Art as an Investment and the Underperformance of Masterpieces

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Abstract

This paper constructs a new data set of repeated sales of artworks and estimates an annual index of art prices for the period 1875-2000. Contrary to earlier studies, we find art outperforms fixed income securities as an investment, though it significantly under-performs stocks in the US. Art is also found to have lower volatility and lower correlation with other assets, making it more attractive for portfolio diversification than discovered in earlier research. There is strong evidence of underperformance of masterpieces, meaning expensive paintings tend to under-perform the art market index. The evidence is mixed on whether the "law of one price" holds in the New York auction market.

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Two major obstacles in analyzing the art market are heterogeneity of artworks and infrequency of trading. The present paper overcomes these problems by constructing a new repeated-sales data set based on auction art price records at the New York Public Library as well as the Watson Library at the Metropolitan Museum of Art. As a result, we have a significant increase in the number of repeated sales compared to earlier studies by William J. Baumol (1986) and William N. Goetzmann (1993).[1] For the artworks included in the present study, we have 4,896 price pairs covering the period 1875-2000. With a larger data set, we are able to construct an *annual* art index as well as annual sub-indices for American, Old Master, Impressionist and Modern paintings for various time periods. The annual indices are then used to address the question of whether the risk-return characteristics of paintings compare favorably to those of traditional financial assets, such as stocks and bonds.

The larger data set also permits us to test two propositions frequently advanced by art dealers and economists. The first one states that art investors should buy only the top works of established artists (masterpieces) or buy the most expensive artwork they can afford. The empirical evidence on the return performance of masterpieces is mixed. James E. Pesando (1993) presented strong evidence of underperformance while Goetzmann (1996) found no such evidence. Our study will extend their analysis with a new testing procedure based on repeated sales regression (RSR).

The second proposition states that prices realized for identical paintings at different locations at the same time should be the same. Pesando (1993) compared prices of alternate copies of the same prints sold at Sotheby's and Christie's in New York and found substantial evidence of violation of the "law of one price" during the 1977-1992 period. While no art piece in our data has ever been sold simultaneously in both auction houses, we will conduct a test of the "law of one price" by examining return differentials for artworks sold at different auction houses over much longer time periods. If there is systematic pricing bias from one auction house to the other, then we should expect to see systematic difference in returns for artworks sold at

[1] Goetzmann (1993) uses price data recorded by Gerald Reitlinger (1961) and Enrique Mayer (1971-1987) to construct a decade art index based on paintings which sold two or more times, during the period 1715-1986. His data set contains 3,329 price pairs. Baumol (1986) uses a subset of the data recorded by Reitlinger (1961) to study the returns on paintings during the period 1652-1961. His data set contains 640 price pairs. Buelens and Ginsburgh (1993) re-exams Baumol's work with different sample periods. Pesando (1993) uses data for repeat sales of modern prints which has 27,961 repeat sales. But his data only covers a short time span from 1977 to 1992.

different houses. We will examine the return differentials with a RSR procedure that is different from Pesando (1993).

The remainder of the paper is organized as follows. Section I describes the art auction data set and provides a discussion of sampling biases. Section II reviews the repeated sales regression procedure used to estimate the index for painting prices and provides an asset-pricing framework for estimating the systematic risk of paintings. Section III provides risk and return characteristics of the estimated art price index. Section IV presents evidence on the underperformance of masterpieces. Section V tests the hypothesis of the "law of one price" while Section VI concludes the paper.

I. Painting Data and Biases

Since individual works of art have yet to be securitized nor are there publicly traded art funds, studying the value of works of art from financial sources is not possible. Gallery or direct-from-artists prices tend not to be reliable or easily obtainable. Repeat sale auction prices however are reliable and publicly available (in catalogues) and can be used as the basis for a data base for determining the change in value of art objects over various holding periods and collecting categories.

We created such a database for the American market, principally New York. For the second half of the 20th Century we searched the catalogues for all American, 19th Century and Old Master, Impressionist and Modern paintings sold at the main sales rooms of Sotheby's and Christie's (and their predecessor firms) from 1950 to 2000.[2] If a painting had listed in its provenance a prior public sale, at any auction house anywhere, we went back to that auction catalogue and recorded the sale price. The New York Public Library as well as the Watson Library at the Metropolitan Museum of Art were our major sources for this auction price history. Some paintings had multiple resales over many years resulting in up to six resales for some works of art. Each resale pair was considered a unique point in our database that now totals over five thousand entries. Some of the original purchase dates went back to the 17th century. If the art piece was sold overseas, we converted the sale price into US dollars using the

[2] Our data does not include "bought-in" paintings that did not sell due to the fact that the bid was below reservation price. Our data for the year 2000 only includes sales before July.

long-term exchange rate data provided by Global Financial Data. Our data has continuous observations since 1871 and has numerous observations that allow us to develop an annual art index since 1875.

