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ABSTRACT

Art Auctions: A Survey of Empirical Studies*

This Paper contains a review of the burgeoning research that has been designed to shed light on how the art auction system actually works and what it indicates about price formation. First, we find that in recent years returns on art assets appear to be little different from returns on other assets. In addition, some researchers have found that because of the weak correlation between art asset returns with other returns, there may be a case for the inclusion of art assets in a diversified portfolio. Second, we find evidence of several anomalies in art market pricing. The evidence clearly suggests that, contrary to the view of the art trade, 'masterpieces' under-perform the market. In addition, there is considerable evidence that there are fairly long periods in which art prices may diverge across geographic areas and even auction houses. Third, we review the public record of the criminal trial of Sotheby's former Chairman, who was accused of price fixing, to show how the collusion with Christie's, the other great public auction house, was actually engineered. Contrary to the way the proceeds from the settlement of the civil suit in this case were distributed, we show that buyers were almost certainly not injured by the collusion, but that sellers were. In addition, based on the public record of settlement, it appears that the plaintiffs in the civil suit were very handsomely repaid for their injury. Finally, we review the extensive research on the effects of the auction institution on price formation. There is now considerable theoretical research on strategic behaviour in auctions, much of it in response to empirical findings, and we review three key findings. First, the evidence suggests that art experts provide extremely accurate predictions of market prices, but that these predictions do not optimally process the publicly available information. Second, high reserve prices, and the resulting high unsold ('buy- in') rates are best explained as optimal search in the face of stochastic demand. Third, extensive research has documented that the prices of identical objects are more likely to decline than to increase when multiple units are sold, and this has led to considerable theoretical research. Subsequent empirical research has tended to document declining demand prices even when the objects are imperfect substitutes.

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Keywords: art, asset pricing, auctions, price anomalies and price-fixing

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Submitted 05 April 2002

The value of most important works of art is established by public auction, either directly, by an actual sale, or indirectly, by reference to other sales. How the auction system works is thus a critical determinant of how the public's preferences are translated into the evaluation of artistic work. The auction system is thus central in the determination of the incentives for artistic work, and the efficiency of the auction system is a key determinant of the cost of creating and distributing works of art.

This paper contains a review of the burgeoning new research of the last decade that has been designed to shed light on how the art auction system actually works, what it indicates about price formation, and how well it performs. We begin the paper with a description of the mechanics of the auction system. We organize the remainder of our discussion around four major topics. First, we review what the data have shown about movements of art asset prices over time. Art objects are generally unique, so that measuring time-series movements in their prices requires careful measurement and extensive data. A primary goal of the measurement of time-series movements in art prices is to evaluate the benefits of including art assets in a balanced investment portfolio, and we review the key findings on this topic next. We find that in recent years returns on art assets appear to be little different from returns on other assets. In addition, some researchers have recently found that because of the weak correlation between art asset returns with other returns, there may be a case for the inclusion of art assets in a diversified portfolio. Since the key parameters for making this decision are difficult to estimate, this issue deserves far more research.

A second primary topic is the study of potential anomalies in art market pricing. The evidence clearly suggests that, contrary to the view of the art trade, "masterpieces" underperform the market, although the precise interpretation of this finding is still open for study. In addition, there is considerable evidence that there

are fairly long periods in which art prices may diverge across geographic areas and even auction houses.

A third area of research, where public interest has been particularly great in the past few years, is the role of the competitive behavior of the auction houses in the determination of prices. We review the public record of the criminal trial of Sotheby's former Chairman, who was accused of price fixing, to show how the collusion with Christie's, the other great public auction house, was actually engineered. Contrary to the way the proceeds from the settlement of the civil suit in this case were distributed, we show that buyers were almost certainly not injured by the collusion, but that sellers were. In addition, based on the public record of settlement, it appears that the plaintiffs in the civil suit were very handsomely repaid for their injury by the auction houses.

Finally, we review the extensive research on the effects of the auction institution on price formation. There is now considerable theoretical research on strategic behavior in auctions, much of it in response to empirical findings, and we review three key findings. First, the evidence suggests that art experts provide extremely accurate predictions of market prices, but that these predictions do not optimally process the publicly available information. Second, high reserve prices, and the resulting high unsold ("buy-in") rates are best explained as optimal search in the face of stochastic demand. Third, extensive research has documented that the prices of identical objects are more likely to decline than to increase when multiple units are sold, and this has led to considerable theoretical research. Subsequent empirical research has tended to document declining demand prices even when the objects are imperfect substitutes, although the empirical analysis required in this case must be much more sophisticated.

