Vested Interest and Biased Price Estimates: Evidence from An Auction Market

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Abstract

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KEYWORDS:

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Evidence from an Auction Market

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ABSTRACT

This paper employs a new data set from art auctions to examine the relationship between auctioneer presale price estimates and the long-term performance of artworks. We find that the price estimates for expensive paintings have a consistent upward bias over a long period of thirty years. High estimates at the time of purchase are associated with adverse subsequent abnormal returns. Moreover, the estimation error for individual paintings tends to persist over time. These results are consistent with the view that auction house price estimates are affected by agency problems and some investors are credulous.

Rationality has long been a key assumption of much of modern economics. Given its importance, numerous studies recently have examined its empirical validity and have discovered some evidence of bounded rationality or information inefficiency. For example, in behavioral finance, several studies have provided evidence suggesting that investors on average do not discount sufficiently the incentives of interested parties, such as firms, brokers, and analysts, to manipulate the information they provide. Womack (1996) finds that securities analysts are biased in their forecasts and recommendations. Stock recommendations favor buys over sells. Capstaff, Paudyal, and Rees (1998) also discover that earnings forecasts are generally optimistic, especially at long time horizons. Recently, Bradshaw, Richardson, and Sloan (2003) also discover that sell-side analysts routinely manipulate their investment advice in response to investment banking pressures in order to temporarily inflate stock prices around securities issuances. These biases result from agency problems. Information is manipulated in order to drum up investment banking business,[1] to maintain access to information, or to stimulate trading by investors. (See for example, Hayes (1998), Lim (2001), and Michaely and Womack (1999). Also see Barberis and Thaler (2003) for a recent survey of behavioral finance.)

While it is not surprising that agency problems could result in analyst biases, an important question is whether the biases affect asset prices. Teoh, Welch, Wong (1998a, b) and Rangan (1998) discover that investors do not adequately discount for earnings manipulation at the time of IPOs or seasoned equity issues. They show that greater earnings management at the time of these equity issues is associated with subsequent long-run underperformance. These researchers note that cognitive limitations make it hard for economic agents to make the appropriate adjustments for the biases systematically. Critics, however, point out that statistical problems for some of the above studies may account for the long-run underperformance of IPOs (see S.P. Kothari (1999) and Schultz (2003)). Moreover, the results of Keane and Runkle (1990, 1998) even cast some doubt on the existence of bias in analysts' forecasts.

This paper will join the investigation by employing a new data set from a different field (art auctions) to examine the estimation bias and its impact on prices. While auction houses typically made no price estimates before 1973, they started providing price estimates for all artworks thereafter to attract individual collectors. Thus, we have a natural experiment to observe changes in price behavior under the influence of auctioneer presale price estimates. By using data with over 5,500 pairs of transactions and covering a long time period, between 1875 and 2002, we can control for price fluctuations due to art market movements and isolate the price impact of auctioneer estimates. This unique data set permits us to study several issues in behavioral finance:[2]

First, we examine whether auctioneer estimates are unbiased over a long period of 30 years from 1973 to 2002, rather than much shorter time periods analyzed in early studies. We are the first to document a persistent upward bias for price estimates in an open English auction setting. Second, we examine whether high estimates at the time of purchase are associated with negative future abnormal returns; this will help us find whether investors make appropriate adjustments for a natural auctioneer bias due to self-interest. Third, we will study whether the estimation bias will persist over time. Fourth, our study will employ a repeated sales regression approach to control for heterogeneity in artworks. We will employ two asset-pricing models to control for the difference in risks of artworks when measuring abnormal returns. As a result, our study complements the existing empirical literature that has focused on analyst earnings estimates and stock prices.[3]

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. Section III provides an empirical examination of auctioneer price estimates and the long-run performance of artworks. We will also study the persistence of estimation bias. Section IV will conclude the paper.

I. Auction Data and Potential Biases

Since individual works of art have yet to be securitized, 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. Auction prices, however, are reliable and publicly available. Galenson and Weinberg (2000, 2001) use auction price data to study the value of artistic creation during the life cycle of artists. Since 1973, the two major auction houses in New York, Sotheby's and Christie’s, have also provided presale price estimates in their catalogues for all objects that are up for sale. As a result, the prices and their estimates can be used as the basis for a data base for determining the change in value of art objects over various holding periods as well as the influence of auctioneer presale estimates.

We created such a database for the American market, principally New York, based on repeated sales. We searched the catalogues for all American, 19th Century and Old Master, and

Impressionist and Modern paintings sold at the main sales rooms of Sotheby's and Christie's (and their predecessor firms) from 1950 to 2002.[4] If a painting had listed in its provenance a prior consummated public sale, at any auction house anywhere, we went back to that auction catalogue and recorded the sale price. In addition to price and date information, we also recorded auctioneer price estimates when they became available after 1973.[5] The change to provide price estimates was exogenous. The auction market for works of art has been in existence for hundreds of years and its customer base was almost exclusively made up of dealers, other arts professionals, and museum curators. Thus, the market was principally a wholesale market. The problem with a wholesale customer base from the auctioneer point of view is that it usually leaves 50 percent of the eventual sale price of the item to be garnered by the dealer. By the early 1970s, the auction houses were not satisfied with their slice of the pie and decided to move their customer base to a more retail clientele. In order to attract individual collectors, the auction houses needed to level the playing field between the wholesale and retail customers by giving its own estimate on the value of artworks. To play it safe, the auction houses actually gave a range, a high and low price estimate for each piece.

The New York Public Library as well as the Watson Library at the Metropolitan Museum of Art were our major sources for this auction data history. 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. Some paintings had multiple resales over many years, resulting in a subset of observations that had three public sales with one of the pairs straddling 1973, the year of the introduction of auctioneer presale price estimates. Each resale pair was considered a unique point in our database, which now totals over fifty-five hundred entries. 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. Most artworks in our database are held for long time periods (on average 28 years).

Before 1979 auction houses made their money by charging a fee to the seller, for consummated sales, of 10%. This fee was negotiable, like real estate commissions, based on the importance or forecasted value of the work or collection being offered for sale. Items not reaching their reserve price were also charged a small fee. After 1979, an additional fee was imposed on the successful bidder, the one offering the highest price in the English style outcry auction used by most of the world's major auction houses. This fee was initially set at 10% of the winning bid (hammer price) and was not negotiable. Since 1979 this latter fee has been changed four times and is now about 20% of first $100,000 and 12% of every thing above $100,000 at both of New York major auction houses. Thus, it is clear that auction houses are interested in results that yield high prices and a high percent of lots sold.

The percent of lots sold is dependent on market demand and reservation price. Reservation prices are generally set based on sellers' expectation of market demand and their own funding needs. The exact number of works offered with a reserve has grown substantially over the last 50 years to a point today where probably over 95 percent of the lots are so offered. The typical reserve price is often 60 up to 80% of the low estimate, while its actual level is negotiable but legally cannot be above the low estimates at New York auctions. Auction houses often compete to get the seller's business by providing high price estimates. But they are constrained by the fact that the painting may fail to sell if reservation prices are set too high due to high price estimates. Moreover, auction houses also have a reputation to protect. Their long-term business viability depends on their reputation as experts in the art field who understand market conditions.

The selection bias in the data set is an important issue that could bear on the interpretation of our empirical study. The selection procedures based on multiple sales from major U.S. 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.[6] However, the "survivorship" 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 also have incentives to sell inexpensive artworks from established artists to attract first-time collectors. Thus, our data do include artworks whose prices have fallen substantially. Moreover, Mei and Moses (2002) argue that the upward bias tends to be further moderated by the fact that expensive masterpieces are often taken off the market by museums through donations.

Second, there seems to be a high rate of survival for Old Master and Impressionist artists at auction. This can be shown in a sample study we conducted for those artists whose works were sold in 1950.[7] We proceed by returning to the auction catalogs and record every artist's name that was entered in 1950. We find a total of 187 named artists whose works were up for sale in 1950.[8] Of the 187 artists in 1950, 97 appear in the 2000 auction catalogs and an additional 35 appear in our data from the 1990 to 2000 period. An incremental 47 artists were found on the Art Sales Index database from the same period.[9] This brings our survival total to 179 or a high survival rate of 96% (See Appendix A for a list of the artists and their survival status,). In comparison, the survival rate for the 30 stocks in the Dow Jones Industrial between 1950 and 1999 was less than 33%, with 20 stocks being replaced by new stocks, sometimes more than once! Moreover, robustness tests using data after 1950 show that our results are not affected by this "survivorship" bias.

