Fall December 8, 2016

FROM TICKER TAPE TO OIL PAINT: A COMPARATIVE ANALYSIS OF RETURNS TO FINE ART AND STOCK INVESTMENT

Anna Ghadar, *Scripps College*

FROM TICKER TAPE TO OIL PAINT: A COMPARATIVE ANALYSIS OF RETURNS TO FINE ART AND STOCK INVESTMENT

by

ANNA GHADAR

SUBMITTED TO SCRIPPS COLLEGE IN PARTIAL FULFILLMENT OF THE DEGREE OF BACHELOR OF ARTS IN ECONOMICS

PROFESSOR ROBERTO PEDACE

PROFESSOR BRUCE COATS

DECEMBER 8, 2016

Abstract

This analysis explores the relationship between US stock indices and the international fine art market with the hopes of shedding light on the viability of fine art, more specifically, paintings, as a form investment. I hope to provide insight to art collectors and prospective buyers on the estimated future value of artworks as it compares to the estimated future value of stock. I have compared these markets using average annual returns for three US stock indices, as well as annual US Consumer Price Index data, to repeat sales of selected artworks sold at auction within the 29-year period of 1987-2015, with data collected from the AskART database. Stock data was collected for the S&P 500, Dow Jones Industrial Average, and NASDAQ indices. Annual average rate of returns for this sample of artworks show a lower rate of returns, on average, than each stock index listed for this period. However, art investment may offer a potential form of portfolio diversification to a risk-neutral investor.

Acknowledgements

I would like to thank my Economics advisor Professor Roberto Pedace, without whom I could never have completed this thesis, for his constant guidance and support throughout the research and writing process. I would also like to thank my Art History advisor, Professor Bruce Coats, for his contributions to this thesis, as well as my peer reviewer, Gwen Marter, for her continued assistance with the technical and analytical difficulties I faced while conducting my analysis. Thank you to my siblings, Otessa and John Ghadar, for listening to my constant complaints about how busy I am even though you both have just as much, if not more, work of your own. Finally, I would like to thank my parents, Fariborz and Lis Ghadar, as well as my aunt, Margaret Ghadar, for being constant sources of unwavering motivation, inspiration and love for the duration of this process, despite my struggles with stock terminology! Again, thank you so much, I truly cannot express my gratitude enough.

Table of Contents

I. Introduction

Auction sale prices have reached record highs this year for fine art and do not show signs of slowing down; in 2015 both Paul Gauguin's *When Will You Marry?* and Willem de Kooning's *Interchange* sold in private sales for $300 million each, tying the two works for the highest price ever paid for a painting. Art – unlike typical forms of investment, such as stocks or bonds – can be considered both a consumption good and an investment good, meaning an artwork in and of itself provides utility as well as existing as a platform for investment. Is art a substitute for typical forms of investment? If so, what is the incentive to an investor, collector, (here I will use these terms somewhat interchangeably although investor connotes a buyer with higher investment incentives for purchasing art, while a collector has significant consumption valuation of a piece) or both?

In this analysis I compare stock market indices to art auction sales. I will investigate if investment trends in the art market mimic those of the stock market, based on returns to repeat sales and annual rates of return for various stock market indices. This may hold valuable information to art investors and collectors alike by showing potential trends in returns and helping potential buyers take the plunge if they know their pieces will be a good investment relative to stocks. Most investors seek various methods to diversify their assets. Whether or not art makes for a good investment on these grounds can also be explored by comparing variances in average returns within both markets. These theories serve as the foundation for my analysis of returns to art investment, and influence the statistical methodology utilized to explore and predict returns to a given sample of artworks over the years.

When dealing with such expensive assets risk has to be addressed. Risk, which can be loosely defined as probability and extent to which one may face a loss, plays a great role in the choice to invest in a particular asset. I will explore the risk of art investment (which is considered notoriously high in art economics literature, relative to average investments in the stock market) further in my research. The art market is quite volatile in comparison to standard forms of investment, and is most likely not a viable form of investment for every investor. Higher risk in the art market may be due to fears of counterfeit pieces, physical damage or deterioration, trends in popular styles or periods, and influence of famous collectors or artists, which will be discussed later.

I will include some critical review of current writing within the field of art economics, auction theory as it pertains to fine art and collectables, theories as to why the minimum denomination for fine art is so high, and the multifaceted incentives behind art investment. However, I plan to run regressions between index data and repeat sales of specific artworks as my main research. I will consider the Dow Jones Industrial Average, S&P 500, and NASDAQ stock indices as well as the United States Consumer Price Index (CPI) within this analysis. Much of the current literature follows repeat auction sales data because it is more prevalent than private sales data, although this does leave out a substantial amount of the art market, including the aforementioned Gauguin and de Kooning works that sold for record high prices. I have chosen this approach because the regression will be a tangible way to compare investment between the stock and art markets. This will hold numerical rather than conceptual information on the trends of the art market and give more insight to current and future investments. Do artworks usually follow, lead, or move at the same time with these stock indices? What does this mean for asset diversification? Does art investment have a higher rate of return, on average, than

stock investment? I will attempt to provide answers to these questions by exploring how projected increase in artwork value corresponds to auction house of sale, year of sale, and years between repeat sales of unique works, among other variables. A complete list of independent variables utilized in this analysis can be seen in table 1. I will consider how each given variable affects a final sale, or "hammer", price of an artwork. These are questions that interest me as someone captivated by the intricacies of the art market and the merging of the fields of Economics and Art History. I hope this research will provide answers for art collectors who are thinking of buying or selling work, potential and current art investors, and artists alike.

II. Previous Economic Literature

The current literature on the fine art market reflects on various peculiarities of art investment as it compares to "traditional" means of investment, notably stocks and bonds. Various elements impact sales prices for art works outside the frameworks of traditional investment. It is also important to note that fine art sales prices are notoriously high, and the cohort of fine art collectors is extremely wealthy and small relative to the general population.

Thompson (2008), who focuses on the contemporary art market, considers the influence of auction house, dealer and past owner prestige, aesthetic and consumption benefits, and collector's personal preferences, among other qualitative differences, on consumer behavior in the art market. These aspects influence buyers in the art market in ways they may not impact those of other sectors. In Thompson's *The $12 Million Stuffed Shark: The Curious Economics of Contemporary Art* he mentions that art investors not only hope to make decent returns on their purchases, but that their purchase will signify

wealth and prestige to others who recognize it, thus labeling fine art a "positional good" (2008). This prestige can come from branded auction houses (like Christie's or Sotheby's), branded former collectors/owners (Charles Saatchi or The Louvre), branded artists (Warhol), branded dealers (Larry Gagosian) and the like; for each "branded" element that is attributed to a work of art its prestige rises and in turn its sales price rises.