1. The Mechanics of Art Auctions

Historically, the major auctioneers of art have been the English houses of Sotheby's and Christie's. These houses, along with other smaller houses such as Phillips in England and regional auction houses elsewhere, such as Butterfields in California, have invented and refined the rules of what have now come to be called "English" or "ascending price" auctions. Almost all art is auctioned in this ascending price format. Bidding starts low, and the auctioneer subsequently calls out higher and higher prices.[1] When the bidding stops, the item is said to be "knocked down" or "hammered down", and the final price is the "hammer price."

Not all items that have been put up for sale and "knocked down" have been sold. Sellers of individual items will set a secret reserve price, and if the bidding does not reach this level, the items will go unsold. Auctioneers say that an unsold item has been "bought-in." As we show below, sale rates vary tremendously across time and across different types of auctions

An item that has not been sold is rarely, if ever, actually bought by the auction house. It may be put up for sale at a later auction, sold elsewhere, or taken off the market. It is a part of the auctioneer's art to "get the bidding started," and this may involve accepting fictitious bids ("off the chandelier" or "from the order book") so long as the bidding has not exceeded the reserve price. Legally, the auctioneer is bidding on behalf of the seller when this occurs, but must refrain from accepting further bids on behalf of the seller once the bidding exceeds the reserve price.

Auction houses differ with respect to whether they announce during the sale whether an item has been "sold" or is merely "knocked down" and is unsold. In New York, all the auction houses have been compelled by law since the early 1980s to

announce whether the bidding has resulted in a sale. The practice elsewhere varies by location and auction house, but there has clearly been a slow movement toward adopting the practice originally enacted by law in New York. While difficult, it is sometimes possible during an auction, if one listens carefully, to determine whether an item has been sold or "bought in."

Prior to an auction, it is common for a pre-sale catalogue to be published with information on the individual items coming up for sale. Included in the pre-sale catalogue is information on the title of a painting, the artist, the size of the painting, and the medium. The auction houses also publish a low- and a high-price estimate for the work. The auction house does not publish, and indeed is very secretive about, the seller's reserve price for the work of art. The auction houses do commonly observe an unwritten rule of setting the secret reserve price at or below the low estimate, but the auctioneer is very careful about revealing anything about the reserve price during the bidding process.

Auction houses earn income primarily from commissions charged to buyers and sellers. The commission charged to buyers is called the "buyer's premium." The total sale price to the buyer is thus the sum of the "hammer price" and the buyer's premium. In recent years published buyer's premiums have typically hovered around 10% to 17.5% of the hammer price of an object, but they are often lower for large purchasers. Although buyers may attempt to negotiate special arrangements regarding buyer's premiums, it is our impression that the typical buyer purchases such a small fraction of the objects on sale at a particular auction house that special terms for buyers are unusual.

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[1] What is called an English auction is, in fact, Roman. The word auction comes from the Latin "auctio," which means to ascend.

Sellers also pay a commission to the auction house called the ”seller’s commission.” Although the seller’s commission is often stated as a percentage of the hammer price (typically 10%), it is our impression that actual seller’s commissions are often negotiated arrangements that differ by seller. In some cases, sellers pay no commission and may even be guaranteed a minimum sale price. Some key issues related to the negotiation of seller’s commissions, and the extent of competition and collusion in the setting of commission rates have recently surfaced in the trial of Alfred Taubman, former Chairman of Sotheby’s, who was convicted of price fixing. We discuss issues related to competition among auction houses in more detail below.

2. Art Price Indices

A key feature of art auctions is that the items on sale are typically unique, or nearly so. The result is that there will be some ambiguity in the construction of a single index of the movement of prices over time. One concern about simply using average prices is that price rises may be exacerbated during booms as “better” paintings may come up for sale. For example, Wynne Kramarsky, whose family formerly owned Van Gogh’s “Portrait of Dr. Gachet,” said of the London market prior to the poor sale of May 15, 1990: “’I did not think that London was poor in terms of performance; I thought that the pictures were not up to it.’” (Watson, 1992, p.10) In general average prices will indicate variability over time in art prices that is better described as movements in the heterogeneity of the quality of the objects offered rather than movements in prices.

The extent of heterogeneity, and thus the ambiguity in the construction of auction price indices, differs across the items typically offered for sale by auction. Identical prints may be offered for sale monthly, while identical Impressionist

paintings, such as the “Portrait of Dr. Gachet” may not be offered at all in a single decade.

Most art auction indices are based on a model where the price of the ith object sold in time period t is

$$p_{it}=p_i+p_t+e_{it},$$

where p_i is the fixed component of the price that reflects the unique and fixed character (or “quality”) of the object, p_t reflects the index of aggregate movements in prices, and the remainder is an idiosyncratic error term. The key distinction in the construction of price indices is whether the fixed component is treated as determined by a small number of hedonic characteristics, x, that may be controlled by regression, or whether it is treated as a parameter that must be controlled explicitly.