Ashenfelter, Graddy, and Stevens (2001) pointed out that another source of selection bias is that not all items that are put up for sale at auctions are sold, because some final bids may not reach the reservation prices. In Appendix B, we will demonstrate that, under certain conditions, our results for equation (3) and (4) are unaffected by this data truncation due to no sales ("bought-ins").

II. Methodology For Repeat-Sales Regression

This paper will use the repeat-sales regression (RSR) methodology to measure the impact of auctioneer estimates after controlling for overall art market movements. The 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. Pesando (1993), Goetzmann (1993), and Mei and Moses (2002) 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.

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:

$$r_{i,t} = \mu_t + \varepsilon_{i,t} \quad , \tag{1}$$

where μ_t, may be thought of as the average return in period t of paintings in the portfolio, and the painting specific return, $\varepsilon_{i,t}$, is assumed to be uncorrelated over time and across paintings. 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

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

$$= \sum_{t=b_i+1}^{s_i} \mu_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{i,t} \quad . \tag{2}$$

In order to measure the impact of auctioneer presale price estimates on returns, we may run a regression like the following, $r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \theta\, x_i + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}$, where x_i is a painting i specific variable such as price estimates at purchase. Thus, θ measures directly the impact of x_i on art returns adjusted for overall market movements. To estimate the above equation, we will employ a generalized least-squares regression in the form of $\hat{\mu} = \left(X'\Omega^{-1}X\right)^{-1}X'\Omega^{-1}r$, which is a maximum-likelihood estimate of μ as noted in Goetzmann (1993). Here X is a matrix that has a row of dummy variables for each asset in the sample and a column for each holding interval. In addition, it also includes a column of x_i. Here Ω is a weighting matrix whose weights will be based on error estimates from a three-stage-least-square estimation procedure used by Case and Shiller (1987).

III. An Empirical Examination on the Impact of Price Estimates

A. Art Prices Tend to be Affected by Expert Opinion

Following Ashenfelter (1989), we begin by examining whether auctioneer presale price estimates are biased. We regress estimation error, $(\ln \overline{\mathrm{P}}_{i,s} - \ln P_{i,s}) / \ln P_{i,s}$, in percentage against the log price over the 1973-2002 period, where $\overline{\mathrm{P}}_{i,s}$ is the average of the high- and low- estimates. The regression is estimated with 6114 observations with an adjusted R^2 of 0.036, using all transactions with price estimates. The intercept is –0.041 with highly significant t-statistics of 11.4. The slope coefficient is 0.005 with highly significant t-statistics of 14.5. These results indicate that the estimation biases are generally quite small, but the bias could be fairly large for high price paintings. Given the fact that the regression is based on paintings actually sold and the highest bid for unsold pictures is generally below the lower estimate, the actual bias should be more severe than the regression indicates. Our result here is quite different from that of Keane and Runkle (1998). They found that analyst forecasts are unbiased. Moreover, our study covers a much longer period of 30 years from 1973 to 2002, compared to nine years by Keane and Runkle (1998) and eleven years by Abarbanell and Bernard (1992).

To find the consistency of our result over time, we also run the above regression annually from 1973 to 2002. We allow the intercept and the slope coefficients to vary over time.[10] The results on the slope coefficient and 95% confidence bounds are presented in a graphic plot in Figure 1. It is quite striking to see a persistent upward bias for high priced paintings over the 30-year sample period, since the slope estimates are above zero for almost all years. The mean of the slope coefficient is 0.0053 with a standard deviation of 0.0028. Thus, the slope coefficient is close to but significantly different from zero. The negative intercept and slightly positive slope of the regression allows the price estimates to be biased slightly downwards for low price paintings but upwards for the high price paintings. This result is consistent with the view that auction house performs a delicate balance between their long-term reputation and short-term interest. As a result, they will try to maintain an overall unbiasedness in their estimates, but tilt their estimates upward for expensive paintings, since they can benefit the most from such bias if investors are credulous. Daniel, Hirshleifer, and Teoh (2002) also point out that the problem of credulity is likely to be greater for firms with high valuations or firms that are able to weave hard-to-refute stories to tell investors about future prospects.[11]

[Insert Fig. 1 about here]

An alternative way of measuring the influence or forecast ability of auctioneer presale price estimates is to run the following regression (3):

$$r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \gamma_1 \ln\left(\overline{P}_{i,s} \Big/ \overline{P}_s\right) \cdot D_{1,i} + \gamma_2 \ln\left((P^H_{i,s} - P^L_{i,s}) \Big/ \overline{P}_{i,s}\right) \cdot D_{1,i} + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} , \qquad (3)$$

where r_i is the return on painting i and μ_t is the return to the art market index. The expression b_i indicates the time of purchase and s_i the time of sale. The variable $\overline{\mathrm{P}}_{i,s}$ stands for the average of the high- and low- estimates for painting i in year s , and $\overline{\mathrm{P}}_s$ is the mean of $\overline{\mathrm{P}}_{i,s}$ across paintings in year s. The expression ($P^H_{i,s} - P^L_{i,s}$) is the difference between high- and low- estimates at the sale. The dummy variable $D_{1,i}$ indicates that the sale of the painting happened after 1973. This variable $D_{1,i}$ allows us to measure the change in return dynamics before and after price estimates are made available. In order to measure the impact of the spread of the sale estimates, - that is the difference between high- and low- estimates-, we also include the difference ($P^H_{i,s} - P^L_{i,s}$) in regression (3). We then scale it by the average estimate for that object at the time of the sale ($\overline{P}_{i,s}$). Our hypothesis is that if investors are credulous and they are given two paintings with the same average estimates, they may be inclined to pay more for the painting with a higher $P^H_{i,s}$. We will estimate equation (3) using all artworks as well as the three collecting subcategories. Thus, if auctioneer estimates simply forecast market returns and have no impact on prices of individual artworks, then we would expect γ_1 and γ_2 to be close to 0.

The regression results are reported in Table I. The γ_1 estimates are uniformly positive and highly significant across all collecting categories. High price estimates relative to average price estimates of the year, $\overline{P}_{i,s} / \overline{P}_s$, positively affect returns, implying that the investors at the sale are influenced by the price estimates when they decide how much to pay for the paintings. Our γ_1 estimate for Old Master artworks indicates that a 10% increase in sale price estimates on average tend to increase price (excess returns) by 0.65%. Moreover, its γ_2 estimate suggests that a 10% increase in estimate spread on average tend to increase excess returns by 0.7%. However, the γ_1 estimates are not significant for other collecting categories. Overall, our study suggests that art investors are likely influenced by price estimates. They tend to pay more for paintings with high price estimate.[12] This need not be irrational, however, since the fashion of particular artists and periods is incorporated by the auction houses in their estimates, which are also reflected in sale prices.

[Insert Table I about here.]

B. Long-term Underperformance Due to the Influence of Auctioneer Estimates

The above study has shown that investors are influenced by auctioneer estimates. But this does not necessarily imply that investors are credulous. If auctioneers do have information on the value or future performance of paintings, then investors could be simply taking advantage of the information and buying according to their suggestions. This is quite similar to investor reaction to Wall Street analyst recommendations. Prices generally go down if a stock is downgraded from a "buy" to a "sell." What would be interesting is, if we can show that investors have been influenced by information that is adverse to their future returns. Our first test involves a simple study in which we compare the return performance of two groups of paintings with triple sales as illustrated in Figure 2. Our first group (A) of paintings consists of those whose 1st sale occurred before 1973 with no price estimates, and whose 2nd and 3rd sale happened after 1973, when auctioneer presale price estimates were made available. As a result, the 1st sale price is not influenced by auctioneer estimates, while the 2nd and 3rd prices could be. Our second group (B) of paintings consists of those whose 1st and 2nd sales occurred before 1973 and whose 3rd sale happened after 1973. If price estimates have an upward pressure on prices, we would expect that the first holding period return for A will be higher than that of B. This is because the 2nd sale price of A is under the influence of estimates, while that of B is not. Further, if the auctioneer presale estimates have led to high purchase prices and then a lower return for the future, we would expect that the second holding period return for A will be lower than that of B.

[Insert Figure 2 about here.]

Table II presents our empirical findings. We discover that, while the overall holding period returns (1st+2nd) is only slightly different (1.2%), the first holding period return for A is 3.97% higher than that of B, with a statistical significance of 1%. Moreover, the second holding period return for A is 3.79% lower than that of B. Again, the difference is highly statistically significant. Both findings are consistent with the view that investors are influenced by auctioneer estimate information, which then turns out to be adverse to their future returns.