Feldman and Mehra (1993) write on auction theory, which is imperative to this analysis as both equity shares and fine art are sold via auction. While theory rarely applies perfectly to real-life, valuation of items sold at auction must "[vary] enough to preclude any direct pricing schedule," (Feldman & Mehra, 1993) both in theory and in practice. Essentially, this means that that an item at auction does not have a "fixed or determinable" market price, thus an auction assists in the "discovery" of the good's market value (Feldman & Mehra, 1993). Feldman and Mehra (1993) write on various types of auctions, although each type of auction yields essentially the same expected price and revenue to seller. This analysis will follow their work on English (or "ascending-price") auctions as fine art auctions normally follow this style. In English auctions the price of a good is increased (hence the name "ascending") until only a single highest bidder (or collective group of bidders) is willing to pay the amount announced. Here, price is increased until "demand falls to match the fixed amount at auction" (Feldman & Mehra, 1993). As auctions ascribe to specific "well-defined" rules they can be considered "games" where auction theory incorporates game theory and bidders are risk-neutral and symmetric (thus valuing the item at auction with the same "distribution function") (Feldman & Mehra, 1993).

The "common-value assumption" is a key element of auction theory, which states that value paid by the buyer for a good at auction considers future resale value of said

good in secondary markets (Feldman & Mehra, 1993). This is certainly the case for stocks (or, "equity shares"), which are generally considered purely investment goods. However, this assumption varies in applicability to buyers of fine art, which exists within a limbo between consumption and investment good. For some art collectors purchasing an artwork is purely for consumption purposes with no plans to resell later, while other art investors purchase works strictly for their estimated resale value. However, it is safe to say most buyers in the fine art market purchase with a mindset that is some combination of the two. Feldman and Mehre find that English auctions do run efficiently, and produce and equilibrium price from multiple bidders regardless of the fact that the market price of the item at auction is "unknown" (1993).

Campbell, in her *Art as an Alternative Asset Class (2005),* writes on the subject of non-traditional, or "alternative", assets (read: investment goods). Campbell's (2005) analysis considers growth in both commodities and hedge fund investments, although the focus for this literature review will be on the former. She has found that alternative assets have low correlation to traditional assets, thus providing benefits to diversification of investments. Campbell (2005) compares investment in traditional "blue-chip" stocks, commonly seen in indices like the S&P 500, to fine art or creation of an "art fund" as a means of "alternative asset" investment. A "blue-chip" is generally described as a high quality investment that "[weathers] downturns and [operates] profitably in the face of adverse economic conditions," making them relatively stable investments (Investopedia 2016). Diversification is beneficial for investors as it provides various channels to invest that are impacted differently by various downturns, or shifts in the economy, making your overall portfolio (collection of investments) more stable in the long run. With this theory in mind, the age-old advice "do not keep all your eggs in one basket" rings true:

the more diverse your assets are, the "safer" your investments will be, overall. With the international art market valuing at approximately $30 billion this form of alternative asset provides a large channel for "investment flows" (Campbell, 2005).

As addressed earlier, art is both a consumption and investment good, with various other incentives to purchase aside from fiscal gain, such as prestige, consumption, and aesthetic values; hence, the appeal of collecting art is definitely not solely monetary. Baumol (1986) explores other factors that differentiate art investment from stock investment in his *Unnatural Value: Or Art Investment as Floating Crap Game*, although both art and stock markets exhibit "random behavior". First, each work of art is an imperfect substitute for another, while stocks are essentially perfect substitutes. Second, many people own equity shares in a given company, but the owner of an artwork has a monopoly over that unique work. Third, stocks are sold and traded frequently, while artwork sales (and resales) are few and far between. He also points out that there is a principle to what a "true", or equilibrium, stock price *should* be – "the stock's pro rata share of the discounted present value of the company's expected stream of future earning" – while there is no equivalent for a piece of art, and, subsequently they are "unnatural" in the classical sense. For many works, particularly those by deceased artists, elasticity of supply is zero, which results in a price that is driven almost entirely by consumer demand (Baumol, 1986).

Baumol's results for rates of return were fairly low and he suggests they are likely overstated, with a compounded rate of return of .55%, while the median rate of return was .85%. These cases were fairly dispersed, implying high risk. These findings lead me to consider that art investors are most likely risk neutral or even risk loving, as he found "cases with compounded rates of return as high as 27 percent per year and others as low

as -19 percent per year" (1986). On top of this, 40 percent of cases examined had negative returns (Baumol, 1986). Such "unpredictable oscillations" (Baumol, 1986) seem rather unenticing when examining fine art as a financial investment, particularly to a risk-averse investor.

Goetzmann (1993) compares UK stock, art, and bond prices to create an art return index in his *Accounting For Taste: Art and the Financial Markets Over Three Centuries*. He found a high correlation between an index of the London Stock exchange and an art index constructed from "transaction prices of paintings brought to market at least twice over the period 1715-1986," (Goetzmann, 1993) as well as evidence supporting the notion that there is a positive relationship between the stock and art markets over short periods of time. Here, demand for fine art increased as aggregate financial wealth of the investor increased, which sheds light on the high-income identity of art investors.

Circling back to Baumol's findings, Goetzmann (1993) points out that returns before 1850 are poorly estimated, while returns in the 20th century are "relatively reliable." When fixed for sales after 1950 painting prices grew at a rate of 6.2 percent, as opposed to stock prices, which grew at a rate of 2.6 percent (Goetzmann, 1993). These differences between analyses may be due to using stock indices from different countries, which highlights the fact that although an auction may take place in one country, the art market is global, and buyers from all over the world regularly participate in auctions. Agenello (2002) found that "auction sales increase an average 7 percent annually from 1971 to 1996" where volume of sales peaked in 1987, offering an insight to Goetzmann's (1993) findings on reliability post-1950. Goetzmann (1993) does not suggest that art investment is superior to stock investment, but rather, appeals to a "risk-neutral investor" who is comfortable with a slightly more volatile portfolio. He reiterates the importance of

aesthetic valuation of art, and that both wealth *and* taste come into play here, where they may not in the purchasing and sales of bonds or stocks.