“Hedonic models” control for the fixed effect p_i with the assumption that $p_i=ßx_i + e_i$, where e_i is an error term independent of the p_t’s, and estimate

$$p_{it}=ßx_i+p_t+ e_i + e_{it}$$

Alternatively, “repeat sale” models include a dummy variable for each painting.

The great attraction of hedonic models is that all the data may be used in the estimation, including data on objects that are only offered for sale once in the sample period. The disadvantage of these models is the strong assumption that a (typically small) set of x variables captures much of the variability in the fixed components of price (important if the estimates of the time effects are to be precise) and that the characteristics of the objects offered do not vary systematically over time (important for unbiased estimates of the time effects). Although the repeat sale method overcomes the primary disadvantages of the hedonic model, it does so at the cost of discarding much data. There must be at least two observations on a painting’s price or it provides no information to help identify the time index. Indeed, depending on the

frequency at which repeat sales occur, it may not be possible to identify all the time effects in the model. For example, in our own data on Impressionist and Modern paintings, our hedonic model incorporates as many as 8792 observations, while the repeat sale estimates are based on only 474 observations.

Comparisons of the results from repeat sale and hedonic models have been reported by Chanel, Gerard-Varet, and Ginsburgh (1996). The overall results indicate that both hedonic and repeat sales regressions yield estimates of real rates of return in art assets over long intervals that are the same magnitude. In some cases the hedonic model may also provide adequate estimates of time-series movements in aggregate prices. The danger remains that systematic movements in the unobserved characteristics of the objects being offered for sale may bias the results.

The nature of possible systematic movements is made clear when we do a detailed comparison using our data on Impressionist and Modern Art. When yearly price indices are constructed, the two types of indices at first appearance are very similar. Figure 1 presents a graph of the hedonic and repeat sales price indices for Impressionist and Modern art from 1980 to 1991. The correlation between the two estimates is .9559, the standard deviation of the hedonic price index is 1.024, and the standard deviation of the repeat sales index is 1.166. However, because of movements in the very last year, the two indices give very different internal rates of return. The hedonic index gives a real return of about 4%, while the repeat sales price index results in a real return of about 9%! Which is correct? For 1991, our data ends in May. The "major" impressionist sales are generally held in October. One explanation is that the hedonic index has underestimated the returns for this short period of time, because it was unable to correct for quality differences that occur during sales in the early part of the year. An alternative explanation is that because

the repeat-sales index is based on such a small number of paintings during that period, these paintings were unrepresentative (i.e. their price held up better in poor market conditions) of the market as a whole.

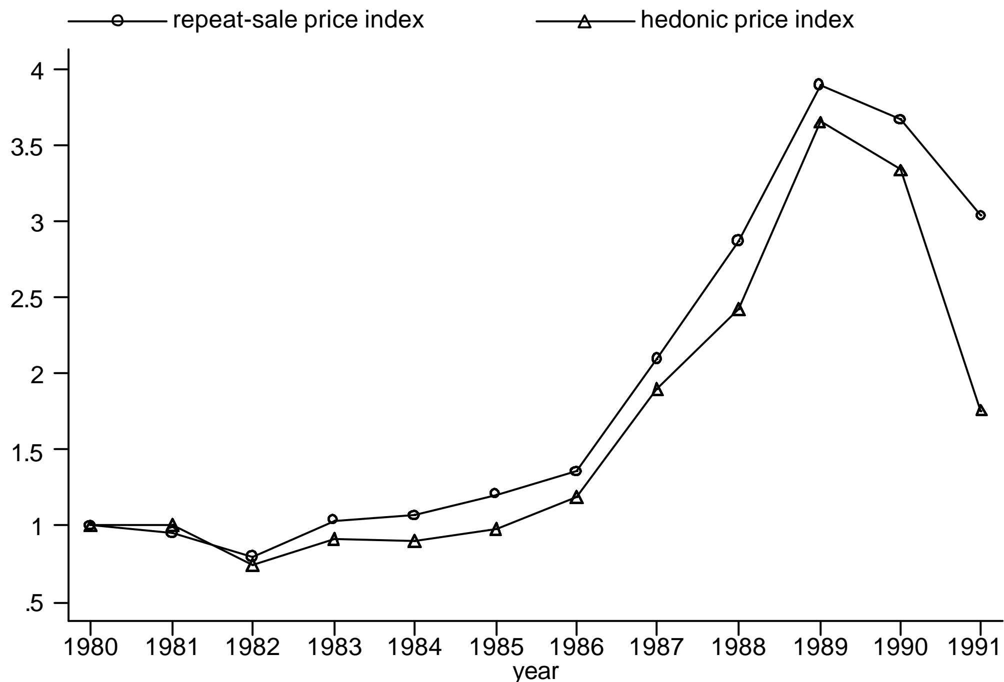

Figure 1: Repeat-Sales and Hedonic Indices for Impressionist Art

One can also measure the extent to which one type of index deviates from the other. Suppose, for example, that the repeat sales index, x, is the true index, and x* is a measured hedonic index, where