[Insert Table II here]

Critics may argue, however, that while the above results are suggestive of investor credulity, the estimation procedure did not adjust for differences in time periods and market movements. To address this concern, we will evaluate the impact of auctioneer estimate on future returns by explicitly controlling for market movements in the following regression:

$$r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \gamma \, D_{2,i} \ln(\overline{P}_{i,b}) + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} \quad , \tag{4}$$

where $D_{2,i}$ is a dummy variable indicating that the *purchase* of the painting happened after 1973 and $\overline{\mathrm{P}}_{i,b}$ is the average of the high- and low-estimates at the purchase. Again, $D_{2,i}$ allows us to measure the change in return dynamics before and after price estimates are made available. [13] The results are reported in Table III. Our results are uniform across all categories: the higher the purchase price estimates, the greater the future under-performance of the artworks with respect to art market indices. Moreover, our results are robust to whether nominal prices or real prices are used in the regressions.[14] To help understand the economic significance of our results, consider an average Old Master Painting that has an average price estimate of $19,200 during the period of 1981 to 1985. A one standard deviation increase in the estimate ($19,400) would increase $\ln(\overline{\mathrm{P}}_{i,b})$ by 9.8, which would on average imply a drop of future return by 29%, or a reduction of 1% per annum![15]

[Insert Table III here]

One of the difficult tasks of this study is to show that our results occur because analyst forecasts affect auction prices and not because smart analysts simply reflect the beliefs (or exuberance) of the investors.[16] While our results here are not conclusive, they nonetheless suggest that the latter is unlikely. Unless the decision to provide price estimates coincides with a permanent upward shift in investor sentiment, it is hard to explain why the year 1973 has had such an important impact on art returns. It is worth noting that, until very recently, when the Internet made art auction price information widely available, auction catalogues were probably the most important source of price information for art objects on sale. Moreover, heterogeneity and infrequent trading makes it hard to evaluate works of art even for a knowledgeable person. As a result, the price estimates were an important part of the information set on which investors form their price expectations. As a result, auction houses are in a good position to affect and not just reflect investor expectation.

Our case is further strengthened by common advice given to their clients by art dealers, which is to buy the best (i.e., most expensive) artworks they can afford. This advice presumes that masterpieces of well-known artists will outperform the market. In other words, masterpieces might have a higher expected return than middle-level and lower-level works of art. Casting doubt on this popular advice, Pesando (1993) was the first to show that print masterpieces (defined by their high prices) actually tend to underperform the market. [17]

Why would auction houses recommend expensive paintings to their clients while there is no (or even opposing) evidence of masterpiece over-performance? We suspect that it could be due to their self-interest. As we know, auction house commissions (both seller commission and buyer premium) are based on the prices of art fetched at auctions. The higher the price, the higher the commission. So to the extent that auctioneer estimates could influence prices, auction houses would naturally inflate their price estimates and recommend that investors buy "masterpieces."[18] This paper establishes a statistical relationship between price estimates and future returns. We extend the results of earlier studies by showing that the underperformance could be due to investors paying dearly for paintings with high price estimates.

Our results here are consistent with those in behavioral finance. Firms tend to "manage" their earnings when they are selling equity. Teoh et al. (1998a, b) and Rangan (1998) discovered that accruals tend to be abnormally high at the time of new IPO and seasoned equity issues, suggesting that firm earnings are reported higher than cash flow. Teoh and Wong (2001) also found that greater earnings management is associated with more optimistic errors in analyst earnings forecasts, both in new and seasoned equity issues. They found that greater earnings management at the time of a new issue is associated with more adverse future abnormal stock returns. This suggests that "…investors, possibly under the influence of analysts, do not adequately discount for earnings manipulation (page 176)."[19]

C. Underperformance after Controlling for Risk

An alternative hypothesis to our results is that auctioneer estimates provide valuable information to investors by reducing the risk in art investment.[20] The auctioneer presale estimates are particularly valuable for expensive paintings because market participants believe that they tend to be the most risky. Thus, investors are willing to pay a premium for masterpieces when price estimates are available. To examine the validity of this explanation, we need to estimate systematically the return risk of art works. This is not a trivial task, since artworks do not trade very often and they have different holding periods and thus are under the influence of different overall market movements. We will approach this problem by using the classic capital asset pricing model (CAPM) to decompose the return risk into systematic and painting specific risks. As a result, we have two possible explanations related to risk.

The first explanation would be that masterpieces have smaller systematic risk. As a result, investors would be willing to pay a premium for them relative to other works of art, due to smaller market risk exposure. To test this hypothesis, we partition our data into two groups for each year based on purchase prices (or price estimates later) and define those whose prices are in the top one third to be masterpieces. Because it is not possible to estimate stock market betas for each artwork, we assume that all masterpieces (non-masterpieces) have the same betas. Here, we allow betas to vary over the two groups and over two time periods, before and after 1973, to take into account a possible change in betas due to the availability of price estimates or other changing market conditions. For simplicity, we will use the classic CAPM model to estimate the systematic risks of artworks, and we will employ the S&P 500 as the market index. Using equation (2) and the CAPM, we have:

$$
\begin{aligned}
r_i &= \sum_{t=b_i+1}^{s_i} r_{i,t} = \sum_{t=b_i+1}^{s_i} (r_{ft} + \beta_{it} MKT_t + \varepsilon_{it}) \\
&= \sum_{t=b_i+1}^{s_i} r_{ft} + \sum_{t=b_i+1}^{1972} \beta_{1,k} MKT_t + \sum_{1973}^{s_i} \beta_{2,k} MKT_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} \text{ , k=M and NM,} \qquad (5)
\end{aligned}
$$

where M (NM) stands for masterpieces (non-masterpieces), r_{ft} is the riskfree rate, and MKT_t is the stock market excess return. Note that we may not have either the first term if the purchase happened after 1973 or the second term if the sale happened before 1972. Re-arranging terms and adding two constant terms to measure the Jensen's α (risk adjusted excess return) before and after 1973, we have the following regression:

$$r_i - \sum_{t=b_i+1}^{s_i} r_{ft} = \alpha_{1k} D_{3,i} + \alpha_{2k} D_{4,i} + \beta_{1k} \sum_{t=b_i+1}^{1972} MKT_t + \beta_{2k} \sum_{1973}^{s_i} MKT_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} , \qquad (6)$$

where k=**M, NM**. The variables α_{1k} and α_{2k} measure the average excess returns to paintings before and after 1973. Here masterpieces are defined by purchase price. Here we will use the return to the United States Treasury Bills Total Return Index as the risk free rate and MKT_t as the excess return on S&P 500. The sources of the data are the Federal Reserve Board and Global Financial Data (5th edition). We employ the same Case and Shiller (1987) estimation procedure to estimate (6) separately for the masterpieces and non-masterpieces. The results are reported in Table IV.

[Insert Table IV here]

There are several interesting results. First, with the exception of Impressionists in the post-1973 period, masterpieces tend to be less risky than non-masterpieces. Thus, market participants were wrong if they believed that masterpieces are much more risky. Second, there is a substantial drop in systematic risk after 1973. This could be a confluence of many factors. While the availability of price estimates may have contributed to the drop, Japanese influence in the 1980s and the art market correction in the 1990s may have also reduced the correlation with the U.S. equity market. It is interesting to note that there is little difference in systematic risks between the American masterpieces and non-masterpieces after 1973. While Impressionist masterpieces do have higher betas, the opposite was true for Old Masters. Lastly, after adjusting for systematic risk, masterpieces tend to have lower excess returns (both $\alpha_{1,M}$ and $\alpha_{2,M}$) than non-masterpieces. Moreover, the impact of price estimates on excess returns are uniformly negative but much more severe for masterpieces. The last row of Table IV provides the difference between excess returns of the two groups ($\alpha_{2,NM}$-$\alpha_{2,M}$) after 1973. We can see the difference in excess return between a representative Impressionist non-masterpiece and a masterpiece to be a staggering 21.6% (0.77% annually on an average 28- year holding period)). This result is statistically significant at 1%. Note the difference is also large and significant for old masters and the whole sample.[21] Thus, systematic risk cannot explain the "masterpiece effect."

The second explanation related to risk would be that masterpieces have smaller idiosyncratic risk. Idiosyncratic risk matters because art investment is lumpy. As a result, investors could be paying a premium for masterpieces relative to other works of art, due to smaller painting specific risk. To obtain the annual idiosyncratic risk σ_ε estimate, we take the squared residuals from (6) and scale it by (s_i-b_i). We next sum them up for all paintings sold before 1973 (or purchased after 1973) and divide it by the total number of paintings sold during the period. That is: $\sigma_{1,\varepsilon}^2 = \sum_{s_i<1972} \left(\eta_i^2 \big/ s_i - b_i \right) \Big/ N_1$, where N_1 is the total number of paintings sold before 1973, and η_i^2 is the squared residuals in equation (6).[22] We discard the sample of paintings bought before 1973 and sold after 1973 to get a clean estimate of idiosyncratic volatility before and after 1973. We then compute two F-statistics, which is the ratio of idiosyncratic volatility of non-masterpiece over masterpieces.[23] Under the assumption of annual homoscedasticity across the two time periods, we can show that the F-statistic has a distribution with the degrees of freedom equal to the numbers of paintings used in the computation of the volatility minus 1.

