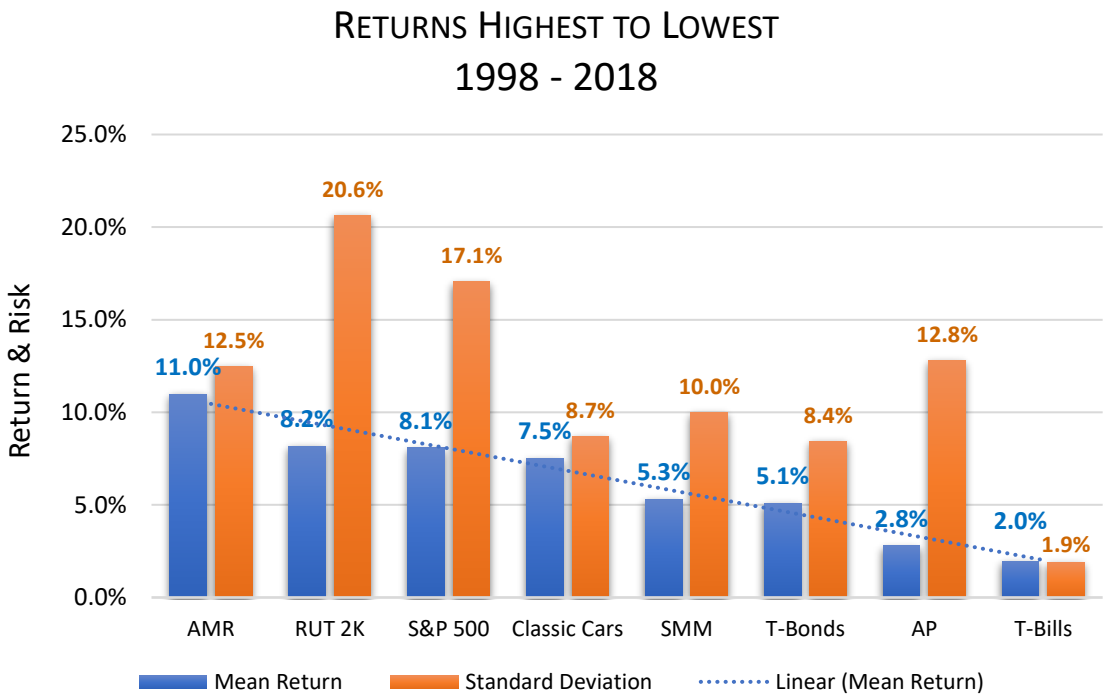

Figure 8.3. Highest to Lowest Returns, 1998–2018.

Figure 8.4 presents risk from highest to lowest from 1998–2018 in order to visualize the relationship between risk and corresponding return. The highest risk for art returns was reported by AP at 12.8%, although AP had the smallest return. The second

highest risk for art investments was reported by AMR at 12.5% followed by SMM at 10.0% (see Figure 8.4). The analysis reveals that for risk-adverse investors, art may be a viable investment strategy since all art markets shown have less risk than equity securities. In fact, AMR had lower risk (12.5%) with a higher return (11.0%) than large and small stocks.

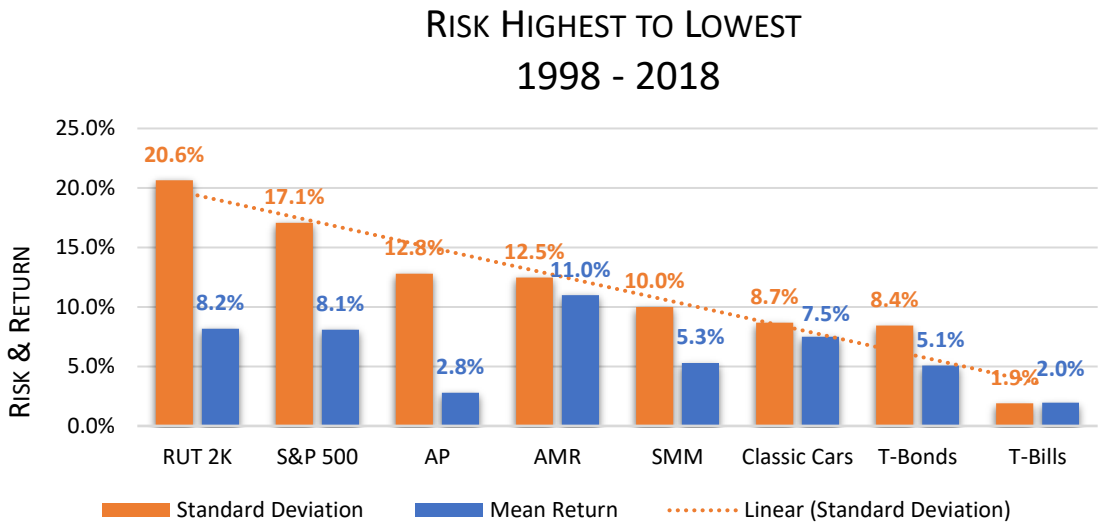

Figure 8.4. Highest to Lowest Risk, 1998–2018.

Figure 8.5 summarizes the returns from highest to lowest from 1976–2018 in order to visualize the relationship between return and corresponding risk. AMR's all art index from presented the highest return on art at 11.8% with a risk of 14.0%. SMM's all art index for the same period produced a return of 8.3% with a risk of 14.5%. The variance between the two art indices was 3.51%, although the risk was slightly higher for SMM by 0.50% for less return. Since AP data were not available during this period, it is not included in the analysis.