$$x^* = x + v^*$$

If x were not measured with error then a regression of x* on x would give a slope of unity. If not, the difference from unity provides an estimate of the measurement error as a fraction of the total variance in the hedonic index. (A more complex model would have x measured with error, but uncorrelated with v*, say as a result of sampling error.) Computing the above regression, we find that x has a coefficient of .8400, and a standard error of .086, thus indicating statistically significant measurement error. The implication is that about 16% of the variance in the hedonic measure of prices is measurement error.

Other studies that have calculated price indices for art include Stein (1977), Baumol (1986), Frey and Pommerehne (1989), Buelens and Ginsburgh (1993), Pesando (1993), Goetzmann (1993), Barre, Docclo, and Ginsburgh (1996), and Mei and Moses (2001). The details of these studies and the estimated rates of return on art assets they contain are presented in Table 1.

Table 1
Estimated Returns to Art from Various Studies

Author	Sample	Method	Nominal return	Real return
Anderson (1974)	1780-1960:Art	hedonic	3.30%	2.6%*
	1780-1970:Art	repeat sales	3.70%	3.0%*
Stein (1977)	1946-1968	assumes random sampling	10.50%	
Baumol (1986)	1652-1961:Art	repeat sales		0.55%
Frey and Pommerehne (1989)	1635-1949	repeat sales		1.40%
	1950-1987	repeat sales		1.70%
Buelens and Ginsburgh (1992)	1700-1961	hedonic		0.91%
Pesando (1993)	1977-1991: Modern Prints	repeat sales		1.51%
Goetzmann (1993)	1716-1986: Art	repeat sales	3.2	2.0%*
Barre, et. al. (1996)	1962-1991: Masters	hedonic	12%	5%*
Barre, et. al. (1996)	1962-1991: Other	hedonic	8%	1%*
Chanel, et. al. (1996)	1855-1969	hedonic		4.9%
Chanel, et. al. (1996)	1855-1969	repeat sales		5%
Mei and Moses (2001)	1875-2000:Art	repeat sales		4.90%
Graeser (1993)	1967-1986: Antique Furniture	neither**	7.00%	
Ross and Zondervan (1993)	1803-1986: Stradivari Violins	hedonic		2.2
Frey and Eichenberger (1995)	A survey			

*As many of the surveys only report nominal returns, the authors calculated the real return rates as follows. For the Anderson and Baumol studies, an inflation rate of .7 percent a year was used. This number is based on Baumol's estimate of inflation during the 300 year period of his study using the Phelps-Brown and Hopkins price index. Goetzmann's estimate of inflation during the period of his study (also based on Phelps-Brown and Hopkins) is 1.2%. French price inflation between 1962 and 1992 according to OECD statistics was 7%.

**Assumes random sampling within a portfolio of fixed furniture types.

The estimated returns to holding art are quite dependent upon the time frame actually studied, which is not unexpected.[2] Even among authors looking at similar time frames, the returns can vary. The variation reflects differences in data, along with differences in method. It is difficult to come to any broad conclusions about the differences in estimates when using repeat-sales or hedonic indices. Anderson (1974) finds a real return of 2.6% using hedonic indices and 3.0% using repeat sales on art data from 1780-1960, and Chanel et. al. (1996) find real returns of 4.9% and 5.0% for hedonic and repeat sales indices, respectively, for the period 1855-1969.

3. Art as an Investment

A primary concern of many of these papers is whether art outperforms or underperforms stocks and bonds and the correlation of art investment returns with other investment portfolios. Once a rate of return on art assets is calculated based on one of the price indices above, it is possible to use this return to decide whether it may be sensible to include art investments in a diversified portfolio. Generally, art investments are more attractive as investments (using the standard capital asset pricing model) the greater is their return relative to the return on a risk free asset and the weaker the correlation (or beta) between art investment returns and the return on other assets. Pesando (1993) has used the standard market model to assess these two characteristics of art investments in the case of modern prints. Pesando estimates the model:

$$R_t^P - r_{f,t} = a + ß(R_{m,t} - r_{f,t}) + u_t$$

where R_t^P denotes the return on the print portfolio, $R_{m,t}$ denotes the return on the market portfolio (Pesando uses the S&P 500 stock index), and $r_{f,t}$ denotes the risk free rate (Pesando uses 180-day Treasury Bills). Pesando estimates a ß for the entire print

[2] For example, Goetzmann (1996) (not included in Table 1) estimates real returns from 1907-1977 on

portfolio of .315 and estimates negative, but insignificant, risk adjusted returns. This implies that print investments tend to reduce the riskiness of a portfolio comprised of stocks only.