The results are reported in Table V. Our results are uniform across all categories: idiosyncratic volatility of masterpieces is smaller than those of non-masterpieces. Our σ_ε estimate on the American masterpieces indicates that annual volatility is 0.063, compared to 0.075 for non-masterpieces after 1973. Moreover, volatility has generally declined after price estimates were made available after 1973. Thus, price estimates tend to help reduce future return volatility. Thus, idiosyncratic risk may help explain why investors would pay a premium for masterpieces. However, since paintings are usually bought by wealthy individuals and large institutions, it is a puzzle why investors would pay more, because painting specific volatility can be easily diversified.

[Insert Table V about here]

Finally, in order to make sure that our results in Table IV and V are not just driven by over-payments but also by the upward biased price estimates, we estimate Table VI based on price estimates at the purchase. To control for systematic risk, we use Fama and French (1996) factors, plus the Pastor and Stambaugh (2003) liquidity factor. We start by partitioning our data into two groups for each year based on the *ex ante* purchase price estimates and define those whose price estimates are in the top one-third to be masterpieces. We assume that all masterpieces (non-masterpieces) have the same betas. Since price estimates are only available after 1973, we will assume the alphas and betas to be constant during the sample period. Thus, we estimate:

$$r_i - \sum_{t=b_i+1}^{s_i} r_{ft} = \alpha_k + \beta_k \sum_{t=b_i+1}^{s_i} MKT_t + \gamma_k \sum_{t=b_i+1}^{s_i} SMB_t + \theta_k \sum_{t=b_i+1}^{s_i} HML_t + \phi_k \sum_{t=b_i+1}^{s_i} LIQ_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}\,, \qquad (7)$$

where MKT is the market factor, SMB is the "small minus big" size factor, HML stands for the "high minus low" book-to-market factor, and LIQ is the value-weighted liquidity factor.[24] For simplicity, here we only report the abnormal returns (Jensen's α) in Table VI. Our results are quite similar to those reported in Table IV. After controlling for systematic risks, masterpieces, - that is, those with high purchase price estimates -, tend to have a more negative excess return than non-masterpieces. For example, the difference in excess returns (α_{NM}-α_M) is 13.7% on average for Impressionists. While this difference is quite large in magnitude, due to a relatively large standard deviation of the parameter estimates as a result of a smaller sample and more parameters, we cannot tell whether the differences are statistically different from zero. Nonetheless, our result here shows that risk cannot explain the "masterpiece effect."

[Insert Table VI here]

To rule out the possibility that our results may be driven by the "backward filled" survivorship bias discussed in Section I, we have re-estimated equation (7) using data after 1950. This sample is free from the above survivorship bias, because it includes all paintings that had a repeated resale after 1950. Our result on the abnormal returns for the masterpieces remains unchanged. These result are available upon request.

It is worth noting that the so-called winner's curse--the tendency for buyers to overbid at auctions--would also have a hard time explaining the abnormal returns, since the impact of overbidding at the purchase may be cancelled out at the sale if the new buyer also has a tendency to overbid.[25]

An effective strategy against auctioneer bias is refusing to pay the high prices suggested by their estimates. Given the upward bias of price estimates and the high reservation price set based on the estimates, the painting may fail to sell at the auction (i.e., "be bought-in") if we have shrewd investors. If more and more investors learn over time that there is an inherent bias in auctioneer estimates, then more and more paintings will fail to sell at auctions if auctioneers do not significantly alter their behavior. In an earlier version of the paper, we have presented some preliminary evidence that the percentage of paintings sold have been falling over time since 1973. While the reasons for the falling sale rate are numerous, the evidence seems to be consistent with the view that investors are becoming more aware of the upward bias in price estimates.

D. Return Performances within Masterpieces

A common criticism of the repeated sales approach used in this paper is that our data are conditional on the sale of the artworks. To the extent that some masterpieces are donated to museums and some non-masterpieces are never sold again at auction due to expected poor returns, it is possible that sample bias could lead us to find spurious underperformance for the masterpieces. While Section I has informally addressed the "survivorship" bias issue, here we will directly evaluate the impact of price estimates by comparing the return performance *within* the group of masterpieces. Our intuition is that, if masterpieces with high estimates tend to under-perform masterpieces with low estimates, then, our result on the negative effect of the high estimates holds in the sub-sample of masterpieces as well.

To conduct our test, we will form four portfolios of paintings based on the triple sales data (Group A) used in Section IIIB. We will first divide the sample into two groups: masterpieces and non-masterpieces, based on their 1st sale prices within each collecting category. We will define those whose prices were at the top one third for the 1st sale year as masterpieces. We will then obtain their "fundamental" value estimates at the 2nd sale by inflating their 1st sale prices with the art market index estimated using equation (2). Next, we will calculate the ratio of the average price estimates provided by the auctioneers at the 2nd sale over the “fundamental” value estimates and sort the paintings in each group into two portfolios of equal size based on the ratios.[26] Those masterpieces with high price estimates relative to “fundamental” values will be put into a “masterpieces with high estimates” portfolio and the rest will be put into a “masterpieces with low estimates” portfolio. The same procedure is also repeated for the non-masterpieces.

Table VII presents the return performance comparison of two groups with different price estimates. Because the paintings may enter the portfolios at different times, we remove their common market component so that we can just compare the annualized excess return performance. We will compute the return performance based on two different models. In Panel A, the annual excess return is computed based on the art market index. In Panel B, the annual abnormal return is computed based on the CAPM model of equation (6) and the estimates given in Table IV. As we can see clearly from the chart, “masterpieces with high estimates” significantly underperform “masterpieces with low estimates” in Panel A. The mean excess return difference is –4.9% with a significant t-statistic of 2.32. The same underperformance for the high estimate portfolio is also present in Panel B but not statistically significant.[27] Thus, our results here indicate that the negative effect of the high estimates is independent of sample selection.

[Insert Table VII about here.]

E: How Persistent is the Upward Bias?

An interesting question here is how the upward bias may persist over time. If price estimates are driven by rational learning, then we would expect the upward bias to dissipate over time. However, if the estimates are driven by self-interest or agency problems, then the upward bias will continue. In the following regression, we examine several variables that may affect the bias over time. Under the null hypothesis of rational expectations, none of these variables in the past should have any explanatory power over the unexpected estimation error:

$$\ln(\overline{P}_{i,s}) - \ln(P_{i,s}) = \gamma_0 + \gamma_1[\ln(\overline{P}_{i,b}) - \ln(P_{i,b})] + \gamma_2 \ln(\hat{P}_{i,b}) + \gamma_3 \sum_{t=b_i+1}^{s_i-1} \hat{\mu}_t + \eta_{it}, \tag{8}$$

where the dependent variable, $\ln(\overline{P}_{i,s}) - \ln(P_{i,s})$, is the estimation error at the sale. The first regressor, $\ln(\overline{P}_{i,b}) - \ln(P_{i,b})$, is the estimation error at the purchase. The second regressor is the real price at the purchase. The third regressor, $\sum_{t=b_i+1}^{s_i-1} \hat{\mu}_t$, is a proxy for the respective art market returns during the holding period just before the sale. We will run the regression for each collecting category using data post 1973 when both purchase and sale price estimates are available. The results are reported in Table VIII.

[Insert Table VIII here]

We can see that γ_1 is positive and significant for all collecting categories except Impressionist. This implies that the estimation error has a positive autocorrelation between the purchase and sale. Given an average holding period of 28 years, the upward bias seems to be quite persistent over time! Thus, our result here is more consistent with biases resulting from auction house self-interest. Moreover, there is some evidence (γ_2) that the upward bias *at the sale* is also positively and significantly related to price estimates *at the purchase* for Impressionist. This seems to indicate that the upward bias tends to be higher for masterpieces, though the result is insignificant for other collecting categories. We next examine the impact of art market prices on estimate bias (γ_3). There is weak evidence that high market returns in the past tend to dampen the bias. This suggests that the auction houses may suffer from a minor conservatism bias, which leads them to underweight recent art market movements.

It is worth noting that, while high private consumption benefits may explain lower returns on the masterpieces, it is hard to explain why the upward bias should persist over time under rational expectations. Thus, the results of Table VIII tend to reaffirm the self-interest story.