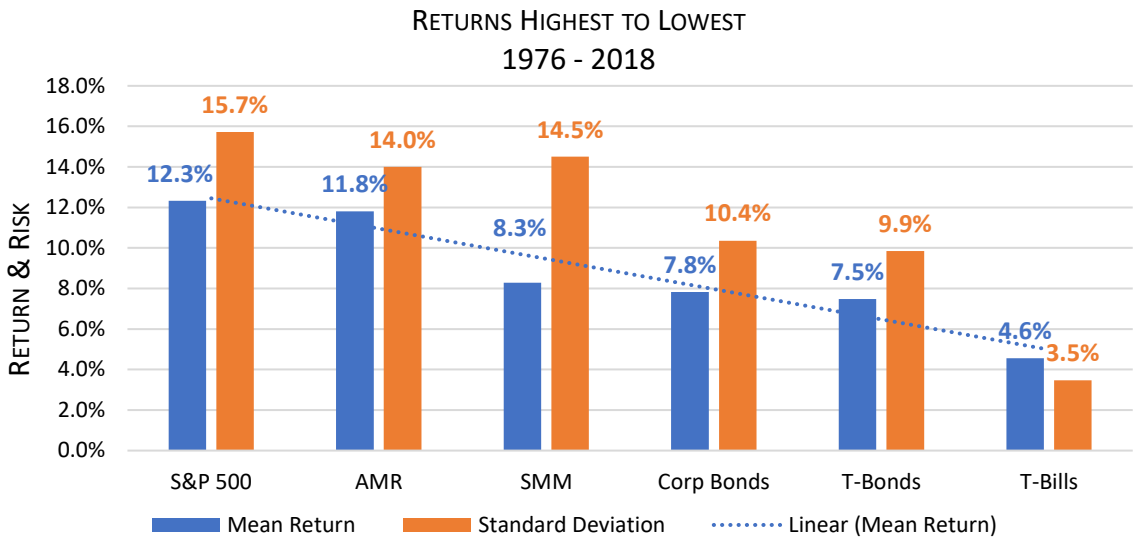

Figure 8.5. Highest to Lowest Returns, 1976–2018.

Figure 8.6 presents the risks from highest to lowest from 1976–2018 in order to visualize the relationship between risk and corresponding return. Equity risk of large stocks were similar to the two art indices' risks. The highest risk for art investments was reported by SMM at 14.5%. The second highest risk for art investments was reported by AMR at 14.0%. During this period, investors who would have accepted a level of risk over 13.0% would have received solid returns by investing in the art market.

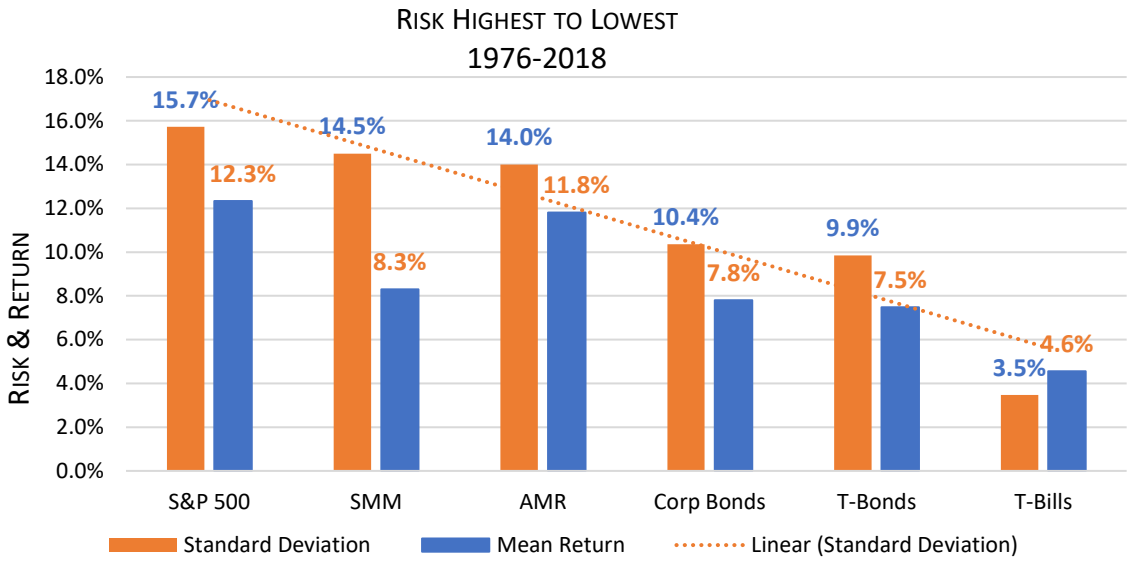

Figure 8.6. Highest to Lowest Risk, 1976–2018.

8.4.3 Historical Art and Financial Market Returns

The analysis of historical investment returns and correlations, stratified by decade, is presented in Table 8.4 in order to explore the correlation of the art market with the financial market from 1858 and 1871, respectively. This study uses SMM all-art market index returns as the proxy for the rate of return of the art market and the SPX composite index returns as the proxy for the rate of return of a portfolio of equity securities. In Table 8.4 the data series is stratified into short-term annual return correlations by decade to identify relationships between these two markets during historical periods of economic interest. The art market data were available from SMM from 1858, and the SPX data was compiled from a combination of annual data available from Robert Shiller's (2019) dataset from 1871–1927, and Damodaran's (2019) dataset from 1928–2018.

8.4.3.1 Historical correlations 1858–2018. Table 8.4 summarizes the means, SD, and correlations by decade for the art and equity markets. While some prior studies have found high correlation between the two markets, and others have found negative correlations, the present study has found low correlation when investigating art returns utilizing the Sotheby's Mei Moses comprehensive all-art index. The variability in results suggest that there may be some times that art is more correlated to the financial markets than others. In order to explore the correlation between the historic art and financial markets, Table 8.4 presents the returns and correlations divided into 10-year periods from 1858 through 2018.

The analysis in Table 8.4 reveals that art is more correlated with the financial markets during economic crises. This analysis indicates that the decades with the highest correlation was during the 1929 crash, with a correlation of 59.9% and 2008 global crisis, with a high correlation of 65.4%, that interestingly was followed by a negatively correlated decade (-3.1%). This may suggest that severe overall global economic climates do impact the art market.