As well as analyzing our data as a totality we have also separated it into three popular collecting categories. The first is American Paintings (American) principally created between 1700 and 1950. The second is Impressionist and Modern Paintings (Impressionists) principally created between the third quarters of the 19th and 20th century. The third is Old Master and 19th century paintings (Old Masters) principally created after the 12th century and before the third quarter of the 19th century. The number of observations in our resale data by year of purchase and sale from 1875-2000 are depicted in Figure 1. For convenience, we will call the first price from each price pair "purchase price" and the second price "sale price" from the perspective of the collector for the time period between the two transactions corresponding to the price pair. The database for this time period contains 4,896 price pairs, consisting of 899 pairs from American, 1,709 from Impressionist, and 2,288 from Old Masters. We can see that our data is rather spotty for the beginning of our sample but increases rapidly after 1935.[3] We can also see that most artworks bought are held for long time periods (on average 28 years) so that not many purchases in the early years are sold right away.

The selection bias in the data set is an important issue that bears on the interpretation of our empirical study. The selection procedures based on multiple sales from major US auction houses tend to truncate both sides of the return distribution. Our sample may suffer from a "backward filled" data bias since our transactions data before 1950 are collected only from those paintings that were sold in Christie's and Sotheby's after 1950.[4] Given the reputation of the two auction houses, our data may have a bias toward those paintings that have a high value

[3] Note that the scarcity of "sales" data before 1935 was compensated to some extent by more "purchase" data in the repeated sales regression, which use both sets of data in the construction of the art market index. However, the scarcity of data before 1935 would impact the volatility of the index since the art index portfolio then was poorly diversified because of few artworks in the portfolio.

[4] This bias is similar to the "back-filled" data bias for emerging market stocks where historical data on their returns is "back-filled" conditional upon the survival of emerging markets. Thus, data for those emerging markets that submerged as result of revolution or economic turmoil were not included, which tend to create a downward bias. See Campbell Harvey (1995) for a detailed discussion. We like to note, however, unlike Russian bonds and Cuban stocks, paintings from established artists sold in auctions seldom disappear from the market completely. Thus, one can still observe a large number of art pieces sold at estate auctions at a fraction of their purchase price.

after 1950. However, this “backward filled” bias is mitigated by two facts: first, our data set does have a large number of paintings with poor returns. This is partly due to the fact that auction houses are obliged to sell all estate holdings whether they have high values or not. Auction houses such as Sotheby’s and Christie’s also have incentives to sell inexpensive artworks from established artists to attract first time collectors. Thus, we do observe prices of artworks that had fallen substantially. Second, our data before 1950 also come from well known auction houses around the world, so our data principally include works of artists established at the time of purchase. This will tend to moderate the upward bias of our return estimates due to survival. Moreover, expensive paintings today that were bought a long time ago at low prices directly from dealers or artists are not included in our sample due to the lack of transaction records. This will partially offset the upward bias as well. Moreover, masterpieces collected by museums through donation rather than auction sales are also excluded from the sample, further offsetting the upward bias.

In addition to these selection biases, Orley Ashenfelter, Kathryn Graddy, and Margaret Stevens (2001) pointed out that not all items that are put up for sale at auctions are sold because some final bids may not reach the reservation prices. Goetzmann (1993) also argues that the decision by an owner to sell a work of art (and consequently the occurrence of a repeat sale in the sample) could be conditional upon whether or not the value has increased. These would also tend to bias the estimated return upward.[5] Because of these biases, the mean annual return to art investment provided by repeated-sale data should be regarded as approximate, or as an upper bound on the average return obtained by investors over the period. The return could be further reduced by transaction costs. We like to note, however, that return estimates for financial assets, to some extent, also could suffer from the same biases, such as lack of market liquidity, transaction costs and survival.

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[5] Goetzmann (1993, 1996) also argues that auction transactions may not adequately reflect an important element of risk for the art investor: stylistic risk. In other words, the future sales price will depend upon the number of people who wish to buy the work of art when it is put up for sale. Since the repeat-sales data principally reflect auction transactions, they necessarily focus upon artworks that have a broad demand to attract a large number of competitive bidders. Thus, the repeat-sales records will fail to capture the price fluctuations of paintings that are not broadly in demand. The stylistic risk is similar in many respects to the liquidity risk in financial markets, where prices of assets are affected not only by fundamental values but also by market liquidity.

II. Methodology for Estimating the Art Index and Asset Pricing

The repeat-sales regression (RSR) uses the purchase and sale prices of individual properties to estimate the fluctuations in value of an average or representative asset over a particular time period. Robert C. Anderson (1974), Goetzmann (1993), and Pesando (1993) apply it to the art market. The benefit of using the RSR is that the resulting index is based upon price relatives of the same painting that controls for the differing quality of the assets. Thus, it does not suffer from arbitrary specifications of a hedonic model. The drawback is that the index is constructed from multiple sales, which are a subset of the available transactions. Olivier Chanel, Louis-Andre Gerard-Varet, and Victor Ginsburgh (1996) provided a detailed discussion on the weakness of the RSR model.