Determining whether art outperforms or underperforms a market portfolio is not an easy question to address. First of all, as Goetzmann (1993) points out, there are many problems with the calculation of the returns to art, beginning with selection bias in the data. As all of the sales prices are drawn from auction records, only paintings that have been re-auctioned are included. This excludes both the high end and the low end of the return distribution. Paintings that fall drastically in value or are not generally in demand are generally not resold at auction; in addition, paintings that are donated to museums do not reappear. Furthermore, whether or not an owner decides to sell a painting at auction may be determined by whether or not the painting has increased in value. Other problems with estimating returns are that transaction costs are excluded and in contrast to stocks and bonds, as we noted above, these can be quite high (as much as 25% of the value of the object considering both buyer's premiums and seller's premiums). Finally, there is significant theft and fire risk (and hence insurance costs) and cleaning costs involved in investing in art.

On the other hand, unlike stocks and bonds, art also pays some dividends in the form of the pleasure the viewer (and owner) receives. In principle, the value of these dividends could be measured by the rental cost of similar art assets, but we are unaware of any study that has attempted to do this. Moreover, it seems unlikely that these returns would be significant for a large, diversified art portfolio that is not displayed.

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auction data to be 13.3%, and even after correcting for survivorship problems, the returns remain at 5%.

Baumol (1986) and Goetzmann (1993) tend to concur that art is dominated as an investment vehicle. Goetzmann writes "While returns to art investment have exceeded inflation for long periods, and returns in the second half of the 20th century have rivalled the stock market, they are no higher than would be justified by the extraordinary risks they represent." Goetzmann (1993) does not formally estimate a CAPM, but simply reports correlations of art returns with inflation, the Bank of England Rate, consol bond returns, and the London Stock Exchange.

Although their estimates of the return to art are not significantly different from previous estimates, Mei and Moses (2001) take a different view. They argue that "a diversified portfolio of artworks may play a somewhat more important role in portfolio diversification than discovered in earlier research." They base their conclusions on their finding that their art price index has lower volatility and a much lower correlation with other asset classes than reported in previous research. They report that these differences are partly due to sample selection and partly due to a different time frame studied. Although Mei and Moses (2001) estimate a more sophisticated form of CAPM than has previously been estimated for art, they primarily base their conclusions on their estimates of the art index and simple correlations with bond and stock portfolios.[3]

Thus, it appears that different views about the financial benefits of investments in art assets are primarily based on empirical issues that revolve, in part, around the temporal instability and sensitivity of the estimates of key parameters related to the

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[3] For the CAPM, Mei and Moses follow Campbell (1987) and estimate

$$r_{i,t+1} = E_t[r_{i,t+1}] + ?_{k=1}^{K} ß_{ik} f_{k,t+1} + e_{i,t+1},$$

where $r_{i,t+1}$ is the excess return on asset I held from time t to time t+1. $E_t[r_{i,t+1}]$ is the conditional expected return on asset, conditional on information known to market participants at the end of time period t. It is allowed to vary over time (see Mei and Moses (2001) for details). $f_{k,t+1}$ are excess returns on k different asset classes.

market performance of art investments. This suggests that an important area for additional research is the development of a more general empirical model that will provide an explanation for temporal instability and thus lead to better-informed decisions.

Some authors have looked at the financial returns to holding other collectible items. For example, Ross and Zondervan (1989) estimate the real returns to holding Stradivari Violins between 1803 and 1987 to be 2.2%, and Graeser (1993) estimates returns to holding antique furniture between 1967 and 1986 to be 7%. For a very good survey of papers calculating the rate of returns in various markets, see Frey and Eichenberger (1995).

4. The Masterpiece Effect

Pesando (1993) describes the "Masterpiece Effect" by quoting art dealer Edward Merrin: "`…it's always better to buy one $10,000 object than ten $1,000 objects, or one $100,000 object --- if that is what you can afford---than ten $10,000 ones.'"[4] There have now been several authors who have tested for the masterpiece effect.