Table 8.4

Sotheby's ALL with SPX: Returns and Correlations by Decade

		Returns by Decade		Correlation
Date Series		Art Market	Equity Market	Art with Equity Market
1859–1868	Mean	23.1%	*N/A*	*N/A*
	SD	*54.6%*	*N/A*	*N/A*
1869–1878	Mean	11.1%	3.9%	-0.246
	SD	*39.0%*	*10.4%*	
1879–1888	Mean	8.5%	10.5%	0.406
	SD	*47.8%*	*18.2%*	
1889–1898	Mean	7.7%	6.7%	0.243
	SD	*31.1%*	*13.0%*	
1898–1908	Mean	11.8%	10.6%	-0.088
	SD	*55.1%*	*19.1%*	
1909–1918	Mean	5.7%	5.3%	0.134
	SD	*26.2%*	*13.7%*	
1919–1928	Mean	15.3%	19.5%	0.392
	SD	*50.6%*	*16.1%*	
1929–1938	Mean	-2.6%	3.6%	0.599
	SD	*26.1%*	*32.2%*	
1939–1948	Mean	3.2%	7.7%	0.100
	SD	*22.5%*	*15.7%*	
1949–1958	Mean	8.9%	21.6%	-0.108
	SD	*18.8%*	*18.5%*	
1959–1968	Mean	16.6%	10.6%	-0.134
	SD	*16.3%*	*12.3%*	
1969–1978	Mean	13.1%	4.8%	-0.210
	SD	*24.4%*	*18.2%*	
1979–1988	Mean	16.4%	16.7%	0.147
	SD	*14.9%*	*10.9%*	
1989–1998	Mean	2.4%	19.9%	0.304
	SD	*16.0%*	*13.8%*	
1999–2008	Mean	9.0%	0.7%	0.654
	SD	*7.9%*	*19.2%*	
2009–2018	Mean	1.2%	13.5%	-0.312
	SD	*10.8%*	*10.8%*	

Note: Art Market returns are represented by SMM ALL index. Mean = Nominal, Arithmetic, SD = Standard Deviation

SPX annual returns are represented by Shiller's composite data, 1871–1927 and S&P 500 returns from Damodaran, 1928–2018

* SPX returns only for 1871–1878

With the SPX returns as a proxy for the financial market returns, and SMM's all-art index as a proxy for the global art market from 1871–2018, Table 8.5 reveals a low correlation of 0.1627 between the two markets over the 148-year period, suggesting long-term investment in art may mitigate investment risk in equity securities.

Table 8.5

Correlation SMM ALL and SPX, 1871–2018

	ART	*SPX*
ART	1.0000	
SPX	0.1627	1.0000

Figure 8.7 presents art market returns compared to the SPX from 1871 through 2018. The graph presents a visual of the volatility in the art market compared to the financial market returns. Perhaps the high returns on art in the late 19th and early 20th century were a result of the art market capturing the highest returns on masterpieces that entered the market and has now tapered off as the art indices include a more comprehensive index of the market as a whole. The trends in the graph suggest that art is likely a less volatile asset than it was in the past. Since the 1990, it does not appear that the art market as a whole has outperformed the U.S. financial market. Since the Great Depression, art market negative returns were the largest in approximately 1990, followed by 2009 after the global financial crisis. Figure 8.7 also reveals that the art market did not take as large of a hit during the 2008 global crisis but has also not recovered at the same pace as the financial markets.

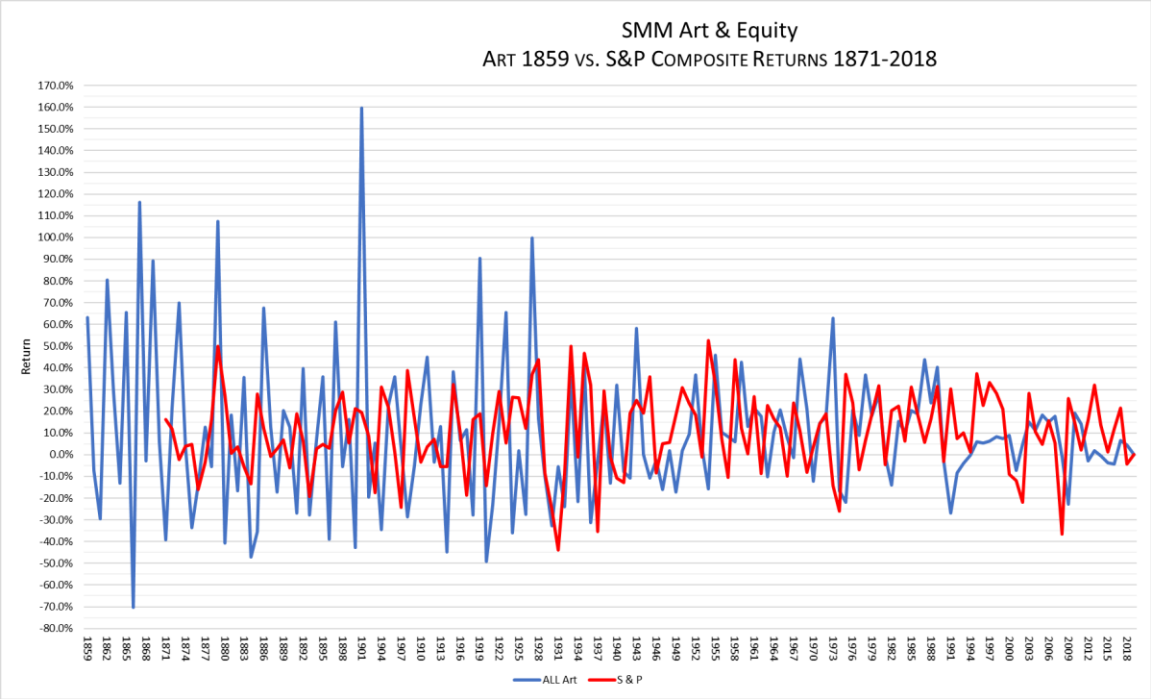

Figure 8.7. SMM ALL 1859–2018 and SPX, 1871–2018.