We begin by assuming that the continuously compounded return for a certain art asset i in period t, $r_{i,t}$, may be represented by μ_t, the continuously compounded return of a price index of art, and an error term:

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

where μ_t, may be thought of as the average return in period t of paintings in the portfolio. We will use sales data about individual paintings to estimate the index μ over some interval t = 1... T. Here, μ is a T-dimensional vector whose individual elements are μ_t. The observed data consist of purchase and sales price pairs, $P_{i,b}$, and $P_{i,s}$, of the individual paintings comprising the index, as well as the dates of purchase and sale, which we will designate with b_i, and s_i. Thus, the logged price relative for asset i, held between its purchase date b_i and its sales date, s_i, may be expressed as

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

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

Let **r** represent the N-dimensional vector of logged price relatives for N repeated sales observations. Goetzmann (1992) shows that a generalized least-squares regression of the form

(3) $$\hat{\mu} = \left(X'\Omega^{-1}X\right)^{-1}X'\Omega^{-1}r$$

provides the maximum-likelihood estimate of μ, where X is an NxT matrix, which has a row of dummy variables for each asset in the sample and a column for each holding interval. Ω is a weighting matrix, whose weights could be set as the times between sales as in Goetzmann (1993) or could be based on error estimates from a three-stage-stage estimation procedure used by Karl E. Case and Robert J. Shiller (1987).[6]

To calculate the standard errors associated with estimation error for any statistic, such as the mean return of the art index, we first let μ and V represent the whole set of return parameters and their variance-covariance matrix respectively. Next, we write any statistic, such as the mean return, as a function f(μ) of the parameter vector μ. The standard error for the statistic is then estimated as the square root of f_μ'Vf_μ, where f_μ is the gradient of the statistic with respect to the parameters μ. This is often called the δ method in econometrics.

To estimate the systematic risk of art as an investment, we follow John Y. Campbell (1987) by assuming that capital markets are perfectly competitive and frictionless, with investors believing that asset returns are generated by the following one-factor model:

(4) $$e_{i,t+1} = E_t\left[e_{i,t+1}\right] + \beta_i f_t + \xi_{i,t+1}$$

Here $e_{i,t+1}$ is the excess return on asset i held from time t to time t+1, and represents the difference between return on asset i and the US treasury bill rate. $E_t[e_{i,t+1}]$ is the expected excess return on asset i, conditional on information known to market participants at the end of

[6] The RSR is known to introduce certain biases in the estimated series. The most serious of these are a spurious negative autocorrelation in the estimated return series. This bias is potentially severe at the beginning of the estimated series. Goetzmann (1992) propose a two-stage Bayesian regression to mitigate the negative autocorrelation of the series over the early periods. The Bayesian formulation imposes an additional restriction that the return series μ, is distributed normally and is independently and identically-distributed. The effect on the estimate is dramatic for the early period when data are scarce, and minimal for the period when data are plentiful. The form of the- Bayesian estimator is:

$$\mu_{Bayes} = \left[\left(X'\Omega^{-1}X\right) + \kappa\left(I - \frac{1}{T}J\right)\right]^{-1} X'\Omega^{-1}r$$

Goetzmann and Peng (2001) also proposed an alternative repeated sales estimate that is unbiased and based on arithmetic average of returns.

time period t.[7] We use the S&P 500 to proxy for the systematic factor and assume $E_t[\xi_{i,t+1}] = 0$. The conditional expected excess return is allowed to vary through time in the current model but the beta coefficients are assumed to be constant. In computing $e_{i,t}$, we use return indices from five different asset class: the Art index, the Dow Jones Industrial Total Return Index, the US Government Bonds Total Return Index, the US Corporate Bond Total Return Index, and the United States Treasury Bills Total Return Index. With the exception of the art index, the sources of these data are from Federal Reserve Board and Global Financial Data (5th edition), which has derived its data from historical data on prices and yields collected by Standard and Poor's, the Cowles Commission, and G. William Schwert (1988). The model is estimated using Lars P. Hansen's (1982) Generalized Method of Moments (GMM).[8]

III. Risk and Return Characteristics of the Art Price Index

Figure 2 provides a graphic plot of the art index over the 1875-2000 period with the base year index set to be 1. The index is estimated with 4,896 pairs of repeated sale prices. Our reported art index is based on the three-stage-least-square procedure proposed by Case and Shiller (1987).[9] The Adjusted R-squares for the estimation is 0.64, suggesting the art index explains 64% of the variance of sample return variation. The F-statistic equals 104.32 with a significance level equal to 0.000, indicating the index is a highly significant common return component of our art portfolios. Due to a smaller number of observations, the three sub-indices, American, Impressionist, and Old Masters, were estimated only for the 1941-2000, 1941-2000,

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[7] We assume $E_t\left[e_{i,t+1}\right] = \sum_{n=1}^{L} \alpha_{in} X_{nt}$, where the forecasting variables X_{nt} include a constant term, the yield on US treasury bills, the dividend yield on Standard and Poor's 500 index, the dividend payout ratio on the Standard and Poor's 500 index, the spread between the yields on Moody's Baa Corporate Bond and US government bonds, and the spread between the yields on US government bonds and US treasury bills. For more details on the estimation of this model, see Campbell (1987).

[8] We have also run OLS regressions of various asset returns directly against the S&P 500 index, assuming the first term to be constant in equation (4). The results are quite similar for all assets except that the estimation errors for betas tend to be larger. These results are available upon request.