Mei and Moses (2002) considered the work of both Baumol and Goetzmann in their *Art as an Investment and the Underperformance of Masterpieces*. In this paper they have created an annual index for art sales prices from 1875-2000, based on auction sales from fine art auction houses Sotheby's and Christies as they compare to the S&P 500, which they believe the art market moves in the same direction as. However, they do pay mind to the fact that using these two well known, high price auction houses can create an upward bias. The Mei Moses Index (2002) focuses on the US art and stock markets, particularly in New York, and utilizes return indices for US bonds as well. Within this art index they have created sub-indices for American, Old Master, Impressionist, and Modern paintings.

Mei and Moses (2002) found that art outperforms bonds, but underperforms stocks, which differs from both Baumol's and Gautzmann's findings. They also found art to have "lower volatility and lower correlation with other assets", which suggests art investment could be helpful for portfolio diversification, again a result differing from both aforementioned researchers. They did find that the art index had more risk than the S&P 500 and the Dow Jones indices, although its volatility decreased from 42.8%, within the 1875 to 1999 period, to 21.3%, within the 1950 to 1999 period (Mei, Moses, 2002). Their contribution to the study of art economics focuses mainly on the New York market but explores art sales in a refined manner, where auction house and period or style of work are differentiated to produce a more in depth understanding of projected returns to art investment across artistic styles and movements.

Although art investment is clearly a feasible form of investment, as noted in the literature mentioned here, it is important to keep in mind that art investment, or, collecting, does have intrinsic value in both consumption and investment valuation. Agnello (2002), who writes on luxury consumption and collecting, argues that collection of scarce goods (that have a high monetary and, assumedly, consumption values) works against neoclassical economic theory and may defy traditional price determination (Koford, Tschoegl 1997). This is in line with Baumol's (1993) considerations that art investment does not cater a risk-averse buyer. However, for certain investors, some art has zero consumption value, where valuation is purely on projected returns; this complicates art valuation as each piece has different consumption value to each investor (Agnello, 2002). He also considers "structural changes" (Agnello 2002) within the art market via increased interest in the modern art movement, much like Thompson's (2008) research on trends within the art market as a result of "branded" dealers, artists, and so on.

Agnello (2002) breaks down the art market in a three sub-market hierarchy; the first, or "primary", market consists of artists proving their skill to the secondary market. The "secondary" market consists of galleries and dealers, which serve as the middleman between artist and the final, or "highest", market, which consists of a few auction houses with high prestige and command of the market and is oligopolistic in nature. This final market is where I will be collecting most auction sales data from, often dubbed "blue chip" auction houses, such as Sotheby's and Christie's.

It is interesting to note the differences in findings from one country to another, and from one period to another. Further sub-categorization of location of sale and genre or period of painting, as well as comparing repeat sales data to multiple asset indices

(across assets, countries, etc.) has proven to provide new and previously unexpected understanding to the intricacies of the art market. Considering these factors and different elements of buyer behavior and branding serves to build a greater understanding of this market, and how this form of investment relates to standard investment assets.

The current literature on repeat auction sales of fine art compares large periods of auction sales data, to a various stock indices within and outside the US. This provides a solid foundation to my art investment analysis. However, the ever changing art (and stock) market(s) necessitates constant amendments and additions to the current literature. I hope to contribute to furthering the analysis of art investment within this "final" market (Agnello 2002) in recent years, by analyzing multiple US stock indices as well as the US consumer price index. I predict that, for an updated and more specific period from 1987 to 2015, average annual rate of returns will be higher for art than stock, but much more volatile. I also hypothesize that there will be significant opportunity for portfolio diversification. Although this analysis will look at monetary returns to art investment I will analyze data with a conceptual framework based on the understanding that there is a consumption value that cannot be attributed to other financial assets, specifically stocks. With this I hope to further explore art sales data within the context of standard forms of investment *and* the oscillation of an individual's valuation of other goods throughout our specific period.

III. Data

I have collected time series data from AskART, a leading art auction database with auction sale data spanning over 300,000 artists. I will use three US stock indices: the S&P 500, NASDAQ, and Dow Jones Industrial Index (DJIA), from the years 1987-2015.

This time frame was chosen to examine price changes over multiple decades post-1950 to the most recent full calendar year (2015) at the time I am running these regressions (mid to late 2016). The base year, 1987, was chosen based on the year of the first observed auction in my sample of unique sales. I have chosen to collect auction sale data post-1950 in accordance to Baumol's (1993) observation that art sales after 1950 had a rate of returns above both the S&P 500 and Down Jones Industrial indices; where the estimated returns for these years were far more reliable than years prior to 1950. This is a notable data selection bias but will serve to continue the literature on comovement of the US art and stock markets in recent years.

All reported repeat sales for *paintings* by Camille Pissarro, Pablo Picasso, Williams Merritt Chase, Morris Louis, Georgia O'Keeffe, Edward Hopper, Giorgio de Chirico, Rene Magritte, Claude Monet, Anthony van Dyck, and Mary Stevenson Cassatt from the Askart database for the 1987-2015 period were sampled. These artists were chosen as they represent various top-selling artists across styles, periods, nationalities, races and genders (artnet 2016). Other mediums will be ignored to keep continuity of prestige and preference of medium. I do not account for type of paint, although it would be interesting to subcategorize in a more in depth analysis, as oil paints often reach higher sales prices than other types of paint (such as watercolor or tempera)(Agnello & Pierce 1996). All pieces that were bought in (unable to reach price threshold to sell in auction, thus "bought in" by the auction house) were removed from the sample to reduce possible inflation in average sales price (Agnello 2002). Qualifiers (pieces attributed to the artist or the school of the artist, but not by the artist themselves) were also removed from the data set for this reason.

This analysis considers 21 independent variables and one dependent variable, as seen in table 1. The year of each sale is indicated to create a chronological list of sales and to serve as a foundation for repeat sales data, where repeat sales are defined by more than one sale within the sample period. Our dependent variable, hammer price, is a phrase used in auction house terminology for the price at which the "bid caller" drops their hammer to signify there has been a final sale price agreed upon. Stock index and Consumer Price Index (CPI) data for each given year will also be listed. Average annual rate of returns for all indices are taken without dividends for general simplicity over the period. These yields can be significant depending on the fluctuations of the profit of a company, among other circumstances. Numerical values for annual stock index data are the annual percent changes for each index, which must be looked at separately due to collinearity, but provide the main source of comparison between patterns in the stock and art markets.