8.4.2.2 Historical correlations 1928–2018. Table 8.6 reports the correlation between the SMM art index and the S&P 500 between 1928–2018. Sotheby's Mei Moses's comprehensive ALL index includes data from 1858, with the dataset becoming more robust through time as more sales are tracked by the index (Sotheby's, n.d.). Similarly, from 1928 there was a larger composite of stocks used in the S&P 500 returns, and therefore, this time series of data are used as a robustness check for the correlation between the art and equity markets. During the 91-year period, there has been a 0.1751 correlation between the U.S. financial markets and the art market. Additionally, the low correlations of 0.1751 between the two markets indicates the correlation is similar to the 148-year period (1871–2018) reported in Table 8.5 of 0.1627.

Table 8.6
Correlation SMM ALL with S&P 500, 1928–2018

	SMM ALL	*S&P 500*
SMM ALL	1.0000	
S&P 500	0.1751	1.0000

Figure 8.8 presents the time series correlation between the financial and art market returns from 1928 through 2018. Although the correlation is low between the two indices, there appears to be a pattern of bull and bear markets in the art market. During the depression, while the stock market plummeted, the art market's reaction was the inverse. Although in the 1930s it appears that the markets correlated with each other, in actuality there was a slight lag with the financial markets during this time. This observation may suggest that one market may predict the other. The presentation of the shorter time series in Figure 8.8 illustrates a more detailed visual of the markets' movements than Figure 8.7 from 1858–2018.

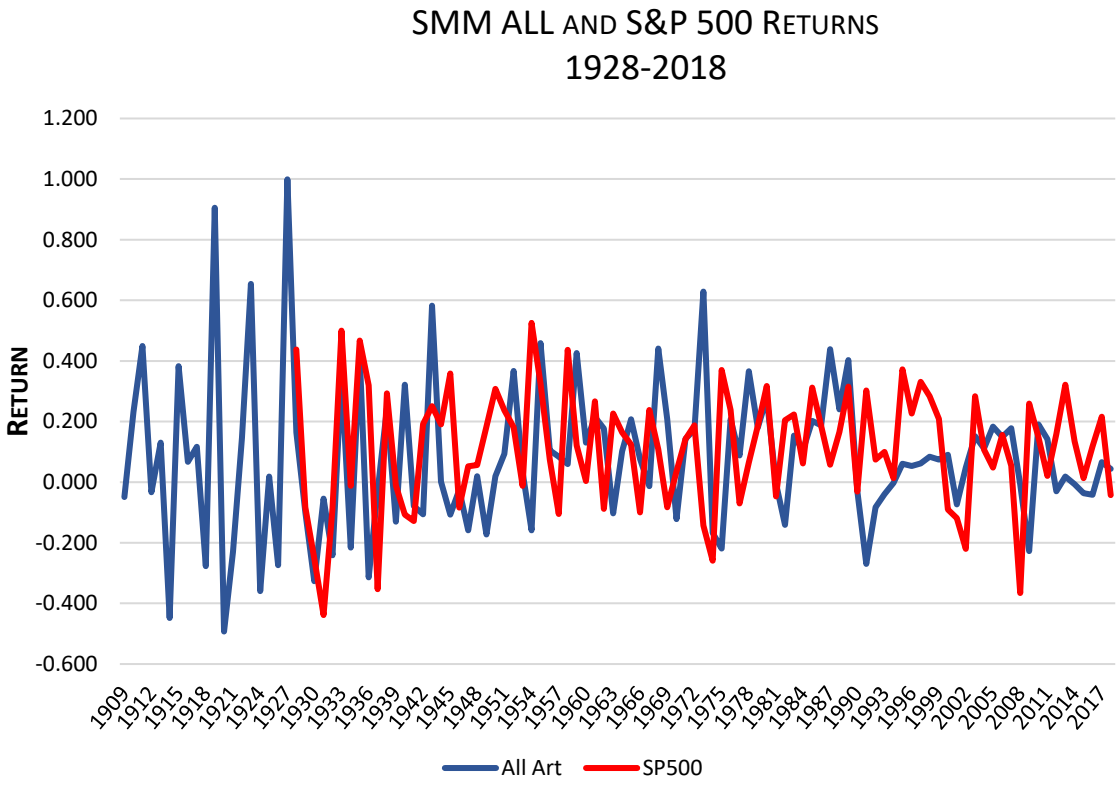

Figure 8.8. SMM ALL and S&P 500 Returns, 1928–2018.

In summary, this section presented the analysis of art market returns from 1871–2018 (Figure 8.7) and 1928–2018 (Figure 8.8) of the overall co-movements with the financial markets returns during those two periods. The historical correlations between the art and financial markets is an important part of understanding the financial implications of art as an investment. Both time frames represented a low correlation between the financial and art market for the 148-year period (0.1627) and 91-year periods (0.1751). The differences in these correlations between the two periods are relatively immaterial for the historical returns, considering the approximate fifty years of additional data, suggesting that the long-term correlation of art as an investment is low compared with the securities market.

8.4.2.3 Historical correlations for various art categories through 2018. Figure 8.9 presents Sotheby's Mei Moses historical art categories and art market returns compared to the financial market (represented in red). While the ALL art returns are available from 1859 forward, the longest time series of categories is available for Old Masters/19th Century Art, from 1897–2018, followed by Impressionist/Modern Art from 1930–2018, and finally Post-war/Contemporary from 1961–2018. In order to understand the art market in comparison to the financial markets, this study examines Sotheby's Mei Moses' categories of art throughout a variety of time periods. Figure 8.9 reveals that historically, some subcategories have outperformed over other categories and the SPX. Note that Old Masters/19th Century Art started strong, but were then surpassed by Impressionist/Modern, and finally Post-War Art. It may be concluded that the overall market of art is getting closer to the financial returns.