[9] We use the Case and Shiller (1987) procedure because it allows us to adjust for a downward bias in annual returns estimation due the log price transformation (see Goetzmann (1992)). We have also estimated the art index using GLS and the two-stage Baysian estimation proposed by Goetzmann (1992). The correlation between the Case and Shiller (1987) procedure and the other two procedures are 0.970

and 1900-2000 periods respectively. The figure shows a sharp rise in prices in the 1980s with the art index peaking at 8640 in 1990 followed by a 36% drop in 1991. We can also see that, even after ten years of market adjustment, the Impressionist Paintings still have not recovered from its high level of 1990. Thus, total performance has been much affected by the bear market for art during most of the 1990s. While the boom and bust was well documented in the art market, the price indices allow us to estimate the precise time and magnitude of the price change. Our indices have also identified major price drops during the 1974-75 oil crisis and the 1929-1934 depression. See Appendix for the actual values of the All ART Index.

Table 1 provides summary statistics on the behavior of real returns for each of our six asset classes. The real returns are computed as the nominal return minus annual inflation using the US CPI index. For each variable, we report the mean, standard deviation, and its correlation with other assets. We also report the standard deviation of the art return estimates due to estimation error using the δ method. We can see that our estimates are fairly accurate. The standard error for the mean return estimate was only 0.2% for the 1950-1999 period and 0.3% for the 1875-1999 period.[10] Table 1 reveals that art had a real annual compounded return of 8.2% comparable to that of stocks during the 1950-1999 period. Moreover, art out-performed bonds and treasury bills. Corporate and government bonds derived a 2.2% and 1.9% annual return respectively while the S&P 500 and the Dow Industrial gained 8.9% and 9.1% respectively. Our results are quite similar for the 1900-1999 period, though the performance gap between art and stocks widened. The art index also out-performed fixed income securities during the 1875-1999 period.[11] Moreover, we found that the volatility of art market price index dropped to 21.3% during the 1950-1999 period from 42.8% during the 1875-1999 period, making the art index just a bit more risky than the two stock indices.[12]

To compare our results with those obtained in earlier studies, we also estimated real returns of various assets for the same sample period as in Goetzmann (1993) and Pesando (1993). The results were reported in the bottom panel of Table 1. While Goetzmann's art index

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and 0.917, suggesting that the results are quite robust. We have also discovered that the two-stage Baysian estimates tend to have smaller estimation errors though they may be biased.

[10] We did not include the year 2000, since our data only has sales from the first half of the year.

[11] This result is similar to Goetzmann (1993) during the 1850-1986 period.

[12] There was a large drop in the volatility of the art index for the most recent sample period. This should be expected, since the number of artworks in our art index portfolio increased rapidly after 1935.

significantly out-performed both stocks and bonds during 1900-1986 sample periods, our art index only outperformed bonds.[13] We conjecture that the differences in art performance could be partly due to a difference in sample selection, since the artists chosen by Reitlinger (1961, 1963 and 1973) could be affected by his taste and other selection biases. This could bias the performance result upward. In comparison to Goetzmann's findings, our art index also has less volatility (and lower correlation with other asset class). This could be the result of our larger sample, which makes our art index portfolio better diversified and less volatile. Our art index performed better than that of Pesando (1993) who used modern prints sold in US and Europe. He found modern prints under-performed both stocks and bonds during the 1977-1992 sample period. Using semi-annual returns, he also found the print returns could be less volatile than stock and bonds.[14] Because of the lower volatility and correlation with other assets reported in Table 1, our study suggests that a diversified portfolio of artworks may play a somewhat more important role in portfolio diversification.

In Table 2, we report the estimates of the one-factor asset pricing model (4). Using the S&P 500 index as the systematic factor, we observe that the art beta was 0.718 during the sample period and it was significant with a t-statistic of 3.119. The smaller beta on art compared to the S&P 500 indicates that art has less systematic risk than the S&P 500 thus it should be expected to earn a lower return than the S&P 500 over the long run. It also suggests that the art index tends to move in the same direction as the S&P 500, consistent with a wealth effect from the stock market discussed in Goetzmann (1993). In addition, the higher systematic risk on art compared to bonds implies that art should earn a higher return than bonds over the long run.

IV. Do Masterpieces Under-perform?

A common advice given to their clients by art dealers is to buy the best (i.e. most expensive) artworks they can afford. This presumes that masterpieces of well known artists will

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[13] It is worth noting that, while both Goetzmann's (1993) data and our data include artworks sold internationally, Goetzmann's data are concentrated in UK sales before 1960 and ours are skewed towards auction sales in the US. While our result on art return characteristics is similar to Goetzmann (1996), he did not use a RSR estimation approach in his 1996 paper.