Dummy variables were created to signify if an auction took place at Sotheby's or Christie's auction houses, as these are notorious "blue chip" auction houses, which regularly reach substantially higher sales prices than smaller auction houses (Mei & Moses 2002). The branch of each Sotheby's or Christie's auction house (New York, London, Shanghai, etc.) is not specified, but multiple sales took place across multiple cities and countries, as art sales are a global market. Dummy variables were also created for each artist of the sample – listed $X_{11\ldots21}$, for independent variables 11 through 21 – for Pissarro (X_{11}), Picasso (X_{12}), Chase (X_{13}), Louis (X_{14}), O'Keeffe (X_{15}), Hopper (X_{16}), di Chirico (X_{17}), Magritte (X_{18}), Monet (X_{19}), Cassatt (X_{20}), and Van Dyck (X_{21}), respectively (seen in table 1).

Table 1

Description of Dependent and Independent Variables

Variable Name	**Description**
Y = "hammer"	Denotes final hammer price of a unique auction sale
X_1 = "title"	Title of unique artwork
X_2 = "sothebys"	Dummy variable where $D_1 = 1$ if unique auction sale took place at Sotheby's, $D_3 = 0$ if otherwise
X_3 = "christies"	Dummy variable where $D_2 = 1$ if unique auction sale took place at Christie's, $D_3 = 0$ if otherwise
X_4 = "year"	Year of unique auction sale and of annual stock/CPI data used
X_5 = "t"	Years since first sale of unique piece, calculated as 0+t where t is the number of years since first sale and the first sale year, or "base year" for that piece, is listed as 0.
X_6 = "djia"	Average annual change in rate of returns for Dow Jones Industrial Average stock index for a given year
X_7 = "nasdaq"	Average annual change in rate of returns for Nasdaq stock index for a given year
X_8 = "sp500"	Average annual change in rate of returns for the Standard & Poor 500 stock index for a given year
X_9 = "cpi"	Annual CPI data is the average percent change since 1982 with a base of 100, where a value of 110 signifies a 10% increase, or "inflation", since 1982
$X_{10\ldots20}$ = artist name	Dummy variable where $D_i = 1$ if the artist of a work is the artist of the independent variable, $D_i = 0$ if otherwise

a. Dummy variables X_{10} through X_{20} correspond to artist list in table 3

Annual data for average percentage change in returns from 1987 through 2015 were collected for the S&P 500, NASDAQ and Dow Jones Industrial Average indices. Descriptive statistics for all variables dependent and independent are listed in table 9. I

will be including annual data from the US CPI in this dataset to account for changes in strength of the US dollar and purchasing power. Agnello and Pierce's analysis (1996, 369) indicates that all investors hope for returns above the inflation rate, which is encompassed in the CPI.

IV. Methods

I will be running regressions comparing art sales data from Askart.net (AskART 2016) to annual data from the S&P 500, NASDAQ, and DJIA indices (Yahoo!Finance 2016) as well as annual CPI data (BLS 2016). The dependent variable for all regressions will be the natural log of hammer price, to show what *percent* of variation in the y variable can be explained by variation in the x variables (listed in equations 1, 2, 3 and 4. below). Each equation will show the percent change in our dependent variable ("lhammer") for each unit change of an independent variable.

The initial equation was a regression consisting solely of art sales data. This will determine what percentage change in sales prices (hammer price for each unique auction) can be determined by unit change in our various independent (or, "X") variables collected from the AskART database:

$$\text{lhammer} = \beta_0 + \beta_1(\text{title}) + \beta_2(\text{Sotheby's}) + \beta_3(\text{Christie's}) + \beta_4(\text{year}) + \beta_5(\text{t}) + \beta_6(\text{pissarro}) + \beta_7(\text{wmc}) + \beta_8(\text{louis}) + \beta_9(\text{okeeffe}) + \beta_{10}(\text{hopper}) + \beta_{11}(\text{gdc}) + \beta_{12}(\text{magritte}) + \beta_{13}(\text{monet}) + \beta_{14}(\text{cassatt}) + \beta_{15}(\text{avd}) + \beta_{16}(\text{picasso})$$

Where each beta coefficient (denoted β_i) represents the predicted percent change in Y (lhammer) that can be explained by the change in each beta's corresponding X variable, shown in each equation.

After conducting a Breusch-Pagan test for heteroskedasticity I found a statistically significant chi-squared value of 0.38, suggesting homoscedasticity within the model. However, after running a variance inflation factor (VIF) test for this regression a high colliniarity of 9.17 for Picasso paintings was detected (see table 8). VIFs were measured for each proposed equation to test for multicollinearity among variables by measuring how much the variance within an analysis is due to colliniarity. Multicollinearity can be defined as correlation between independent variables, or, "predictors", within the analysis, which can distort results. Generally, a VIF less than 1 signifies no correlation between predictors, a VIF between 1 and 5 signifies a slight correlation, and a VIF above 10 indicates high correlation between predictors. As a result the variable "picasso" was removed in an amended base equation, equation 1:

$$\text{lhammer} = \beta_0 + \beta_1(\text{Sotheby's}) + \beta_2(\text{Christie's}) + \beta_3(\text{year}) + \beta_4(\text{t}) + \beta_5(\text{pissarro}) + \beta_6(\text{wmc}) + \beta_7(\text{louis}) + \beta_8(\text{okeeffe}) + \beta_9(\text{hopper}) + \beta_{10}(\text{gdc}) + \beta_{11}(\text{magritte}) + \beta_{12}(\text{monet}) + \beta_{13}(\text{cassatt}) + \beta_{14}(\text{avd})$$

Each following regress will add/substitute x variables for stock index and CPI data to equation 1 (the amended base equation). Equation 2 is as follows:

$$\text{lhammer} = \beta_0 + \beta_1(\text{Sotheby's}) + \beta_2(\text{Christie's}) + \beta_3(\text{year}) + \beta_4(\text{t}) + \beta_5(\text{pissarro}) + \beta_6(\text{wmc}) + \beta_7(\text{louis}) + \beta_8(\text{okeeffe}) + \beta_9(\text{hopper}) + \beta_{10}(\text{gdc}) + \beta_{11}(\text{magritte}) + \beta_{12}(\text{monet}) + \beta_{13}(\text{cassatt}) + \beta_{14}(\text{avd}) + \beta_{15}(\text{djia}) + \beta_{16}(\text{cpi})$$

Where "djia" will be substituted for "sp500" and "nasdaq" for second and third runs of regressions to consider varying adjusted R-squared values (in equations 2, 3 and 4, respectively). These variables will not be used simultaneously as they have high collinearity, which would negatively impact the estimated values.

Adjusted R-squared values will be used to account for increased degrees of freedom when adding variables, as not to overestimate each regression's R-squared value. The adjusted R-squared values for equations with stock data are higher than the adjusted R-squared value of the initial equation (consisting only of data from the Askart database). This suggests that the addition of each stock index within the analyses successfully contributes to further explaining variation in hammer prices. After finding the adjusted R-squared value for each equation we can assume that the highest adjusted R-squared value signifies the stock index that explains the most variation in hammer prices, which is in turn the index that art sales most closely resemble or "mimic".