Pesando tests for the effect by constructing a portfolio of the top 10 or 20% of prints by price, where price is determined during the first few years of his sample. If the "art trade" view is correct, the estimated price indices for these "Masterpieces" should uniformly outperform the general portfolio. He finds no support for this view and in fact finds that in part of his sample, masterpieces provide the lowest cumulative return. Mei and Moses (2001) find a similar negative effect for masterpieces, and in fact find this effect to be uniform across American, Impressionist and Old Master samples.

[4] Quote originally taken from *Art and Auction* ["Antiques"], September 1988, p. 131.

Using our data on Impressionist and Contemporary Art, we find that it does appear that "Masterpieces" have underperformed in the Contemporary Art sample, but not in the Impressionist Art sample. We construct our index by dividing each sample into the top 20% of paintings sold by price, and the bottom 80% sold by price, and then construct a hedonic index. Our index is charted in Figures 1 and 2. We find similar results to Pesando and Mei and Moses in Contemporary Art, but find no effects in Impressionist Art. For Contemporary Art, "Masterpieces" underperform the lower-valued paintings by about 5% on average per year, which is quite significant. There does not appear to be a difference for the Impressionist Art dataset. The latter result may not be inconsistent with the findings of others as the Impressionist Art data consists of paintings that have already been pre-selected to represent the Impressionist artists that show up most at auction. These are among the best known painters of all time and it may be that virtually all of their paintings are considered masterpieces.