Additionally, it is possible that some categories of art may have higher correlation with the financial markets than the art market as a whole. The graph integrates the various categories for the corresponding period. The analysis provides insight into how these art markets have evolved over time. As an example, Old Masters seemed to provide the highest returns from 1984 through 1924; however, similar to the opportunity of purchasing a security in the early stages of an initial price offering (IPO), the early dominant returns become more predictable and consistent with other assets once they have peaked and can demand an efficient price. Therefore, from the categories tracked in the Sotheby's Mei Moses indices, there seem to be fewer chances of capitalizing on the art market for an extreme investment return.

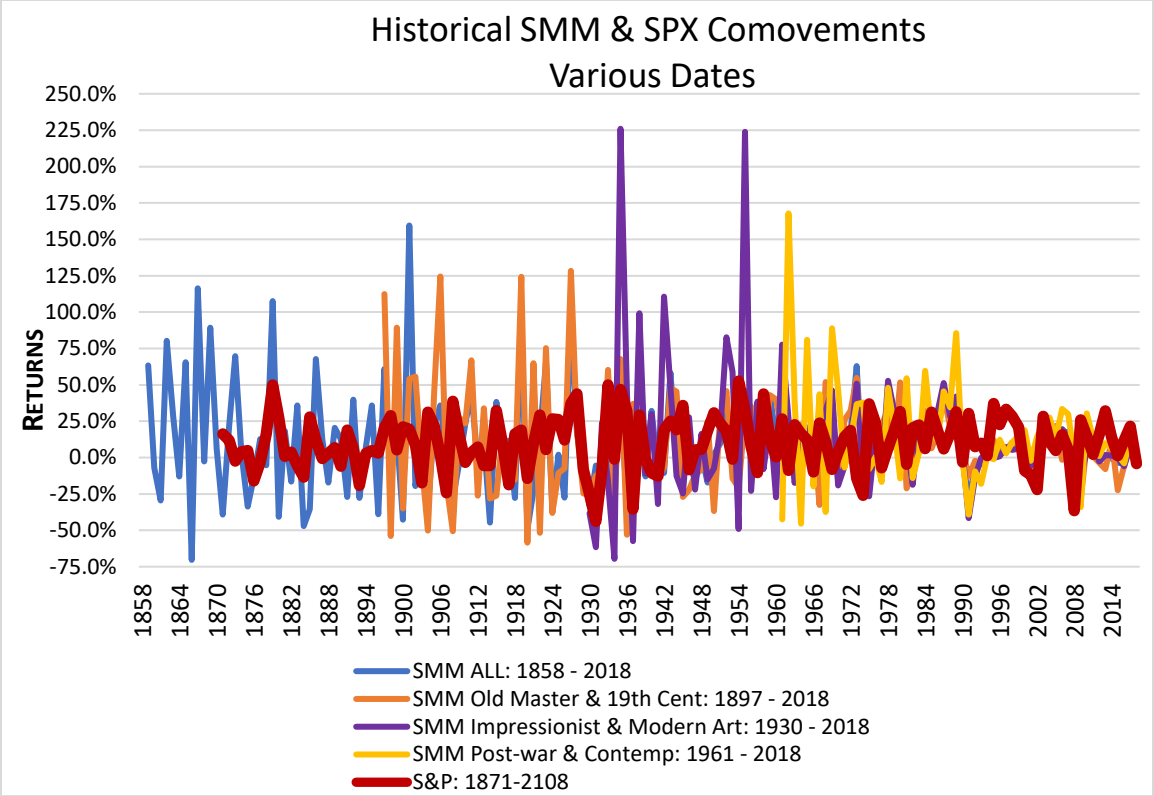

Figure 8.9. SMM Art and SPX Returns, Various Dates

8.4.4 Diversification Benefits

Combining the three art indices with the S&P 500, the following Efficient Frontier was constructed in Figure 8.10. Had AP, AMR and SMM all been separate art funds, the analysis shows that there would be diversification benefits. One noted item is that the S&P 500 return of 8.09% has a high risk during this twenty-one-year period of 17.06%. Through optimization, for an investor who is looking for an 8.09% expected return, a diversified portfolio of art would have potentially reduced the risk to 7.27% when allocating weights between the following investments: 7.95% to AP, 41.65% to AMR, 27.85% to SMM, and 22.55% to S&P 500. This portfolio can be seen on the Efficient Frontier in Figure 8.10 (Min Risk for SP500 Return, SD 7.27, Return @

8.09%). The analysis depicted also reports that for the same level of risk of the SMM index, a 10.5% return could be achieved through diversification, as seen on the efficient frontier.