[14] Pesando's volatility numbers are not directly comparable to ours since his computation was based on semiannual data. Our average return results are also similar to those of Buelens and Ginsburgh (1993) from the 1870-1913 period. Their study was also based on the Reitlinger (1961) data.

outperform the market. In other words, masterpieces might have a higher expected return than middle-level and lower-level works of art. Contrary to this popular belief, Pesando (1993) discovered that masterpieces actually tend to under perform the market. His discovery was based on repeated sales of modern prints from 1977-1992. Since Pesando's data only cover prints that tend to have much lower value when compared to American, Old Masters and Impressionists paintings, one may wonder if this underperformance exists for truly expensive artworks. Moreover, Goetzmann (1996) found no evidence of underperformance of masterpieces. Using repeated sales data covering American, Old Master, Impressionist and Modern paintings, this paper will further examine the performance of masterpieces. We will follow Pesando by using the market price to identify the masterpieces (i.e, expensive paintings are masterpieces). In the first examination, we use prices for all artworks sold between 1875 and 2000. We apply the same repeated sales regression approach by adding an additional term to equation (2),

$$r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \gamma \left(s_i - b_i\right) \cdot \ln \mathrm{P}_{i,b} + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} \qquad (5)$$

where γ is the elasticity of art returns with respect to log price of the property and $(s_i\text{-}b_i)$ is the holding period. Here γ gives the expected percentage changes in annual returns as a result of a 1% change in art purchase prices. For the three subcategories, we also repeat the same estimation procedure. In the second exercise, we use prices deflated by the US CPI index, since the nominal value of art may change due to inflation. The results are reported in Table 3 while Figure 3 provide a simple plot of art returns and purchase prices for Old Masters paintings. Our results are uniform across all categories: masterpieces significantly under-performed their respective art market indices. Our γ estimate on the American artworks indicates that a 10% increase in purchase price is expected to lower future annual returns by 0.1%. Moreover, our results are robust to whether nominal prices or real prices are used in the regressions. Thus, our study seems to suggest that art investors should buy less expensive artworks at auctions.

The underperformance of masterpieces is similar to the "small firm effect" documented by K.C. Chan and Nai-Fu Chen (1988) and many others in their study of the capital asset pricing model. These authors discover that small firms with lower market capitalization tend to achieve excess returns not justified by their risk based on single factor market models. Recent studies by Eugene Fama and Kenneth French (1995), however, suggest that firm size could be a proxy for exposure to systematic risk factors.[15] While it may be possible to argue that masterpieces are less risky or more liquid, it is also likely that there exist mean reversion in art returns. This could be similar to those found in Werner F. M. De Bondt and Richard Thaler (1989) about stock returns. Those artworks that outperformed the art market (expensive paintings) in the past tend to under perform in the future while those that under performed (less expensive ones) tend to outperform in the future.

V: Tests of "Law of One Price"

Pesando (1993) compared prices of alternative copies of the same prints sold in different markets, and he found substantial evidence of violation of the "law of one price" during the 1977-1992 period. He found that prices for prints sold at Sotheby's consistently exceed prices of those sold at Christie's. This is puzzling, since one would expect, in the absence of transaction costs, the "law of one price" would dictate that no significant price difference should exist for identical prints of the same artist. Ashenfelter (1989) also discussed the violation of the "law of one price" on wine auctions around the world.

This paper provides an alternative test of the "law of one price" using the repeated sales data for original paintings from Christie's and Sotheby's. Our null hypothesis is that there is no difference between prices realized at different auction houses so that the returns realized from different auction houses are equal. To test the above hypothesis, we include a set of annualized return dummies for different locations of transactions in the following repeated sales regression:

$$r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \sum_{j=1}^{5} \rho_j (s_i - b_i) \cdot D_{i,j} + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} \qquad (6)$$

where $D_{i,j}$ is a set of dummy variables for different locations of transactions defined in Table 5.[16] ρ_j measures the excess annual return achieved at other auction locations over returns obtained by

[15] Alternatively, one may argue that many people purchase art for their own pleasure and more expensive paintings have larger private consumption values. Thus, the negative returns could indicate a higher private consumption value offset by a lower monetary payoff in an efficient art market.

[16] Due to the construction of our data set of price pairs, there are three possibilities for location of purchase: Christie's, Sotheby's, and other auction houses (Others), while there are only two possibilities for location of sale: Christie's and Sotheby's. Thus, we constructed five dummy variables for six

buying at Christie's and selling at Christie's. Thus, returns obtained by buying at Christie's and selling at Christie's serve as a benchmark. Equation (6) is estimated the same way as equation (5) by adding a few dummy variable columns to the matrix X in equation (3). The results are presented in Table 4. Compared to what was found in Pesando (1993), we have mixed evidence on the "law of one price". The place of transaction did not seem to matter for American paintings.[17] For Impressionist Paintings, while the location dummies were not significant for most cases, collectors did receive a statistically significant higher return when their artworks were bought at other auction houses and later sold at Sotheby's. For Old Masters, while the first three location dummies were not significant, our result has shown a significant negative return impact when the paintings were bought at Sotheby's, indicating that on average paintings sold at Sotheby's fetch a higher price. In addition, when an Old Master piece was bought at Sotheby's but then sold at Christie's, it tended to receive an even lower return than selling the piece at Sotheby's instead. However, we would like to note that the return differences between the two major auction houses appear to be small. Conditional on art pieces being bought at Christie's, place of sale made no statistical difference for collectors. It only mattered when the art piece was bought at Sotheby's. Our study including all collecting categories over the 1875-2000 period confirmed this result. In addition, the study shows that collectors tended to do better when they buy at other auctions but manage to sell their collection at the two major auction houses. This is certainly consistent with the blue chip reputation of the two houses.