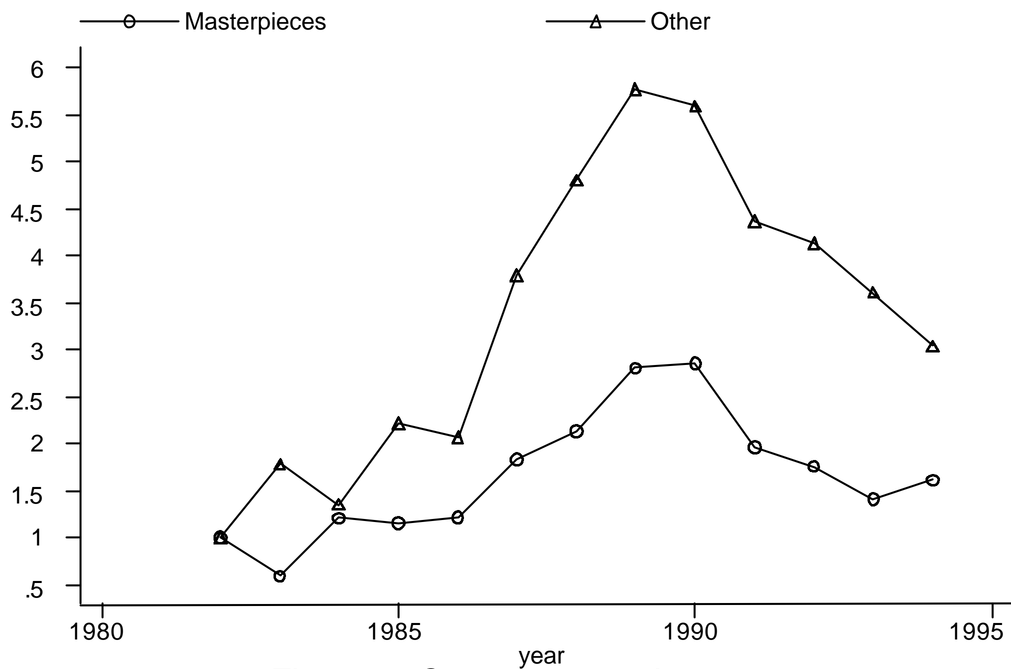

Figure 2: Contemporary Art

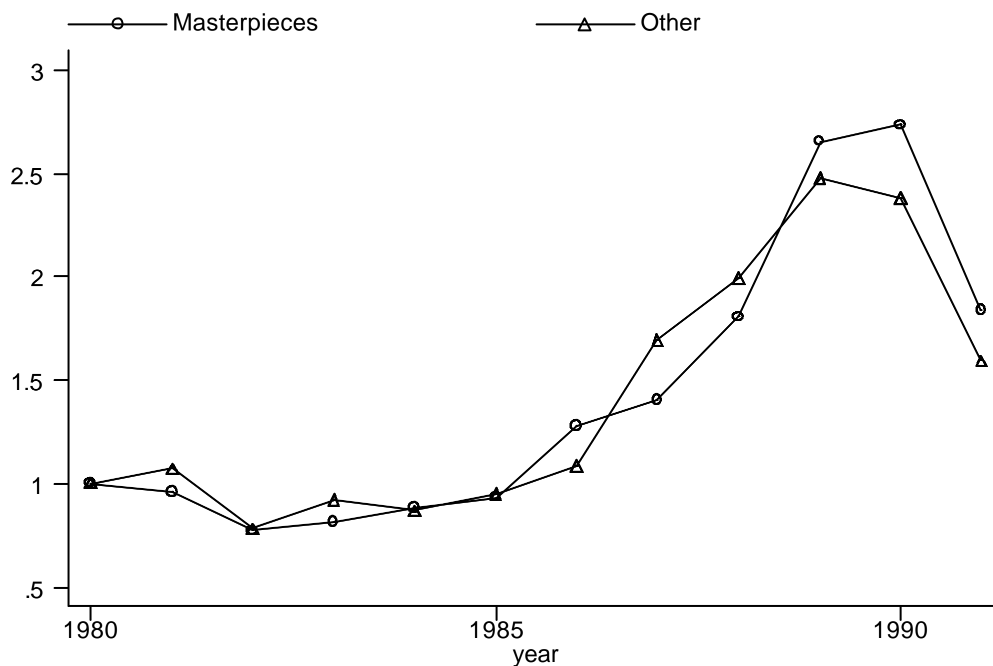

Figure 3: Impressionist Art

Pesando provides no explanation for the "Masterpiece Effect." Mei and Moses (2001) speculate that it may be due to overbidding and then mean reversion. This explanation appears quite reasonable given the way that various studies above have defined "Masterpieces" as the highest price paintings that were sold. If a "Masterpiece" is defined purely by price, there may be some paintings in the

“Masterpiece” sample that randomly commanded a higher price, perhaps because two or more bidders had high private valuations for the paintings. At a later auction, the prices on these paintings revert to the mean, thus resulting in a negative “Masterpiece” effect.

A different explanation for the negative “Masterpiece Effect” may be what Goetzmann (1996) terms “survivorship bias.” It is likely that the more expensive paintings remained in the sample throughout, even if they decreased in value, whereas less expensive paintings have dropped out of the sample. Hence it may appear that “Masterpieces” have underperformed in the sampled data, but in actuality less expensive paintings that have underperformed are no longer in the sample. The result that our sample shows a “Masterpiece” effect for Contemporary Art but no “Masterpiece” effect for Impressionist art tends to support the “survivorship bias” explanation, due to the way the two samples were constructed. A summary of papers estimating a “Masterpiece Effect” is presented in Table 2 below.

Table 2
The "Masterpiece Effect"

Author	Result
Pesando (1993)	A negative "masterpiece effect"
Mei and Moses (2001)	A negative "masterpiece effect"
Ashenfelter and Graddy	A negative "masterpiece effect" for contemporary art No "masterpiece effect" for impressionist and modern art

5. Is There Evidence that Paintings are “Burned?”

As Ashenfelter (1989) noted, it is often claimed that when an advertised item goes unsold at auction, its future value will be affected. Such items are said to have been “burned.” There has been surprisingly little work testing this proposition.

Using our repeat sales data on impressionist art, we present summary statistics of artworks that appear twice in the data. We have looked at whether there appear to be any differences in prices and estimates for paintings that came to auction and did not sell during their first appearance at auction, but sold during their second appearance at auction (unsold-sold sample), vs. those that came to auction, sold during their first appearance, and were resold again during their second appearance at auction. We do this by comparing the ratio of the estimate a painting during its second appearance at auction to the estimate of the same painting during its first appearance at auction (estimate 2/estimate 1) and by comparing the ratio of the sale price during the painting's second appearance at auction to the estimate of the painting during its first appearance at auction (sale price 2/estimate 1). We average these over the unsold-sold sample and the sold-sold sample. We do not correct for the level of the art price index when the paintings came to market; hence, any results are only suggestive.

As reported in Table 3, we find a significant difference between the unsold-sold sample and the sold-sold sample. We find that the sale price in the second sale is on average 1.75 the estimate in the first sale, if the painting was unsold in the first sale, and the sale price in the second sale is on average 3.77 the estimate in the first sale, if the painting was sold in the first sale. Furthermore, it takes much longer for paintings to reappear in the sample if they have been sold the first time around than if they went unsold the first time around. These results do not necessarily indicate that paintings that are bought-in are "burned," and may simply indicate that paintings that reappear in the sample tend to reappear because they have increased in value. Nonetheless, the results are

suggestive.