VI. Conclusions

This paper constructs a new data set from art auctions to examine the relationship between auctioneer presale price estimates and the long-term performance of artworks. It complements the existing empirical literature on behavioral economics, which focuses on analyst earnings estimates and stock prices. We find that the price estimates for expensive paintings have a consistent upward bias over a long period of thirty years. High estimates at the time of purchase are associated with adverse subsequent abnormal returns. Moreover, the estimation error has a positive serial correlation, suggesting the upward bias tends to be quite persistent over time. These results are consistent with the view that auction house price estimates are affected by agency problems and some investors are credulous.

The results discovered in the paper can help us understand some asset pricing puzzles from a new perspective. It is conceivable that the time-variation of estimation errors can generate predictable patterns that can help explain the predictability in returns as well as excess volatility. The results may also help explain the underperformance of "fashionable or hot" assets whose future prospects have been hyped by their peddlers to attract the unsuspecting investors. As a matter of fact, the underperformance of the masterpiece resembles the well-documented underperformance in IPO stocks. The risk-return profile documented in the paper may also help investors decide whether to include art in their long-term investment portfolio.

Our research has left many interesting issues. While the paper has studied the impact of auctioneer estimates on investors, we have not examined how investor behavior influence auction price estimates. It might be interesting to study the impact of auction house competition on price estimates. In addition, we have not studied the optimal bidding strategies for rational investors when price estimates are upward biased and some investors are credulous. We will leave these questions for future research.

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APPENDIX A: ARTISTS WHO APPEARED IN 1950 NEW YORK AUCTION CATALOGUES AND THEIR SURVIVAL STATUS BETWEEN 1990-2000

NAME	STATUS	NAME	STATUS	NAME	STATUS	NAME	STATUS
Adrion	2	Fantin-Latour	1	Loisseau	1	Romney	1
Andre	1	Forain	2	Lopez Rey	3	Roselli	2
Archipenko	1	Fragonard	1	Lotto	1	Rouault	1
Bakhuysen	2	Friesz	2	Lurcat	2	Rousseau	1
Barlach	1	Gainsborough	1	Maclet	2	Rubens	1
Barta	3	Gall	2	Maes	2	Russell	3
Bassano	3	Gall	3	Magnasco	2	Rysdael	1
Batoni	1	Gerband	4	Maillol	1	Salvi	2
Bauchant	1	Gilbert	3	Mancinni	4	Salviati	2
Beechey	2	Gillot	3	Marieschi	1	Sanzio	2
Beerstraten	2	Giorgri	4	Martinez	3	Schiele	3
Bellevois	3	Gris	1	Martyl	4	Seitz	3
Bellotto	2	Gromaire	3	Masson	1	Seurat	1
Bepo	4	Grosz	1	Matisse	1	Severini	1
Berard	1	Guardi	1	Maufra	1	Signac	1
Biddle	3	Guillaumin	1	Middleton	3	Sisley	1
Boldini	1	Hals	1	Mieris the Elder	1	Sorgh	2
Bombois	1	Hanneman	3	Mieris	2	Soutine	1
Bonnard	1	Harkey	4	Miro	1	Spolverini	3
Botton	3	Harlow	2	Modigliani	1	Steen	1
Bouche	3	Heckel	1	Moere	3	Steine	4
Braque	1	Heemskerk the Elder	1	Monet	1	Strauch	3
Brouwer	2	Helion	2	Monticelli	2	Stuart	1
Calder	1	Henner	2	Moore	1	Taunay	3
Canaletto	1	Hiraga	3	Moreelse	3	Tchelitchew	2
Cassatt	1	Hitzberger	3	Moro	2	Teniers the elder	1
Cazin	3	Hofter	1	Nolde	1	Teniers the younger	1
Ceria	3	Hoppner	1	Olivier	3	Terborch	1
Cezanne	1	Isenbrant	1	Orley	2	Tintoretto	1
Chagall	1	Joest	3	Ostade	2	Tintoretto	1
Chirico	1	John	2	Pajou	3	Toulouse-Lautrec	1
Cleef	3	Kalf	2	Pascin	1	Turner	1
Codde	1	Kallen	4	Philipp	3	Utrillo	1
Cosway	2	Kisling	1	Piazzetta	2	Valk	3
Coubine	3	Kokoscka	1	Picasso	1	van Dyck	1
Courbet	1	Kolbe	3	Pissarro	1	van Gogh	1
Cross	1	Lancret	1	Poel	3	Vermeyen	2
Dali	1	Laurencin	1	Pot	3	Veronese	1
Degas	1	Lawrence	1	Pourbus the younger	1	Vestier	2
Dehn	1	Le Nain	3	Preyer	2	Vlaminck	1

Derain	1	Leeuw	3	Raeburn	1	Vois	3
Dufy	1	Leger	1	Raffaelli	2	Vrancx	3
Dufy	1	Legrand	3	Redon	1	Vuillard	1
Dunoyer de Segonzac	1	Lepicie	1	Renoir	1	Wouwerman	1
Edzard	3	Leyster	3	Reynolds	1	Zadkine	1
Eisendieck	3	Liebermann	3	Robert	1	Zick	3
Fages	3	Lippi	1	Rodin	1		

1= 2000 CATALOG ENTRY
2= MEI/MOSES DATABASE, 1990-2000
3=ASI DATABASE, 1990-2000
4=MISSING

APPENDIX B. Robustness with Respect to the "Bought in" Bias

Another main statistical feature of our study is that it is based on artworks sold at the auction. Thus, we do not observe the prices of those paintings that are unsold at the auctions. While we argue in Section IIIA that the result of an upward bias of price estimates with respect to masterpieces should not be affected by the selection bias, it makes us wonder whether the same can be said about our credulity results derived from regression (4). In this appendix, we will demonstrate that, under certain conditions, our results are unaffected by the sample selection bias. We begin by assuming that the errors in regression (4) follow a normal distribution:

$$. r_i = \ln P_{is} - \ln P_{i,b} = \sum_{t=b_i+1}^{s_i} \mu_t + \gamma D_{2i} \ln(\overline{P}_{i,b}) + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}, \sum_{t=b_i+1}^{s_i} \varepsilon_{it} \sim N(0,(s_i - b_i)\sigma^2) \qquad \text{(A1)}$$

For simplicity, we will re-write (A1) as

$$\ln P_{is} = \ln P_{i,b} + \sum_{t=b_i+1}^{s_i} \mu_t + \gamma\ D_{2,i} \ln(\overline{P}_{i,b}) + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}, \qquad \text{(A2)}$$

or simply as

$$y_i = \ln P_{is} = aX_1 + \gamma X_2 + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}, \qquad \text{(A3)}$$

where X_1 would include the exogenous variables in the first two terms of equation (A2), and X_2 would be $D_{2,i} \ln(\overline{P}_{i,b})$. According to William Greene (2000, pages 899-902),

$$E[y_i \mid y_i > \phi \ln(\overline{P}_{i,s})] = aX_1 + \gamma X_2 + (s_i - b_i)\sigma\lambda(\alpha_i), \tag{A4}$$

where $\alpha_i = \left(\phi \ln(\overline{P}_{i,s}) - aX_1 - \gamma X_2\right)/(s_i - b_i)\sigma$. Here, we assume that a painting will be sold if $y_i > \phi \ln(\overline{P}_{i,s})$ and $\lambda(\alpha)$ is the inverse Mills Ratio.[28] It is then easy to show that:

$$\begin{aligned}
\frac{\partial E[y_i \mid y_i > \phi \ln(\overline{P}_{i,s})]}{\partial X_2} &= \gamma + (s_i - b_i)\sigma \frac{d\lambda(\alpha_i)}{d\alpha_i}\frac{\partial \alpha_i}{\partial X_2} \\
&= \gamma + (s_i - b_i)\sigma\lambda(\alpha_i)\left[\lambda(\alpha_i) - \alpha_i\right]\left(\frac{-\gamma}{(s_i - b_i)\sigma}\right) \\
&= \gamma\,[1 - \delta(\alpha_i)] = \hat{\gamma}
\end{aligned} \tag{A5}$$

It is well known that

$$\delta(\alpha_i) = \lambda(\alpha_i)(\lambda(\alpha_i) - \alpha_i), 0 < \delta(\alpha_i) < 1. \tag{A6}$$

Equation (A5) shows that $\hat{\gamma}$ is the marginal effect of price estimates at purchase, which is estimated using regression (4) *conditional* on sold artworks. From equation (A5) and (A6), we can see that the true γ has the same sign as $\hat{\gamma}$. Moreover, the estimated negative impact $\hat{\gamma}$ is smaller in absolute value than the actual γ. As a result, our conclusion of the *negative* relationship between price estimates and future abnormal returns is not affected by the sample selection bias.