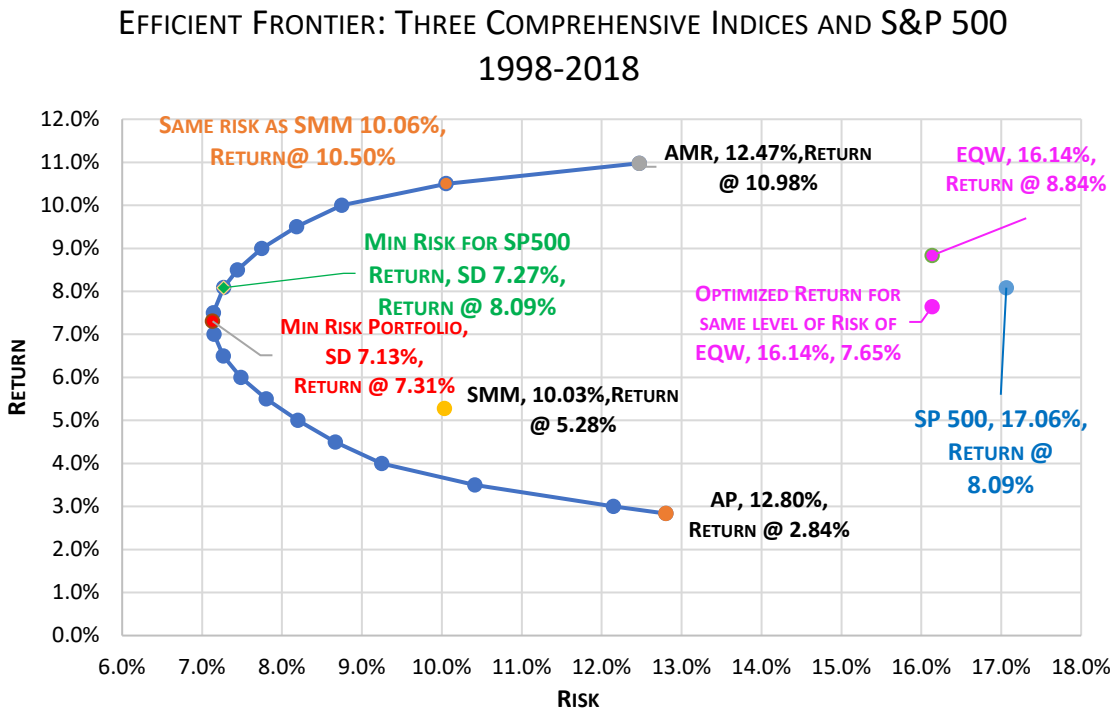

Figure 8.10. Efficient Frontier: Three Art Indices and S&P 500, 1998–2018.

8.5 Discussion

Chapter Eight explored research sub-question five: "Do art and financial market risk and return relationships differ when considering indices from three independent art indices providers simultaneously?" To address this question, first three comprehensive co-movements were explored from 1998–2018 against the S&P 500 to proxy for the art and securities markets. Figure 8.2 revealed that the greatest co-movement was between AP and the S&P 500 in 2008, and again in 2011 followed by 2015. These co-movements

are also supported as shown in Table 8.1, with AP and the S&P 500 correlated at 0.4415 during the 21-year period. Although the correlation appears relatively low, AP represents the strongest relationship with the securities market out of the three comprehensive art indices (AP, AMR, and SMM). It is possible that this higher correlation is attributable to the sample selection. Artprice's econometric data was developed using specific algorithms and accounts for a wide range of art that is likely not currently contained in the AMR or SMM. AMR's correlation with the S&P 500 is -0.2594 and correlation with AP is -0.0743, while SMM's correlation with the S&P 500 is 0.0525 and correlation with AP is 0.2770. The low correlations between the three indices and individually with the S&P 500 suggest that there would be diversification benefits for investors to consider art as a worthy addition to a diversified investment portfolio. Figure 8.2 also reveals that in the twenty-one-year period the S&P 500 has had negative returns in excess of all three art indices. This financial implication is useful to investors, because although the literature has reported the volatility in the art market to be high, the analysis from Table 8.2 reports the SD ranging between 0.10-0.13 between 1998–2018. Conversely, the S&P 500 SD is reported as 0.17 for the same period.

Second, in order to identify the trends of the art market compared to each other and the financial markets, Table 8.3 supports Hypothesis 5 by presenting returns highest to lowest. All three of the art indices' returns did differ from each other and from financial returns. Similarly, when comparing the relationship of risk to each of the art indices, and to the financial measures, there were differences between the standard deviations. Although the returns of the art indices were spread between 11.0% as the highest mean for AMR and 2.8% as the lowest mean for AMR, the SD for the three art

indices were consecutively close to each other compared to the financial measures (see Table 8.3). AP had the highest SD of 12.8%, followed next by AMR for a SD of 12.5%, with SMM reporting the least volatile with a SD of 10.0%. These three art indices fell between large stock SD of 17.1%, Classic Cars of 8.7% as an alternative investment, and 8.4% for Long-term Government Bonds.

As a robustness check, the returns and risks of the markets were examined for the period 1976–2018 and are presented in Table 8.3 in the bottom Panel. Consistent with the discussion for the previous period, this research has found the means and SDs of each investment differed from both art indices and the financial measures. During this period, the SD of SMM (14.5%) and AMR (14.0%) were similar to each other in comparison to the other measures. Therefore, this analysis suggests that the volatility of the art market depends upon the sample of the underlying dataset, and that under both time series, the art markets are less volatile than the equity markets.

Third, this chapter explored the historical art returns from 1859–2018 through the SMM dataset, and its correlation with the extended S&P composite returns from 1871–2018. The results presented in this chapter found the highest correlation between the art and financial markets during the global financial crisis, although the correlation was not necessarily strong enough to diminish the value of art's effect on diversification benefits. The analysis presented in Table 8.4 suggests that the financial implications of the global economic crisis in 2008 did have an impact on the global art market with the highest correlation per decade of the 148 years, at 0.654. Higgs (2012) found a decrease in returns of Australian art during the global financial crisis; however, Higgs found low correlation with stock markets suggestive of portfolio diversification prospects. Based on

the analysis in this study, the financial implications of serious economic downturns also affected the art market during the Great Depression; the correlation for the decade from 1929–1938 was 0.599. Although these correlations were the highest in these two periods, they are low enough to provide diversification benefits during economic downturns.

The last section in this chapter explored diversification benefits through the construction of mean-variance optimization models and the efficient frontier with the three art indices and the S&P 500. As shown is Figure 8.10, the correlation of the art returns of the three independent art markets and the equity market shows AP falls outside the Efficient Frontier, while AMR's is on the opposite spectrum of the frontier curve with the highest return, and lies on the Efficient Frontier for a maximum return portfolio at its given level of risk of 12.47%. These two indices are also negatively correlated with each other as discussed previously in this chapter. The efficiency curve identified two important diversification options. First, the findings in Figure 8.10 suggest by contributing art to a portfolio, an investor could significantly decrease investment risk by 57.4% (from SD 17.06% to SD 7.27% for the same return as the S&P 500 of 8.09%), by choosing the optimized diversified portfolio that falls on the efficient frontier. Second, for a 0.03% increase in risk over SMM's SD of 0.03%, an investor could diversify and would be rewarded with an optimized portfolio return increase of 99% from 5.28% to 10.5%. The optimized portfolios presented in this chapter provides evidence of the investment potential of art for asset allocation.