The initial regressions will provide information on the correlation coefficient of the data used. This correlation coefficient will signify a possibility of portfolio diversification with a value between -1 and 1, where -1 and 1 are perfect correlation (negative and positive, respectively) and 0 is uncorrelated. If the correlation coefficient is less than |1| there is a possibility of diversification potential from investing in art in addition to stock, although ideally the correlation coefficient should be close to zero (completely uncorrelated).

Although it is unlikely that there will be no predictive relationship between stock and art, the closer to zero the correlation coefficient is the better opportunity for diversification there is. Nevertheless, even with a correlation coefficient close to zero such high volatility in the art market may make art a poor diversification tool for risk-averse investors (Baumol 1993, Goetzmann 1992). Consequently, Feldman and Mehra's (1993) assumption that buyers who participate in auctions are risk-neutral holds in the context of other economic literature on returns to fine art. With this we can assume that an investor in stock *and* art must be risk neutral.

V. Results

This sample of auction sales consists of 202 individual sales for 96 unique works of art, by 11 artists, within the 29-year period. The sample has a maximum hammer price of $44,405,000, a minimum of $5,940, and a mean of $1,959,167 (with a standard deviation of 4,282,741)(table 9). However, we will continue our analyses in terms of lhammer (the natural log of hammer price) to stay consistent with percentage change in returns, rather than actual sales prices in US dollars. With an annual rate of returns of roughly 3.85 percent, our sample of repeat art sales reaches lower average annual returns over the period than those of the Dow Jones Industrial Average (~6.86%), NASDAQ (~9.58%), and S&P 500 (~7.57%) stock indices. Each regression is run as a two-tail t test at a 95% confidence interval, where alpha = .05 (thus alpha/2 = .025).

90 of the total observations took place at Sotheby's's, where the sample mean of hammer prices was $2,291,826.60 (table 9). In equation 1 Sotheby's had a beta coefficient of approximately 1.1734 with a p value of 0.000 (where standard error, "se", equals 0.3365)(table 2). Thus we can determine, with statistical significance, that a sale at Christies's increases hammer price by approximately 117%, on average.

92 observations took place at Christie's where the sample mean of hammer prices was $1,841,513.70 (table 9). In equation 1 Christie's had a beta coefficient of approximately 1.3496 with a p value of 0.000 (where se=.03309)(table 2). Consequently we can infer, again with statistical significance, that a sale at Christie's increases hammer price by approximately 134.96%, on average.

No individual sale for a unique piece in a given year can occur at both Sotheby's *and* Christie's (although a unique piece can be sold at Sotheby's one year and Christie's

another). Such classification with dummy variables may contribute to high p values seen in other variables (notably dummy variable signifying artists) and VIF measures within the sample, seen in tables 2 and 8, respectively. This data suggests a slightly higher rate of returns for paintings sold at Christie's, which refutes past literature. Within this sample pieces sold at Christies's auction house have marginally higher returns (134.96% expected increase in hammer price if sold at Christie's) than those sold at Sotheby's (119.80% expected increase in hammer price if sold at Sotheby's), although unique sales at Sotheby's reach a higher average hammer price than those at Christie's ($2,291,877 and $1,841,514, respectively). This may be due to a smaller period and sample of auction sales, but may suggest in recent years sales at all Christie's locations, on average, reach higher sales prices than those at all Sotheby's locations, albeit with data that is skewed left.

The sample data for stock indices will be listed in order of Dow Jones Industrial, S&P 500, and NASDAQ with 29 observations for each index (for a total of 87 observations across indices for annual stock data). The approximate average change in annual rate of returns for each index is 9.08%, 9.02%, and 12.23%, respectively. It is interesting to note that each index's minimum (-38.49%, -33.8%, and -40.54%, respectively) occurred in 2008, while each index's maximum (12.40%, 11.85%, and 15.41%, respectively) occurred in 1988, however, there were no similar patterns for hammer prices (table 9). The index minimums can almost certainly be attributed to the global economic downturn (dubbed, "The Great Recession") of 2008, while the maximums in 1988 may signify the tail end of a consistent period of economic growth and low inflation in the United States during the mid to late 80s. However, this may suggest that art investment moves at a lag compared to, or simply freely from, the stock

market. This may suggest, on a surface level, that art investment is feasible for asset diversification. However, it also may signify that wealthy individuals, who meet the cohort for art collectors, are not as affected by economic downturns as the general public (and may even take advantage of economic downturns as an opportunity to "buy low").

Regression results from equation 1 (with X variables consisting of Askart data alone) can be seen in table 2, with an adjusted R-squared value of 0.5533 and an F-stat of 16.54, where df = (14, 187). This is a relatively high F-statistic, where 55.33% of the variation in hammer price is explained by independent variables collected from Askart data alone. As we have used dummy variables for artists and the natural log of hammerprice for our independent variable each variable's beta coefficient in table 2 can be interpreted as the percentage influence each artist has on the sale value of an individual painting; where a beta coefficient of -2.2693 for variable "pissarro" with a p value of 0.000 can be interpreted as a, statistically significant, 226.93% decrease in hammer price at a 99% confidence interval, *on average*, if a painting is by the artist Camille Pissarro. Chase paintings have a statistically significant 364.52% decrease in hammer price, at a 99% confidence interval. Louis paintings have a statistically significant negative impact on price of 147.66% at a 95% confidence interval. A work by O'Keeffe has a statistically significant decrease in price of 85.76%, at a 90% confidence interval. Hopper paintings have a statistically significant negative impact of 125.95% on price, at a 95% confidence interval. de Chirico has a negative, statistically significant, 107.14% impact on hammer price at a 95% confidence interval. Magritte has a negative, statistically significant, 124.41% impact on hammer price at a 99% confidence interval. Monet has a negative, statistically insignificant, 57.05% impact on hammer price. Cassatt has a negative, statistically significant, 159.38% impact on hammer price, at a 99%

confidence interval. van Dyck has a positive, statistically insignificant impact on hammer price of 8.1%. It is curious that each artist with statistically significant impact on hammer price has a negative coefficient; however, the high positive impact of sales at both blue chip auction houses may influence these findings.