Table I

Influence of Auctioneer Presale Estimates on Prices

This table presents the γ_1 and γ_2 estimates in the following regression:

$$r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \gamma_1 \ln\left(\overline{P}_{i,s} \Big/ \overline{P}_s \right) \cdot D_{1,i} + \gamma_2 \ln\left((P^H_{i,s} - P^L_{i,s}) \Big/ \overline{P}_{i,s} \right) \cdot D_{1,i} + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} ,$$

where r_i is the return on painting i and μ_t is the return to the art market index. The variable b_i indicates the time of purchase and s_i the time of sale. The variable $\overline{\mathrm{P}}_{i,s}$ stands for the average of the high- and low- estimates for painting i in year s and $\overline{\mathrm{P}}_s$ is the mean of $\overline{\mathrm{P}}_{i,s}$ across paintings in year s. The dummy variable $D_{1,i}$ indicates that the sale of the painting happened after 1973. The expression ($P^H_{i,s} - P^L_{i,s}$) is the difference between high- and low- estimates at the sale. The three-stage-generalized-least square RSR estimation of Case and Shiller (1989) is used to estimate the regression for the four collecting categories.

	American	Impressionist	Old Master	All
Sample Period	1941-2002	1941-2002	1900-2002	1875-2002
γ_1	0.095	0.068	0.065	0.052
t-stat	(4.787)	(6.013)	(3.071)	(6.680)
γ_2	0.021	-0.003	0.070	-0.007
t-stat	(1.191)	(-0.222)	(3.116)	(-0.855)
Adj. R^2	0.735	0.784	0.636	0.660
OBS	968	1927	2345	5606

Table II

Summary Statistics of Average Annual Holding Period Returns

This table examines the impact of auction house price estimates on holding period returns for paintings with triple transactions. For the 1st Holding Period, the purchase of both groups of paintings happened before 1973. The difference between A & B is that the sale of group A happened after 1973 while that of B happened before 1973. For the 2nd Holding Period, the sale of both group of paintings happened after 1973. The difference between A & B is that the purchase of group A happened after 1973, while that of B happened before 1973. For the Overall Holding Period (1+2), their purchase both happened before 1973 and their sales both happened after 1973. The presale price estimates were made available in 1973. The symbol ** indicates significance at the 1% level for the parameter of interest.

Group	OBS		1st Holding Period (%)	2nd Holding Period (%)	Overall Period (1st +2nd) (%)
A	227	Mean	10.73	6.28	9.52
		STD	6.40	14.41	4.17
B	256	Mean	6.76	10.07	8.32
		STD	27.02	5.20	3.96
Difference in Mean (**A-B**)			3.97**	-3.79**	1.20**

Table III

Tests of Future Underperformance

This table presents the γ estimates in the following regression:

$$r_i = \sum_{t=b_i+1}^{s_i} \mu_t + \gamma\ D_{2,i} \ln(\overline{P}_{i,b}) + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}\ ,$$

where r_i is the return on painting i and μ_t is the return to the art market index. The variable b_i indicates the time of purchase and s_i the time of sale. Here $D_{2,i}$ is a dummy variable indicating that the *purchase* of the painting happened after 1973, and $\overline{\mathrm{P}}_{i,b}$ is the average of the high- and low-estimates at the purchase. The three-stage-generalized-least square RSR estimation of Case and Shiller (1989) is used to estimate the regression for the four collecting categories. The CPI index is used to compute real value for $\overline{\mathrm{P}}_{i,b}$.

	American	Impressionist	Old Master	All
Sample Period	1941-2002	1941-2002	1900-2002	1875-2002
A: Estimates Using Nominal Value for $\overline{\mathrm{P}}_{i,b}$				
γ	-0.011	-0.005	-0.030	-0.010
t-stat	(-2.062)	(-1.375)	(-5.984)	(-4.476)
Adj. R^2	0.758	0.791	0.636	0.666
B: Estimates Using Real Value for $\overline{\mathrm{P}}_{i,b}$				
γ	-0.020	-0.007	-0.060	-0.019
t-stat	(-2.190)	(-1.275)	(-6.176)	(-4.728)
Adj. R^2	0.758	0.791	0.636	0.666
OBS	814	1699	2078	4957

Table IV

Comparison of Excess Returns between Masterpieces and Non-Masterpieces

This table presents the α_{1k}, α_{2k}, β_{1k}, and β_{2k} estimates in the following regression:

$$r_i - \sum_{t=b_i+1}^{s_i} r_{ft} = \alpha_{1k} D_{3,i} + \alpha_{2k} D_{4,i} + \beta_{1k} \sum_{t=b_i+1}^{1972} MKT_t + \beta_{2k} \sum_{1973}^{s_i} MKT_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} \text{ , k=}\mathbf{M, NM},$$

where r_i is the return on painting i , b_i indicates the time of purchase, and s_i the time of sale. The variable r_{ft} is the riskfree rate and MKT_t is the excess return on S&P 500. The variables α_{1k} and α_{2k} measure the average excess returns to paintings before and after 1973. The variable **M** stands for masterpieces and **NM** stands for non-masterpieces. Here masterpieces are defined by purchase price. The three-stage-generalized-least square RSR estimation of Case and Shiller (1989) is used to estimate the regression for the four collecting categories.

	American	Impressionist	Old Master	All
Sample Period	1941-2002	1941-2002	1900-2002	1875-2002
A: Estimates for Masterpieces				
$\alpha_{1,M}$	0.149	0.092	0.124	0.058
$\alpha_{2,M}$	-0.224**	-0.402**	-0.410**	-0.210**
$\beta_{1,M}$	0.599**	0.757**	0.093**	0.251**
$\beta_{2,M}$	0.102**	0.201**	0.167**	0.083**
Adj. R^2	0.372	0.435	0.032	0.051
OBS	300	579	710	1589
B: Estimates for Non-Masterpieces				
$\alpha_{1,NM}$	0.281**	0.158**	0.466**	0.348**
$\alpha_{2,NM}$	-0.077	-0.186**	-0.057	-0.092**
$\beta_{1,NM}$	0.700**	0.785**	0.284**	0.440**
$\beta_{2,NM}$	0.094**	0.072**	0.218**	0.104**
Adj. R^2	0.410	0.412	0.251	0.291
OBS	654	1237	1511	3402
$\alpha_{2,NM}-\alpha_{2,M}$	0.147	0.216	0.353	0.118
t-stat	(1.265)	(2.109)	(3.324)	(2.150)

The symbol ** indicates significance at the 1% level.

Table V

Comparison of Idiosyncratic Risks between Masterpieces and Non-Masterpieces

This table presents the *average* residual risk $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$ estimates for the following model:

$$r_i - \sum_{t=b_i+1}^{s_i} r_{ft} = \alpha_{1k} D_{3,i} + \alpha_{2k} D_{4,i} + \beta_{1k} \sum_{t=b_i+1}^{1972} MKT_t + \beta_{2k} \sum_{1973}^{s_i} MKT_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} \text{ , k=}\mathbf{M, NM},$$

where r_i is the return on painting i , b_i indicates the time of purchase, and s_i the time of sale. The variable r_{ft} is the riskfree rate and MKT_t is the excess return on S&P 500. The variables α_{1k} and α_{2k} measure the average excess returns to paintings before and after 1973. The variable **M** stands for masterpieces and **NM** stands for non-masterpieces. $\sigma^2_{1\varepsilon} = \sum_{s_i<1972} \left(\eta_i^2 / s_i - b_i \right) / N_1$, where N_1 is the total number of paintings *sold* before 1973 and $\eta_i = \sum_{t=b_i+1}^{s_i} \varepsilon_{it}$ is the residual in the equation. See that $\sigma^2_{2,\varepsilon} = \sum_{b_i>1972} \left(\eta_i^2 / s_i - b_i \right) / N_2$, where N_2 is the total number of paintings *bought* after 1973. The F-statistics are given as $F_1 = \sigma^2_{1,NM} / \sigma^2_{1,M}$ and $F_2 = \sigma^2_{2,NM} / \sigma^2_{2,M}$. Here masterpieces are defined by purchase price. The three-stage-generalized-least square RSR estimation of Case and Shiller (1989) is used to estimate the model for the four collecting categories.