VI. Conclusions

This paper constructs a new data set of repeated sales of art paintings and estimates an annual index of art prices for the period 1875-2000. Our data set has more repeated sales data than previous studies and is also broken down into three popular collecting categories. Based on this new data set, our study made the following discoveries: First, contrary to some earlier studies, we find art has been a more glamorous investment than some fixed income securities, though it under-performs stocks. Our art index also has less volatility and much lower

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different purchase-sale location combinations. We deleted a few observations because information on purchase locations were not available.

[17] Few American paintings were sold at other auctions in our sample so we did not include the first two dummies in our regression analysis.

correlation with other assets as found in previous studies. As a result, a diversified portfolio of artworks may play a somewhat more important role in portfolio diversification.

Second, our study finds strong evidence of underperformance of masterpieces as in Pesando (1993), which means expensive paintings tend to under perform the art market index. Third, there is mixed evidence that the "law of one price" is violated in the New York art auction market. In general, there seem to be little price difference between Christie's and Sotheby's for American and Impressionist paintings. However, we do have some evidence that purchase prices were somewhat higher for Old Masters at Sotheby's for the 1900-2000 sample period.

Our results on the return-risk characteristics of artworks and the correlations between art and financial assets have implications for long-term investors. Contrary to established industry wisdom, our results on the performance of masterpieces suggest that investors should not be obsessive with masterpieces and they need to guard against overbidding. We like to note, however, our results may only serve as a benchmark for those artworks bought at major auction houses. Our return estimates could also be biased due to sample selection. In addition, art may be appropriate for long-term investment only so that the transaction costs can be spread over many years.

Our research has left many interesting issues. First, is there a systematic bias in bidding prices so that winning bids tend to exceed value? In this paper, we have not provided any evidence on the presence of overbidding. While the true value of art is unobservable, one may wonder if there is an alternative proxy to value, such as dealer's estimates, that may serve as a proxy so that we may measure the presence of market wide bias in art auctions. Second, while our study has provided some *cross-sectional* evidence on the mean reversion of art returns, one may wonder if similar *time series* evidence can be found on the market as a whole so that times of great exuberance are also more likely to be followed by times of disappointing performance. To put it differently, it will be interesting to know whether the art market itself may also follow a mean reversion process. We will leave these for future research.

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TABLE 1-- SUMMARY STATISTICS OF REAL RETURNS

		Art	S&P500	Dow	Gov Bond	Corp Bond	T-Bill
1950-1999	Mean	0.082 [0.002]	0.089	0.091	0.019	0.022	0.013
	S.D.	0.213 [0.016]	0.161	0.162	0.095	0.092	0.023
1900-1999	Mean	0.052 [0.003]	0.067	0.074	0.014	0.020	0.011
	S.D.	0.355 [0.048]	0.198	0.222	0.086	0.084	0.049
1875-1999	Mean	0.049 [0.003]	0.066	0.074	0.020	0.029	0.018
	S.D.	0.428 [0.047]	0.087	0.208	0.080	0.080	0.048

Correlations Among Real Returns (1950-1999)

Art Index	1.00					
S&P 500 Index	0.04	1.00				
Dow Industrial	0.03	0.99	1.00			
Government Bonds	-0.15	0.33	0.28	1.00		
Corporate Bonds	-0.10	0.38	0.33	0.95	1.00	
Treasury Bills	-0.03	0.27	0.25	0.61	0.63	1.00

Comparison with Earlier Studies in Real Returns

		Goetzmann	Art	S&P500	Gov Bond	Corp Bond	T-Bill
1900-1986	Mean	0.133	0.052	0.057	0.008	0.015	0.009
	S.D.	0.519	0.372	0.207	0.082	0.081	0.052
		Pesando	Art	S&P500	Gov Bond	Corp Bond	T-Bill
1977-1992	Mean	0.015	0.078	0.088	0.051	0.056	0.024
	S.D.	--	0.211	0.115	0.133	0.129	0.028

Note: The standard errors associated with estimation error for the statistics are in the brackets.

TABLE 2-- ESTIMATION OF THE ONE-FACTOR MODEL (4)

	β_i	t-stat
Excess return on S&P 500 Index	1.000*	----
Excess return on Art Index	0.718	3.119
Excess return on Dow Industrial	1.160	25.84
Excess return on Government Bonds	0.114	3.609
Excess return on Corporate Bonds	0.246	4.845

Notes: Asterisk(*) indicates that the S&P 500 Index is used as the systematic factor. The sample period for this table is 1875-1999.