Table 2
Regression Results for Equation 1

X Variable	Beta Coefficient	Standard Error	T value	P value
Sotheby's***	1.1734	0.3368	3.48	0.000
Christie's***	1.3142	0.3314	3.97	0.000
Year*	0.0384	0.2236	1.72	0.087
T	0.03679	0.0244	1.58	0.117
Pissarro***	-2.2693	0.4141	-5.48	0.000
Chase***	-3.6978	0.4070	-8.95	0.000
Louis*	-1.4891	0.7843	-1.90	0.059
O'Keeffe*	-0.8850	0.7689	-1.15	0.071
Hopper**	-1.3451	0.5437	-2.32	0.022
de Chirico**	-1.0640	0.3742	-2.86	0.005
Magritte***	-1.2404	0.2888	-4.29	0.000
Monet	-0.6831	0.6872	-0.99	0.105
Cassatt***	-1.5938	0.4291	-3.71	0.000
van Dyck	0.0810	0.6252	0.12	0.901
_cons	-63.8365	44.9617	-1.42	.157

n = 202 F(14, 187) = 16.54 R-squared = 0.5533; Adjusted R-squared = 0.5198

a. Artists' full names are listed in table 3.
b. * Denotes significance at a 90% confidence interval (alpha = 0.10); ** denotes significance at a 95% confidence interval (alpha = 0.05); ** denotes significance at a 99% confidence interval (alpha = 0.01)
c. All data is rounded to the nearest fourth decimal.

Equation 2 (base equation including variables “djia” and “cpi”) has an adjusted R-squared value of 0.5227, with an F-stat of 14.75 (table 5). Again, a relatively high F-stat, where 52.27% of the variation in hammer price is explained by independent variables collected from Askart data as well as annual rate of returns of the US CPI and the Down Jones Industrial Average. The beta-coefficient for “djia” is approximately -.8316, which can be interpreted as 1 percent increase in the Dow Jones Industrial Average index’s rate of returns accounts for 83.16% decrease in a hammer price, although, it has a p-value equal to 0.173, which leaves this statistically insignificant. CPI has a statistically insignificant negative impact on hammer price of -5.14%, with a p value equal to 0.298. Artist beta coefficients are slightly affected by the addition of these indices; a comprehensive list can be seen in table 5.

Equation 3 (base equation with “sp500” and “cpi” data) has an adjusted R-squared of 0.5229, with an F-stat of 14.77 (table 6). This equation has an F-stat marginally larger than in with DJIA and CPI (equation 2), where 52.29% of the variation in hammer price is explained by independent variables collected from Askart data as well as annual rate of returns of the US CPI and the S&P 500. Here, the CPI has a negative impact on hammer price of -5.55% and the S&P500 has a negative impact on hammer price of -74.41% (both are statistically insignificant, with p values equal to 0.260 and 0.163, respectively). Again, artist beta coefficients are slightly affected by the addition of these indices (see table 6).

Equation 4 (base equation with “nasdaq” and “cpi” variables included) had an adjusted R-squared value of 0.5660, with an F-stat of 15.08. Equations 2, 3 and 4 all had degrees of freedom of (16, 185). This final equation has an F-stat larger than those of the DJIA and S&P500 indices in conjunction with US CPI (equations 2 and 3), although still

lower than for art data alone. Here 56.60% of the variation in hammer price is explained by independent variables collected from Askart data as well as annual rate of returns of the US CPI and the NASAQ. NASDAQ returns account for statistically significant (p value = 0.042) 81.25% decrease in a hammer price at a 95% confidence interval.

We can interpret from these values that changes in auction sales for our period can be most explained by changes in the NASDAQ, then the S&P 500, and finally the Dow Jones Industrial Average, although adjusted R-squared values for equations using the two latter indices are extremely close. Annual rate of returns for the equation including NASDAQ data was the most statistically significant of each index's impact on change in hammer price.

While this analysis suggests that art does not provide better or even similar rate of returns to stocks within the indices selected, investors do wonder about asset diversification through art investment. Statistically insignificant results for CPI and stock data may be interpreted as a stronger possibility for asset diversification, as it signifies a weaker relationship between movements in the stock and art markets. Table 4 shows an in depth breakdown of correlation between variables "lhammer", "year", "t", "djia", "nasdaq", "sp500", and "cpi". For this sample the natural log of hammer prices is slightly negatively correlated with each stock index over the 29-year period, with correlation values of -0.2133, -0.2229, and -0.1881 to the Dow Jones Industrial Average, NASDAQ, and S&P 500 indices, respectively (table 4). These variables are not totally uncorrelated, indicated by a correlation coefficient equal to zero, which is ideal for asset diversification. However, these values are much closer to 0 than to |1|, suggesting some possibility for diversification. Nevertheless, to establish if these low correlation values are, in fact, a statistically significant evidence for utilizing art investment as a

diversification tool F-statistics must be compared. Equations 2 (including variable "djia"), 3 (including variable "sp500") and 4 (including variable "nasdaq") have F-statistics of 14.75, 14.77, and 15.08, respectively, and are all statistically significant at a 99% confidence interval with p-values of 0.00 (see tables 5-7). An F-statistic essentially shows the strength of the relationship between variables, where a larger F-statistic indicates a stronger relationship as a result of less variance. Hence, a smaller F-statistic suggests a better opportunity for portfolio diversification, or, more variance between art sales returns and the aforementioned stock indices. Given these findings, using art investment to diversify one's assets seems to be the most plausible for an investor who holds stocks solely in the S&P 500, then the Dow Jones Industrial Average, and finally the NASDAQ (although most investors hold varying stock across, and outside of, these indices).

This analysis of repeat sales suggests that art investment, within the 1987-2015 period for our sample of 202 individual sales (for 96 artworks by 11 artists), has a statistically significant increase to returns based on years from initial sale. This sample had an average rate of returns equal to approximately a 3.85% increase ($38745.23 per artwork, per year, on average), as well as an average return per year from initial sale for each unique artwork, over the 29-year period. Over this period DJIA had an average annual return of 9.02%, while NASDAQ had an average return of 9.08%, and S&P500 had an average return of 13.25%. The stock market most likely has a causal relationship to the art market, with both forms of investment being heavily influenced by the consumer price index (CPI). However, it should be reiterated that the cohort of fine art buyers is one of a very high average individual income and/or wealth, which makes up a very small portion of the population. While many people can afford to purchase stocks,

very few can afford to purchase such expensive pieces. Therefore, as discussed earlier, there are certainly differences between the "average investor" in stocks versus fine art.