	American	Impressionist	Old Master	All
Sample Period	1941-2002	1941-2002	1900-2002	1875-2002
A: Estimates of Residual Risk for Masterpieces				
$\sigma_{1\varepsilon}$ (Before 1973)	0.080	0.073	0.179	0.139
$\sigma_{2\varepsilon}$ (After 1973)	0.063	0.093	0.072	0.078
B: Estimates of Residual Risk for Non-Masterpieces				
$\sigma_{1\varepsilon}$ (Before 1973)	0.221	0.210	0.248	0.228
$\sigma_{2\varepsilon}$ (After 1973)	0.075	0.101	0.119	0.099
P-value for F- Test (F_1)	0.032	0.001	0.058	0.000
P-value for F- Test (F_2)	0.088	0.205	0.000	0.000

Table VI

Estimates of Excess Return Using Fama-French and Pastor-Stambaugh Factors

This table presents the α_k estimates in the following regression:

$$r_i - \sum_{t=b_i+1}^{s_i} r_{ft} = \alpha_k + \beta_k \sum_{t=b_i+1}^{s_i} MKT_t + \gamma_k \sum_{t=b_i+1}^{s_i} SMB_t + \theta_k \sum_{t=b_i+1}^{s_i} HML_t + \phi_k \sum_{t=b_i+1}^{s_i} LIQ_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{it}$$, where k=**M**, **NM.**

Here r_i is the return on painting i , b_i indicates the time of purchase, and s_i the time of sale. The variable r_{ft} is the riskfree rate, MKT is the stock market factor, SMB is the "small minus big" size factor, HML stands for the "high minus low" book-to-market factor, and LIQ is the value-weighted liquidity factor. The variable **M** stands for masterpieces and **NM** stands for non-masterpieces. The three-stage-generalized-least square RSR estimation of Case and Shiller (1989) is used to estimate the above model for the four collecting categories. Here masterpieces are defined by purchase price estimates.

	American	Impressionist	Old Master	All
Sample Period	1973-2002	1973-2002	1973-2002	1973-2002
A: Estimates for Masterpieces				
α_M	-0.269	-0.255	-0.394	-0.224
t-stat	(-2.231)	(-2.435)	(-2.905)	(-3.512)
Adj. R^2	0.084	0.469	0.077	0.095
B: Estimates for Non-Masterpieces				
α_{NM}	-0.158	-0.118	-0.277	-0.081
t-stat	(-1.531)	(-1.295)	(-2.805)	(-1.488)
Adj. R^2	0.018	0.350	0.030	0.044
α_{NM}-α_M	0.111	0.137	0.117	0.143
t-stat	(0.699)	(0.987)	(0.697)	(1.705)

TABLE VII

Comparison of Excess Returns between High- and Low- Estimates

This table presents the α_k estimates for four different groups from the following two regressions:

$$r_i = \alpha_k + \sum_{t=b_i+1}^{s_i} \mu_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} \text{ and } r_i - \sum_{t=b_i+1}^{s_i} r_{ft} = a_k + \beta_{1k} \sum_{t=b_i+1}^{s_i} MKT_t + \sum_{t=b_i+1}^{s_i} \varepsilon_{it} .$$

The four groups are masterpieces with high- and low- price estimates and non-masterpieces with high- and low- price estimates. Here r_i is the return on painting i, and μ_t is the return to the art market index. The variable b_i indicates the time of purchase and s_i the time of sale. The variable r_{ft} is the riskfree rate and MKT_t is the excess return on S&P 500. The three-stage-generalized-least square RSR estimation of Case and Shiller (1989) is used to estimate the above models.

	A: Mean Excess Return over Art Market Index		B: Mean Excess Return over S&P 500 Index	
	Masterpieces	Non-Masterpieces	Masterpieces	Non-Masterpieces
Low Estimates	-0.048	-0.043	-0.039	0.002
t-stat	(-2.701)	(-3.918)	(-1.740)	(0.192)
High Estimates	-0.097	-0.034	-0.078	-0.003
t-stat	(-5.725)	(-1.480)	(-4.167)	(-0.144)
Difference (Low-High)	0.049	-0.009	0.039	0.005
t-stat	(2.320)	(0.392)	(1.361)	(0.232)

Table VIII

The Autocorrelation of Estimate Biases

This table presents the parameter estimates for the regressors in the following regression:

$$\ln(\overline{P}_{i,s}) - \ln(P_{i,s}) = \gamma_0 + \gamma_1[\ln(\overline{P}_{i,b}) - \ln(P_{i,b})] + \gamma_2 \ln(\hat{P}_{i,b}) + \gamma_3 \sum_{t=b_i+1}^{s_i-1} \hat{\mu}_t + \eta_{it},$$

where $P_{i,b}$ is the purchase price and $P_{i,s}$ the sale price for painting i. The variable $\overline{\mathrm{P}}_{i,b}$ is the average of the high- and low-estimates at the purchase, $\overline{\mathrm{P}}_{i,s}$ is the average of the high- and low-estimates at the sale, and $\hat{P}_{i,b}$ is the real price at the purchase. The variable $\hat{\mu}_t$ is the estimated return to the art market index, and b_i indicates the time of purchase and s_i the time of sale. The three-stage-generalized-least square RSR estimation of Case and Shiller (1989) is used to estimate the above model for the four collecting categories.

	American	Impressionist	Old Master	All
Sample Period	1973-2002	1973-2002	1973-2002	1973-2002
γ_1	0.104	0.037	0.163	0.065
t-stat	(2.635)	(1.342)	(1.808)	(3.442)
γ_2	0.017	0.019	-0.012	0.010
t-stat	(0.833)	(2.320)	(-0.705)	(1.515)
γ_3	-0.085	-0.009	-0.057	-0.022
t-stat	(-2.560)	(-0.618)	(-1.654)	(-1.717)
Adj. R^2	0.028	0.009	0.016	0.008
OBS	464	922	422	1828

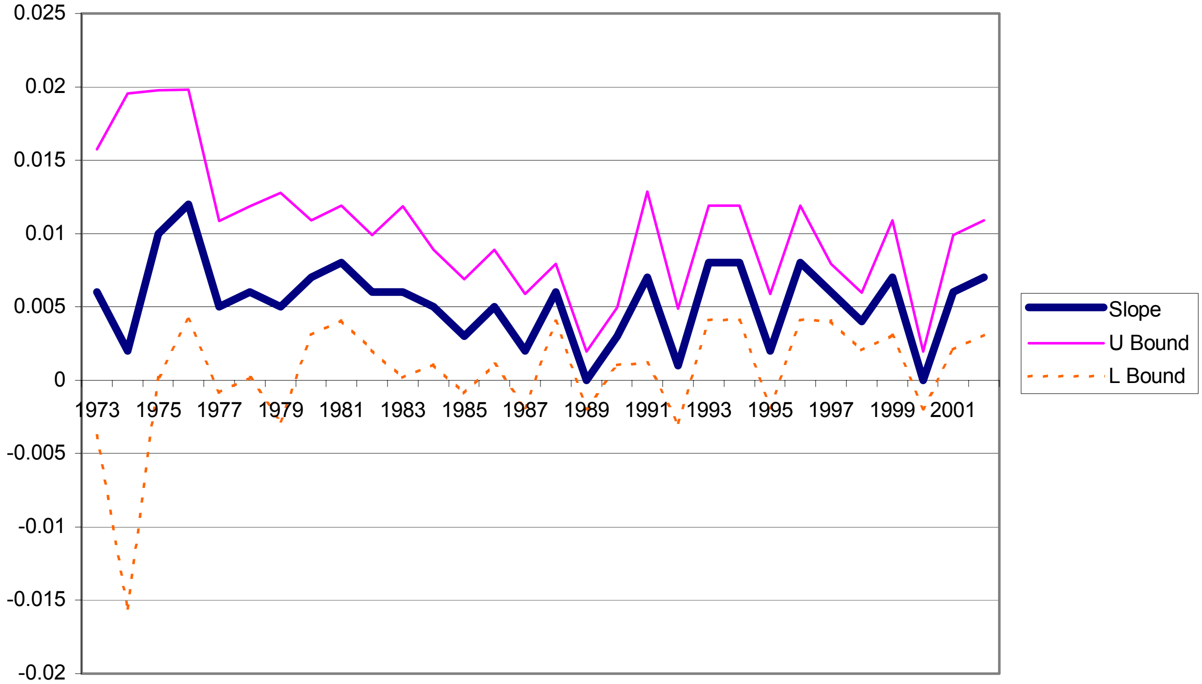

Figure 1. The slope coefficients and their 95% confidence bounds. This figure presents the slope coefficients (d_s) and their 95% confidence bounds for the following cross-sectional regressions over the time periods of 1973 to 2002: $(\ln \overline{P}_{i,s} - \ln P_{i,s}) / \ln P_{i,s} = c_s + d_s \ln P_{i,s} + \upsilon_{i,s}$, where $P_{i,s}$ is the sale price for painting i at time s, $\overline{P}_{i,s}$ is the average of the high- and low-estimates at the sale, and s is the time of sale for painting i.