The results of this study suggest that art and financial market risk and return relationships do differ when considering indices from three independent art indices

providers simultaneously. Chapter Nine concludes with a summary of the key findings from this study.

CHAPTER NINE: CONCLUSION

In conclusion, first, the results of this study suggest that risk and return for art assets differed when considering various indices and categories. Second, this study found that risk and return for art assets differ from other real and financial assets depending upon the indices, categories, and periods explored. Under all three indices, and for all time periods, the research results revealed diversification benefits in both financial and art-asset portfolios. Finally, when studying the co-movements of the art and financial market risks, return relationships, and rewards of diversification with three independent art indices simultaneously, the lack of a consistent trend supported the notion that the rewards of art as an investment are dependent upon the underlying art index sample and methodology.

Although there are many unknowns still to be discovered, the art world is becoming more transparent in measuring the art market as an investment prospect; unlike the financial markets, the demand for art will continue to be a desirable option as art will continue to become more rare over time, and will likely continue to be a way to store wealth. Based on the extant literature, a clear determination on the viability of art as an investment compared to financial assets had yet to be determined. The results of this study suggest that the variability of art as an investment is dependent upon the underlying art asset, including factors such as: the trend of the art category, artist, and the period. The volatility has not been consistently higher than that of the financial markets, and the low correlations with art sub-categories and with the financial markets provide diversification benefits both in an art-asset and financial asset portfolio. This research suggests that significant financial market declines increase the correlation as the overall

economic conditions may affect the return on art assets but still provide diversification benefits during economic downturns, supporting the notion of art as a viable investment strategy.

9.1 Overview

Chapters Four through Seven presented the results of this study including the descriptive statistics and the construction of mean-variance optimization models. Additionally, Chapter Eight presented the results of comparing the co-movement of the three art indices in tandem over the past twenty-one years compared to financial returns. This chapter concludes with a discussion of the implications, contributions, and limitations of the study, and recommendations for future research.

9.2 Implications

This study considered the financial implications for organizations and individuals in holding art as a real asset. High returns and low correlations makes art a desirable investment. As the art market is becoming more professionalized and as the art investment field becomes more commonplace among traditional investors, there comes a greater need to understand what underlines the return growth of art assets.

The results of this study have implications for several types of stakeholders—including investors, fund managers, accountants, advisors, and financial professionals—by providing decision-useful information on capital market and risk strategies. The research supported the recognition of the growth in the art investment field, and the importance of regulations to monitor the global art market in the interest of investors similar to the financial market through assurance services. Investors may rely on the returns of art investments, and this study is important to raise awareness of the risks

specific to the global art market. As there is no official compliance function in the art markets equivalent to audits of financial statements, art investing has many unique challenges in the future. Art market research organizations play an important role in the transparency of the art market and understanding the differences in the creation of their indices and the selection bias that may exist is an imperative to those that rely on these measures. This research also has implications for portfolio selection as well as empirical applications of mean-variance optimization models.

9.3 Contributions

This study extends the research on portfolio theory and adds to the growing economic and finance literature of art as an investment in an emerging global industry. Additionally, it will add to the accounting literature by demonstrating the impact of accounting regulation on the acquisition, retention, and distribution of art as a real asset.

This research extended the literature on the risk, return, and diversification of art as an investment under several conditions. First, this research is the first known study to explore art returns from three art index providers and compare the results through a consistent research methodology, examining the impact of economic trends on art investments over several time periods. The indices included Artprice (1998–2018), Art Market Research (1976–2018), and Sotheby's Mei Moses (1858–2018).The analysis found that much like equity investments, the art market performance is subject to the underlying characteristics of the individual artworks; however, unlike equities underlying characteristics of financial performance, the underlying characteristics of artwork include the rarity of the artwork, the trends in the art market, and the demand for a specific artist or artwork.

This study extends the time period of Mei and Moses's (2002) research on art returns from 1875–2000 and extended it from 1858–2018 with the Sotheby's Mei Moses indices. While art indices can be used to track market sentiment, the sample and method of any specific index is subject to sample and systematic bias. Through exploring the relationships of three independent comprehensive art indices that track the global art movement, this study was able to identify the variances in indices construction that leads to such diverse conclusions in the overall art market. Though this research suggests that it may not be possible to measure an average return of art as an investment, this study does contribute to the art investment field that there may be trends in art investing. Perhaps the most important contribution is that art, similar to equities, require an investor to buy early on before an artist, genre, or category of art peaks. This research found that once the market has developed and obtained efficient pricing with a specific type of artwork, the extreme returns in the early years taper off moving forward and result in more average returns similar to the financial trends in securities. Expanding upon Mei and Moses (2002), who found that Old Masters underperformed, this paper found that a period of outperformance preceded the period of underperformance of Old Masters, and that this relationship between a category of art and the market was apparent in all three categories of art explored in this research. Although sample selection bias is seen within each of the three independent art indices providers, the relationships with each other and the financial market were identified. This study emphasizes that while selection bias cannot be mitigated in these indices, studying various indices simultaneously may contribute to understanding the art market as a whole.

Second, this study extended the research of Worthington and Higgs (2004), that utilized AMR data to explore paintings within an art asset portfolio and art assets within a financial portfolio by constructing optimal portfolios for a given level of risk from 1976–2001. This study extends the time series from 1976 through 2018 utilizing data from AMR. While their research focused on paintings, the present study added sculpture, revealing low correlations with certain types of paintings may be beneficial in mitigating risk for art collections and art investments funds. Additionally, in the financial portfolio, this research added classic cars as another alternative investment to create a multi-class portfolio. The optimized portfolio diversification models using indices from three independent art research organizations identified trends and variations due to differences in underlying index methodology.