VI. Conclusion

The hybridity of art valuation, as both an investment and consumption good, must have a role in the high and varying prices of fine art. Infrequent resales may be a result of collectors sitting on their investment, to create scarcity on the market of an artists work to increase a later sales price, or to wait to sell when a piece may be more desirable (perhaps based on trends in the art market at that time). As well, a collector may simply hold on to a piece for a long time because they value owning and enjoying the artwork for its beauty and prestige (among other attributes) more than they value the money they would make from selling the work. However, an individual's willingness to pay for a piece may be slightly deflated by the knowledge that artwork, particularly paintings, are non-durable goods (Thompson 2010), or, goods that decay over time; this non-durability may contribute to the volatility of art prices.

For those who purchase art strictly for investment purposes I would advise against art investment, as our analysis shows a low rate of returns of art investment compared to that of stock investment for the period and pieces of this sample, with substantial risk. However, if a collector does have returns to art that are lower than that of stock investment, as predicted by this data, the enjoyment of owning the piece over the years it was owned may absolve some of this cost. Individual discount rates for present and future values of a unique work would have to be considered. Still, that conclusion necessitates an individual collector's hedonic pricing for each piece and is not included in this statistical model.

For art investors hoping to beat the odds I would suggest purchasing from an "unbranded" auction house (one that is not Sotheby's or Christies) and reselling at Christie's, if possible. This yields maximum returns by "buying low" and "selling high". There does seem to be a decent opportunity for portfolio diversification by investing in art in addition to stock, but again with such low rate of returns when compared to stocks, as well as buyers' potential risk aversion and personal preferences, the decision to purchase works of art for investment purposes do seem unfavorable.

This sample is limited to accessible repeat sales from Askart, for the selected artists listed in table 3 within the 29-year period, but all listed repeat sales within these parameters were included. Askart does have more repeat sales listed within their auction sales database for other artists not included in this sample. The Blouin Art Sales Index and ArtNet sales indices may provide additional repeat sales data for the artists and works in our regression. Consequently, it may be beneficial to cross-reference multiple databases to generate a more comprehensive repeat sales regression.

Additionally, an artwork's provenance, or chronology of ownership, influences resale value (Agnello, 2002); if a piece was formerly owned by a prestigious collector (or was affiliated with a "branded" (Thompson, 2010) collector, dealer, museum, et cetera) it will, without doubt, be valued higher than if it had a negligible provenance. Although these factors are not considered within this regression it would interesting to explore implications of provenance on returns. This may account for, or be accounted by, trends in the art market, which could be studied by further sub-categorization of each artwork, by period and/or style of work, gender and race of artist, subject and size of piece, country of origin, and so on. If this data were collected over a period greater than 29 years it would be interesting to follow any potential repeating trends (or potential biases,

say in gender or race) of top selling attributes over the years to create a trend index of sorts.

The findings in this analysis refute common assumptions between independent and dependent variables, and show that art sales move more freely from standard forms of investment (based on our aforementioned US stock indices) and the consumer price index. In fact, auction returns have a negative correlation (see table 4) to each stock index used for our period, with a relatively high negative correlation to the NASDAQ, which provided the highest adjusted R-squared value of the stock indices used. However, each correlation was relatively small, thus we can confirm with confidence that art investment is a feasible method of asset diversification (although one with relatively low monetary returns, on average). We can conclude that art investment does not yield higher returns (or even returns on par with) stock investment, although it has some potential as a tool for asset diversification, but it is a gamble that *may* provide high monetary returns every now and then, as well as "returns" in the form of aesthetic and prestige values.

VI. Appendix

Table 3

Sample Auction Sale Breakdown, by Artist

Artist	Unique works by artist in our sample	Total number of sales by artist in our sample
Camille Pissarro	6	12
Pablo Picasso	21	42
William Merritt Chase	13	28
Morris Louis	5	10
Georgia O'Keeffe	6	12
Edward Hopper	4	9
Giorgio de Chirico	7	16
Rene Magritte	15	34
Claude Monet	9	18
Mary Cassatt	8	17
Anthony van Dyck	2	4

Table 4

Correlations Coefficients in Returns

	Lhammer	Year	T	DJIA	NASDAQ	SP500	CPI
Lhammer	1.0000						
Year	0.3760	1.0000					
T	0.0344	0.3515	1.0000				
DJIA	-0.2133	-0.1437	0.0355	1.0000			
NASDAQ	-0.2229	0.0112	0.0849	0.8794	1.0000		
SP500	-0.1881	-0.0834	0.0646	0.9764	0.9053	1.0000	
CPI	-0.3770	-0.9984	-0.3594	0.1443	-0.0126	0.0807	1.0000

Table 5

Equation 2 Regression Results

X Variable	Beta Coefficient	Standard Error	T value	P value
Sotheby's**	1.1733	0.3369	3.48	0.001
Christie's**	1.3141	0.3314	3.97	0.000
Year	-0.1942	0.2236	3.48	0.386
T	0.0368	0.0244	1.51	0.134
Pissarro**	-2.1991	0.4156	-5.29	0.000
Chase**	-3.6025	0.4099	-8.79	0.000
Louis**	-1.3937	0.4886	-2.85	0.005
O'Keeffe*	-0.7896	0.4834	-1.67	0.097
Hopper**	-1.2557	0.5458	-2.30	0.023
de Chirico*	-0.9685	0.3777	-2.56	0.011
Magritte**	-1.2496	0.2882	-4.34	0.000
Monet*	-0.5877	0.3513	-1.67	0.096
Cassatt**	-1.601	0.4295	-3.73	0.000
van Dyck	0.0954	0.6545	0.15	0.884
CPI	-0.0513	0.0492	-1.04	0.298
DJIA	-0.0832	0.6081	-1.37	0.173
_cons	411.1216	456.3572	0.90	0.369

n = 202 F(16, 185) = 14.75 R-squared = 0.5606; Adjusted R-squared = 0.5227

a. Artists' full names are listed in table 3.

b. * Denotes significance at a 90% confidence interval (alpha = 0.10); ** denotes significance at a 95% confidence interval (alpha = 0.05); ** denotes significance at a 99% confidence interval (alpha = 0.01)

c. All data is rounded to the nearest fourth decimal.