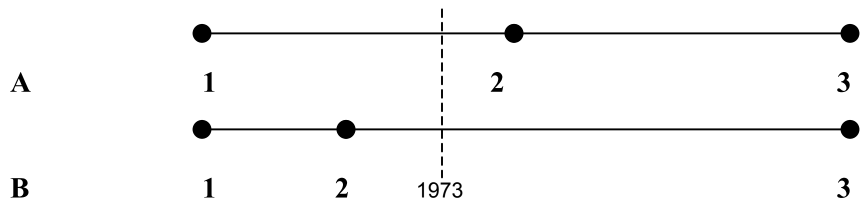

Figure 2. Objects with triple sales. This figure depicts two classes of art objects each having three sales. Class A has only the first sale occurring before 1973, the era of auction house supplied price estimates. Class B has both first and second sales occurring before 1973.

[1] Numerous telecom analysts were alleged or found to have inflated earnings forecasts for companies such as Global Crossing, Quest, WorldCom and Winstar. Despite mounting loss and falling revenues, many continued their buy recommendation for investors until their bankruptcy.

[2] For an extensive literature survey of behavioral finance, see Daniel, Hirshleifer, and Teoh (2002).

[3] Our study builds on a small literature on the study on art prices and auctions. Ashenfelter (1989) was the first to examine whether auctioneer estimates influence art prices. He also pointed out the potential agency problem of auction houses in providing price estimates. Pesando (1993) and Mei and Moses (2002) presented strong evidence of masterpiece underperformance. Their evidence could be consistent with the view that investors overpay for masterpieces under the influence of auctioneer estimates.

[4] Our data does not include "bought-in" paintings that did not sell due to the fact that the bid was below the reservation price. Our data for the year 2002 only includes sales before July.

[5] A small fraction of our data has the presale estimates missing due to missing auction catalogues. We will exclude these data in the regression if the relevant variables are missing.

[6] 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. 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.

[7] Since our data collection starts with paintings sold in 1950 in the New York market, we thought it would be appropriate to see what happens to the artists active in that auction market at the beginning year 1950. Note our data only include artworks that were *bought and sold* at the main auction houses.

[8] In 1950 the categories were not as clean as they are today and thus the Old Master catalogs contain 19th century works and the Impressionists and Modern catalogs of 1950 often contain American artists. After subtracting both of these groups, we find a total of 187 named artists whose work were up for sale in 1950.

[9] The Art Sales Index database covers auction sales from 1970; it includes both single and repeated sales. Our data, however, only include those paintings with repeated sales.

[10] By allowing for time-varying intercept, we have also removed a common factor, which may cause cross-sectional correlation among the residuals. Keane and Runkle (1998) pointed out that the t-statistics for the slope coefficient in Figure 1 may bias upward if no adjustment is made for the cross-sectional correlation.

[11] For simplicity, we will call investors credulous in this paper if they on average do not discount sufficiently the incentives of interested parties, such as firms, brokers, and analysts, to manipulate the information provided.

[12] An anonymous reviewer suggests that the high-estimates $P_{i,s}^H$ are likely to be right skewed relative to the low-estimates. Thus, our results may be affected by the use of the means. To address this concern, we have re-estimated Table I and III by replacing $\overline{\mathrm{P}}_{i,s}$ with $P_{i,s}^H$ or $P_{i,s}^L$. We still find that larger high- or low-estimates tend to lead investors to pay more and are adverse to their further returns. To address the concern that our results may be unduly affected by low priced paintings, we have also re-estimated Table I and III by restricting our sample to paintings with $P_{i,s}$> \$10,000 since 1941. The results are quite similar to those of the whole sample. They are available upon request.

[13] As we have discussed in Section I, there are three major changes in commission fees since 1973: introduction of a seller's premium in 1979, an increase in the buyer's premium at the lower end in 1992, and a further increase in the threshold in 2000. Based on the major changes, we have also re-estimated Table I and III to gauge the effects of price estimates for four distinct sample periods: 1973 to 1978, 1979 to 1992, 1993 to 1999, and 2000 to 2002 by using the whole sample. We observe a large increase in the effect on sale price as reported in Table I after 1979, when the seller's commission was added. But the incremental effects from later fee increases were not as distinct. While there is also some difference in the point estimates on the impact of price estimates on purchase price, they are not significant. These results are available upon request.

[14]In the second exercise, we use prices deflated by the US CPI index, since the nominal value of art may change due to inflation.

[15] An interesting result from Table III is that the negative impact of auctioneer presale price estimates seems to be highest for Old Masters. Given the fact that Old Master paintings, on average, were created much earlier than American and Impressionist paintings, investors will tend to have less information about them. There is a wider difference of opinion as to authenticity, quality and condition for many of the works of art created 200 to 400 years ago than there would be about works created 50 to 125 years ago. Most major Old Master pictures are in museums, so more of the work available is by lesser-known artists. However, the supply of Impressionist and Modern work by the well-known masters is still abundant. Thus, the buying public has less need for expert advice on who is important. As a result, it might be easier for auctioneers to use their "expertise" to sway potential investors in the Old Master market. Thus, our results are consistent with the view that investors are more credulous when they have less information. In an earlier version of the paper, we also added an overpayment term (paying more than original purchase price inflated by the art market index) to the regression (5) and found that a 1% over-payment on Old Master Painting tends to reduce future return by 0.24%! This result is available upon request.

[16] See Rajan and Servaes (1997) for a detailed discussion on the difficulty of separating the two in the IPO literature.

[17] Pesando's (1993) discovery was based on repeated sales of modern prints from 1977 to 1992. Since his data only cover prints that tend to have much lower value when compared to American, and Old Master and Impressionist paintings, one may wonder if this underperformance exists for truly expensive artworks. Using repeated sales data covering American, Old Master and Impressionist and Modern paintings, Mei and Moses (2002) further examined the performance of masterpieces. They found strong evidence of the underperformance of masterpieces.

[18] While the auction houses may want to mislead more at the high end, they are constrained by the ability of high-end buyers to acquire information via expert opinion. But this ability is hindered by a relative lack of time and attention, since the high-end buyers are likely to have many more investment opportunities than low-end buyers. So they may not want to spend scarce time to find out who is a "trustworthy" expert in the field and work out an incentive compatible arrangement to acquire her service. The finite information processing capacity implies a need for imperfect, or heuristic, decision making procedures (see, for example., Tversky and Kahneman (1974), Daniel, Hirshleifer, and Teoh (2002)). This heuristic simplification may imply heavy dependence on auction house estimates (salience and availability effects, i.e., focus on information that stands out or is often mentioned, See Hirshleifer (2001) for a detailed discussion on heuristic simplification). It is also worth noting that the expert might be subject to agency problems similar to stock analysts. Stock recommendations are predominantly buys over sells, by a 7 to 1 ratio (e.g., Womack, 1996). A similar bias would imply an upward bias of price estimates by art experts. This is especially the case if they are paid by a percentage of purchase prices.

[19] See Daniel, Hirshleifer, and Teoh (2002) for further discussion.

[20] The expert's job is meant basically to reduce the range and weight in the tails of the density function of prices for a work of art. The data in Table II tends to bear this out. The standard deviation of the objects sold during the era of no estimates (B 1 T0 2) 27.02 is much higher than the standard deviation of returns during the era of estimates (A 2 T0 3) 14.41.

[21] We have also compared the fall in excess returns for masterpieces and non-masterpieces after 1973. For the three individual collecting categories, the fall in masterpiece excess return exceeds that of non-masterpieces by 1.5%, 15%, and 1.1%, respectively. But the difference was only significant for Impressionists. The test result reverses, however, when we combine all collecting categories. This is partly due to a high initial α for non-masterpieces and also the fact that we impose the restriction that all collecting categories have the same beta.

[22] By the same token, $\sigma_{2,\varepsilon}^2 = \sum_{b_i > 1972} \left(\eta_i^2 \big/ s_i - b_i \right) \Big/ N_2$, where N_2 is the total number of paintings bought after 1973.

[23] $F_1 = \sigma_{1,NM}^2 \big/ \sigma_{1,M}^2$ and $F_2 = \sigma_{2,NM}^2 \big/ \sigma_{2,M}^2$.

[24] Using the equally-weighted liquidity factor yields similar results, and they are available upon request.

[25] The impact of overbidding would exactly offset each other if the overbidding is proportional to prices.

[26] Here we will drop those paintings with missing price estimates. As a result, we have 58 paintings in the masterpiece group and 110 paintings in the non-masterpiece group.

[27] The same results also hold for the non-masterpieces in Panel B but not in Panel A. Both are insignificant.

[28] More generally, our results also hold if the condition of sale is $y_i > f(P_{i,s}^H, P_{i,s}^L)$.