Finally, this research tracked the co-movements between the independent art indices and the S&P 500 and found low correlation with all three indices and the S&P; however, the correlation depended upon the time series. In order to expand upon this finding, historical returns correlations by decade were compiled between the Sotheby's Mei Moses and the extended S&P returns. The results indicate that while during some periods the two markets were negatively correlated, in other periods they ranged between extremely low and moderately low. The highest correlation decade between the two markets during the 148-year series was the year that included the 2008 global financial crisis, followed by the decade that started with the Great Depression in 1929.

9.4 Limitations

There are several limitations to studying the financial implication of art as an investment. First, the sample does not include all art sales, but rather is limited to public

auction houses around the globe and therefore art gallery and private sales have not been considered. Second, unlike financial markets, an independent firm does not audit these auction records, therefore, the accuracy of the underlying sales prices cannot be determined. Third, there are several art items that go up for bid, but do not meet the minimum sales requirement. These failures to sell are not part of returns as they have not been realized and therefore, have not been accounted for in this study. Fourth, this study investigated three comprehensive art indices and several sub-indices; the methodologies used by the indices providers are based on the information they have provided. This study has relied on those calculation to provide an adequate representation of the art market, it may be a limitation that the underlying methodologies have been relied upon.

A final limitation of this analysis consists of the listed expected returns in the analysis for both art and financial assets. It is noted that the analysis is based on prior expected returns, and therefore, there is always an inherit risk that the market as a whole will be impacted due to economic conditions outside the realm of previous market systems. Conditions such as war and natural catastrophes can bring results unavoidable and unforeseeable. Investors should also know that the products and services that underline the financial assets can affect the prices outside the scope of a normal expected return; therefore, keeping abreast of the financial conditions of the stocks is imperative to reduce risk. Additionally, unlike financial assets that have underlining conditions, the demand for subcategories of art and art as a whole could change due to future unforeseen reasons. Therefore, the past performance of art or financial returns presented in this study is not indicative of future rewards.

9.5 Future Research

Although this study tested the relationship between the co-movements of the returns of art with three different independent art indices and the U.S. stock market, this paper did not test the art market's reaction of stock market events. This is one way in that art market research—and investing in art as an asset class—could be expanded by future researchers.

Additionally, there have been no studies to date that have researched the impact of the U.S. capital gain tax rate differential between art and financial assets as a result of the Taxpayer Relief Act of 1997. Since the preferential U.S. capital gain rate of 20% applies to financial assets and not to collectibles such as art, the net return of art as an investment may further decrease the appeal as an investment for U.S. investors. This may not be the case in all countries, where there are tax preferences on art. A future study may aim to account for U.S. capital gain taxes as a transaction cost in the art investment literature. The research question therefore could seek to answer: how do U.S. capital gain tax rates impact the return on investment in art?

The low AP index returns are especially interesting; Artprice has recently created a propriety index they call its "blue-chip" art market index, Artprice100®, that was created in response to the financial and banking industry's demand for a reliable benchmark of the art market (Artprice, 2019). Currently the index has Intellectual Property Protection and the results would likely differ from what has been presented in this study. Artprice reports that the average return over the past 18 years represented an average annual return of 8.9% in the art market's most stable segment (Artprice, 2019), compared to the 2.8% annual return in the Global Art Market as indicated in this study. It

is possible that the blue-chip index, if available in the future, would provide additional research opportunities. It is also noted that the 8.9% return reported per AP's blue-chip index is closer to the 10.98% and 5.20% annual returns of AMR and SMM, respectively.

Similarly, a recent merger between SMM and AP's indices was announced on Artprice's website (Artprice, 2020), forming a new entity called Artmarket.com. The resulting index is likely to reflect the combined data and/or methodologies that are more indicative of the art investment industry and useful to auction houses and the art market at large. This may provide additional insight and transparency into the art investment field, and hence provide new opportunities for future researchers.

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Appendix: Matrices

Matrix 1. Weights of Assets

$$\begin{bmatrix} Wa & Wb & \dots & W\mathit{n} \end{bmatrix}$$

Matrix 2. Vertical Expected Returns of Assets

$$\begin{bmatrix} ER\ a \\ ER\ b \\ \vdots \\ ER\ \mathit{n} \end{bmatrix}$$

Matrix 3. Covariance & Variances of Assets

$$\begin{bmatrix} COVaa & COVab & \dots & COV\ a\mathit{n} \\ COVba & COVbb & \dots & COV\ b\mathit{n} \\ COV..a & \dots & \dots & COV\ ..\mathit{n} \\ COV\mathit{n}a & COVnb & \dots & COV\ \mathit{nn} \end{bmatrix}$$

Matrix 4. Vertical Transposed Weights

$$\begin{bmatrix} Wa \\ Wb \\ \vdots \\ Wn \end{bmatrix}$$

Once the four matrices are created in Excel, they can be multiplied together using the matrix multiplication function to solve for the portfolio's expected returns, variance, and standard deviation as follows:

Step 1: Calculate Expected Return of the Portfolio

ER_p = Matrix 1*Matrix 2

Step 2: Calculate the Portfolio Variance

$VAR_p = \sigma_p^2$ = Matrix 1*(Matrix 3*Matrix 4)

Step 3: Calculate the Portfolio Standard Deviation

$$STD_p = \sigma_p = \sqrt{VAR_p}$$

Step 4: Optimal Portfolio Selection

The add-in Excel Solver Data-Analysis (Solver) tool was used to construct the optimal portfolio weights. This was accomplished by calculating the weights that optimize the expected returns of the portfolio.

Where,

Objective: Calculate the maximum expected return of the portfolio for target level of risk.

Variables: Change the array of weight variable cells in Matrix 1

Subject to: Constraint that the weights must equal 1

Subject to: Constraint that the weights must be greater or equal to zero

Step 5: Construct the Efficient Frontier

From the efficient set of optimal portfolios a graph reports the curve known as the Efficient Frontier.