Table 6

Equation 3 Regression Results

X Variable	Beta Coefficient	Standard Error	T value	P value
Sotheby's**	1.1788	0.3369	3.50	0.001
Christie's**	1.3248	0.3316	4.00	0.000
Year	-0.2121	0.2233	-0.95	0.344
T	0.0370	0.0244	1.52	0.131
Pissarro**	-2.1957	0.4156	-5.29	0.000
Chase**	-3.5986	0.4099	-8.79	0.000
Louis**	-1.3999	0.4886	-2.85	0.005
O'Keeffe*	-0.7940	0.4834	-1.67	0.095
Hopper**	-1.2516	0.5458	-2.29	0.023
de Chirico*	-0.9685	0.3777	-2.56	0.011
Magritte**	-1.2496	0.2882	-4.34	0.000
Monet	-0.5877	0.3513	-1.67	0.102
Cassatt**	-1.601	0.4295	-3.73	0.000
van Dyck	0.0954	0.6545	0.15	0.868
CPI	-0.0555	0.0492	-1.13	0.260
S&P500	-0.7440	0.5317	-1.40	0.163
_cons	447.5868	455.8330	0.98	0.327

n = 202 F(16, 185) = 14.77 R-squared = 0.5609; Adjusted R-squared = 0.5229

a. Artists' full names are listed in table 3.

b. * Denotes significance at a 90% confidence interval (alpha = 0.10); ** denotes significance at a 95% confidence interval (alpha = 0.05); ** denotes significance at a 99% confidence interval (alpha = 0.01)

c. All data is rounded to the nearest fourth decimal.

Table 7

Equation 4 Regression Results

X Variable	Beta Coefficient	Standard Error	T value	P value
Sotheby's**	1.1835	0.3296	3.50	0.001
Christie's**	1.3105	0.3316	4.98	0.000
Year	-0.2022	0.2220	-0.91	0.364
T	0.0359	0.0244	1.52	0.140
Pissarro**	-2.1362	0.4156	-5.29	0.000
Chase**	-3.5217	0.4099	-8.79	0.000
Louis*	-1.3999	0.4886	-2.85	0.009
O'Keeffe	-0.7940	0.4834	-1.67	0.103
Hopper**	-1.2516	0.5458	-2.29	0.028
de Chirico*	-0.9685	0.3777	-2.56	0.017
Magritte**	-1.2227	0.2882	-4.34	0.000
Monet*	-0.5877	0.3513	-1.67	0.094
Cassatt**	-1.601	0.4295	-3.73	0.000
van Dyck	0.0954	0.6545	0.15	0.853
CPI	-0.0540	0.0489	-1.10	0.271
NASDAQ	-0.8125	0.3977	-2.40	0.042
_cons	447.5868	453.1519	0.94	0.347

n = 202 F(16, 185) = 15.08 R-squared = 0.5660; Adjusted R-squared = 0.5285

a. Artists' full names are listed in table 3.

b. * Denotes significance at a 90% confidence interval (alpha = 0.10); ** denotes significance at a 95% confidence interval (alpha = 0.05); ** denotes significance at a 99% confidence interval (alpha = 0.01)

c. All data is rounded to the nearest fourth decimal.

Table 8

VIF Test Results

Variable	**VIF 1 (original equation)**	**VIF 2 (amended equation 1)**
Picasso	9.17	-
WMC	8.38	2.59
Magritte	7.91	1.53
Cassatt	5.52	1.86
Monet	5.03	1.31
GDC	4.62	1.34
O'Keeffe	4.27	1.63
Pissarro	3.78	1.25
Hopper	3.67	1.65
Sotheby's	3.66	3.66
Louis	3.65	1.42
Christie's	3.55	3.55
Year	3.44	3.44
T	3.41	2.41
Mean VIF	4.93	2.05

Table 9

Descriptive Statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Christie's	202	0.4599	3.0689	0	1
Sotheby's	202	0.4455	0.4982	0	1
Hammer	202	1,959,167.00	4,282,741.00	5940	4.44e+07
Lhammer	202	13.2753	1.7932	8.6894	17.6089
Year	202	2006.55	7.7291	1987	2015
T	202	3.7277	5.5557	0	28
CPI	202	153.8177	32.7378	113.6	237.017
DJIA	202	0.0686	0.1538	-0.3384	0.3345
S&P500	202	0.0757	0.1735	-0.3849	0.3411
NASDAQ	202	0.0958	0.2351	-0.4054	0.8559
Pissarro	202	0.0594	0.2370	0	1
Picasso ~	202	0.2079	0.4068	0	1
WMC	202	0.1386	0.3464	0	1
Louis	202	0.0495	0.2175	0	1
O'Keeffe	202	0.0594	0.2370	0	1
Hopper	202	0.0446	0.2068	0	1
GDC	202	0.0792	0.2707	0	1
Magritte	202	0.1683	0.3750	0	1
Monet	202	0.0891	0.2856	0	1
Cassatt	202	0.0842	0.2783	0	1
AVD	202	0.0198	0.1397	0	1

a. Artists' full names are listed in table 3.

b. All stock variables are in percentage annual returns; all artist and auction house variables are dummy variables

c. ~ Denotes variables removed from amended equations

d. All data is rounded to the nearest fourth decimal.

VIII. References

Agnello, Richard J. *Eastern Economic Journal*. Vol. 28, No. 4 (Fall, 2002), pp. 443-463

Agnello, R., & Pierce, R. (1996). "Financial Returns, Price Determinants, and Genre Effects in American Art Investment*". *Journal of Cultural Economics*. Retrieved from http://link.springer.com/article/10.1007/bf00149237

Anderson, A. "HOW TO ESTIMATE A TREND IN A TIME SERIES REGRESSION MODEL". Retrieved October 11, 2016, from http://www.dummies.com/education/math/business-statistics/how-to-estimate-a-trend-in-a-time-series-regression-model/

Askart. (2016). Retrieved October 11, 2016, from http://artsalesindex.artinfo.com/

Baumol, William J. "Unnatural Value: Or Art Investment as Floating Crap Game." *The American Economic Review* 76.2 (1986): 10-14. Web.

Campbell, Rachel. "Art as an alternative asset class." *Journal of Alternative Investments* 17 (2005): 50-63.

Goetzmann, William N. "Accounting For Taste: Art and the Financial Markets Over Three Centuries." *JSTOR* (n.d.): n. pag. Web. 26 Sept. 2016.

Feldman, Robert A., and Rajnish Mehra. *Staff Papers (International Monetary Fund)*. Vol. 40, No. 3 (Sep., 1993), pp. 485-511

Investopedia. *Blue Chip*. 2016. Retrieved November 26, 2016, from http://www.investopedia.com/terms/p/purple-chip-stock.asp

Mei, Jianping, and Michael Moses. "Art as an Investment and the Underperformance of Masterpieces." *SSRN Electronic Journal SSRN Journal* (n.d.): n. pag. Web.

Thompson, Don. *The $12 Million Stuffed Shark: The Curious Economics of Contemporary Art*. N.p.: Palgrave Macmillan, n.d. Print. 2008.

Yahoo!Finance. (2016). Retrieved October 11, 2016, from http://finance.yahoo.com/