TABLE 3--TESTS OF THE UNDERPERFORMANCE OF MASTERPIECES

	American	Impressionist	Old Master	All
Sample Period	1941-2000	1941-2000	1900-2000	1875-2000
Panel A: Test using Nominal Value				
γ	-0.010	-0.006	-0.012	-0.010
t-stat	-8.071	-7.792	-28.32	-30.54
Panel B: Test using Real Value				
γ	-0.011	-0.005	-0.013	-0.010
t-stat	-8.116	-7.467	-27.99	-30.81

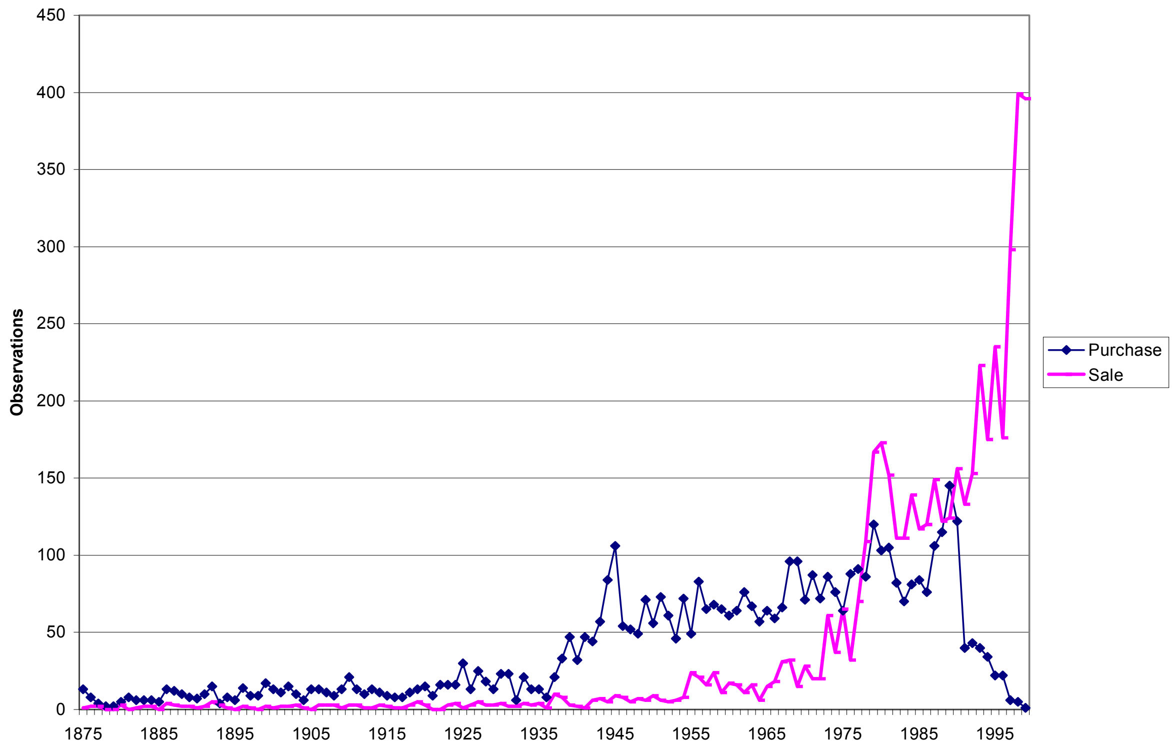
Note: Three-stage-generalized-least square RSR estimation of Case and Shiller (1989) are used to estimate: $r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \gamma\,(s_i - b_i) \cdot \ln \mathrm{P}_{i,b} + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}$.

TABLE 4--TESTS OF THE "LAW OF ONE PRICE"

Buy-Sale	Other-Christie's	Other-Sotheby's	Christie's-Sotheby's	Sotheby's-Christie's	Sotheby's-Sotheby's
	$D_{i,1}$	$D_{i,2}$	$D_{i,3}$	$D_{i,4}$	$D_{i,5}$
American			1941-2000		
ρ	-	-	-0.030	-0.010	-0.015
t-stat	-	-	-1.640	-0.870	-1.477
Impressionist			1941-2000		
ρ	-0.001	0.049	0.002	-0.002	-0.006
t-stat	-0.098	2.878	0.231	-0.322	-1.161
Old Master			1900-2000		
ρ	0.006	-0.001	-0.001	-0.019	-0.012
t-stat	0.924	-0.187	-0.293	-5.461	-4.218
All			1875-2000		
ρ	0.013	0.014	-0.004	-0.010	-0.008
t-stat	3.915	4.096	-1.620	-3.760	-3.652

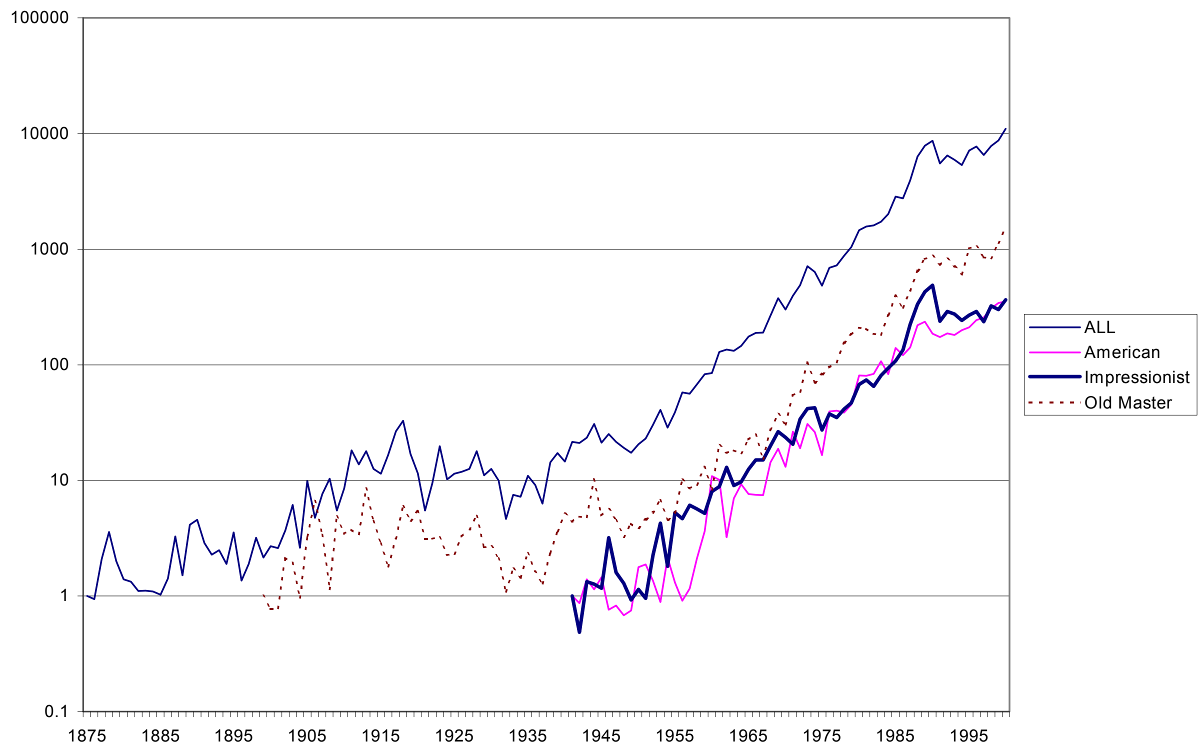
Note: Three-stage-generalized-least square RSR estimation of Case and Shiller (1989) are used to estimate: $r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \sum_{j=1}^{5} \rho_j (s_i - b_i) \cdot D_{i,j} + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}$, where $D_{i,j}$ are dummy variables indicate different location of art auctions for each price pair of repeated sales.

FIGURE 1: NUMBER OF OBSERVATIONS BY PURCHASE AND BY SALE



Note: For convenience, we will call the first price from each price pair "purchase price" and the second price "sale price" from the perspective of the collector for the time period between the two transactions of the price pair.

FIGURE 2: NOMINAL INDICES



(Base Year: All 1875=1, American 1941=1, Impressionist 1941=1, Old Master 1900=1)

Notes: For the All Art Index, regression statistics for the three-stage-generalized-least square RSR estimation of Case and Shiller: R^2=0.64, F(125,4771) =104.32 with a significance level equal to 0.000. Annual returns are computed as $\exp(\mu_t + \sigma^2/2)-1$, σ^2 is estimated in the second stage of RSR.

FIGURE 3: OLD MASTER PAINTINGS RESALE RETURNS

TABLE A1: NUMERICAL VALUES OF THE ALL ART INDEX

YEAR	INDEX	YEAR	INDEX	YEAR	INDEX	YEAR	INDEX
1875	1.000	1907	7.264	1939	16.826	1971	412.032
1876	0.996	1908	9.590	1940	14.295	1972	487.115
1877	2.197	1909	5.323	1941	22.538	1973	713.655
1878	4.223	1910	8.283	1942	20.263	1974	591.168
1879	3.551	1911	17.153	1943	22.924	1975	479.239
1880	1.276	1912	13.205	1944	29.746	1976	690.213
1881	1.127	1913	16.790	1945	21.311	1977	725.746
1882	0.330	1914	12.023	1946	24.105	1978	873.930
1883	0.771	1915	11.050	1947	21.213	1979	1038.362
1884	0.469	1916	16.145	1948	19.227	1980	1462.642
1885	0.801	1917	25.759	1949	16.305	1981	1605.836
1886	1.293	1918	32.117	1950	19.502	1982	1536.404
1887	2.968	1919	16.397	1951	22.334	1983	1709.575
1888	1.408	1920	11.061	1952	29.365	1984	2014.648
1889	3.744	1921	5.346	1953	39.933	1985	2850.073
1890	4.151	1922	10.105	1954	27.782	1986	2738.594
1891	2.828	1923	19.283	1955	36.741	1987	3930.414
1892	2.247	1924	10.116	1956	59.051	1988	6290.526
1893	2.835	1925	11.365	1957	55.351	1989	7893.540
1894	1.782	1926	11.702	1958	67.850	1990	8640.364
1895	3.302	1927	12.535	1959	87.462	1991	5508.788
1896	1.256	1928	17.678	1960	78.351	1992	6452.997
1897	1.839	1929	10.916	1961	127.345	1993	5927.157
1898	3.050	1930	12.370	1962	132.238	1994	5360.433
1899	2.046	1931	9.775	1963	130.569	1995	7103.906
1900	2.546	1932	4.599	1964	152.155	1996	7705.580
1901	2.484	1933	7.402	1965	166.068	1997	6582.698
1902	3.529	1934	7.009	1966	192.539	1998	7810.311
1903	5.795	1935	10.793	1967	188.614	1999	8728.947
1904	2.616	1936	8.933	1968	266.613		
1905	9.473	1937	6.311	1969	358.526		
1906	4.449	1938	14.030	1970	285.117		