Table 3
Repeat Sales of Sold vs. Unsold Paintings

	Estimate 2/ Estimate 1	Sale Price 2/ Estimate 1	Days Between Sales	Estimate 1	No. in Sample
Unsold-Sold Sample	1.41	1.75	768	83673	178
	(2.13)	(2.51)	(642)	(131526)	
Sold-Sold Sample	4.71	3.77	1167	201224	231
	(12.84)	(9.85)	(791)	(762936)	
t-statistic (comparing unsold-sold sample with sold-sold sample)	3.14	3.01	5.33	2.01	

standard deviations in parentheses

6. Competition (or Collusion) Between Auction Houses

Prior to 1995, Sotheby's and Christie's were in fierce competition for consignments from sellers. At times, they would drastically cut commission rates paid by sellers, in many cases to nothing, make donations to sellers' favourite charities, and even extend financial guarantees to the sellers. In March of 1995, this competition abruptly ended. Christie's announced that it would charge sellers a fixed nonnegotiable sliding-scale commission on the sales price, and a month later Sotheby's announced the same policies. Detailed documents kept by Christopher Davidge, Christie's former chief executive, show that the abrupt change was due to a price-fixing conspiracy. By admission, the conspiracy involved at least Christopher Davidge and Diana Brooks, Sotheby's chief executive, and it was alleged to have involved Sir Anthony Tennant and A. Alfred Taubman, the chairmen of Christie's and Sotheby's, respectively. In fact, after a lengthy criminal trial, Taubman, a U.S. citizen, was convicted of price fixing, which is a felony in the U.S. Although

Tennant, a UK citizen, was also indicted in the U.S., price fixing is a civil offence in the United Kingdom and thus he was not extradited or tried. Christopher Davidge (and in some cases Sir Anthony Tennant) had kept detailed records describing the conspiracy. A civil suit, which has been settled, also alleged that Christie's and Sotheby's conspired since 1993 to fix buyer's commissions. Because it ended in a public trial, this lawsuit provides an extraordinary window for viewing the operation of successful price conspirators.

The case progressed as follows (see especially Stewart (2001) for a detailed description). The Justice Department agreed in January of 2000 not to prosecute Christie's in return for its cooperation in the case. Diana Brooks, former president and chief executive of Sotheby's, pleaded guilty to one felony count of price-fixing on October 5, 2000, and promised to cooperate fully in the government's investigation. In September of 2001, Sotheby's agreed to plead guilty to conspiring with Christie's to fix sellers' commissions, and agreed to pay a fine of forty-five million dollars over five years. Sotheby's maintains their innocence with respect to fixing buyer's premiums. Also in September of 2001, a civil suit was settled where Sotheby's and Christie's agreed to each pay two hundred and fifty-six million dollars to the plaintiffs. This class-action suit comprises anyone who had bought or sold items through the auction houses since 1993.

From an economist's point of view, the settlement of the civil suit is interesting, but appears to be misguided. Although Sotheby's did not admit to fixing buyer's premiums in the criminal settlement of the case, both Christie's and Sotheby's agreed to each pay $256M to both buyers and sellers. This amount was calculated taking the price-fixing of buyer's premiums into account. According to *In Re Auction Houses Antitrust Litigation* (2001), "The proposed plan of allocation estimated the

overcharges to sellers as 1 percent of the hammer price, and those for buyers to be 5 percent of the hammer price up to and including hammer prices of $50,000, and $2,500 for buyers at hammer prices exceeding $50,000. The net settlement fund would be distributed to class members pro rata based upon each class member's overcharges during the relevant period."

Even if Sotheby's and Christie's admitted to colluding on buyer's premiums, the usual theory of private value auctions implies that, to first order, buyers deserve no compensation! The following is the reason why. When a buyer decides to bid in an ascending price auction, his strategy should be to bid up to his reservation price, if necessary. The price that the winning bidder has to pay is essentially (epsilon above) the reservation price of the second highest bidder. When buyer's commissions are raised, each buyer should reduce his reservation price by an equivalent amount, resulting in a reduction in revenue to the seller by the amount of the buyer's commission. Hence, the entire increase in buyers' commissions should fall on the seller. Thus, the standard model of private value auctions implies that the entire settlement arrangement in the civil suit was misguided!

The criminal trial of Alfred Taubman, previously Chairman of Sotheby's Board, in the fall of 2001 provided some dramatic revelations about the details surrounding the price fixing. Many of these details were provided in the testimony of Diana Brooks, previously President of Sotheby's. First, although remarkably candid about her role in the fixing of seller's commissions, Ms. Brooks did not provide any evidence of collusion with respect to buyer's premiums. Second, Ms. Brooks estimated that the collusion on seller's commissions resulted in higher profits to Sotheby's of some $10 to $15 million per year. Assuming that Christie's received the same increased profits implies that total damages suffered by sellers would be on the

order of $20 to $30 million per year. Assuming the conspiracy lasted 5 years (approximately the time period involved) suggests total damages of $100 to $150 million. Since price fixing damages are, by statute, tripled, it appears that the plaintiffs were more than amply compensated for the harm they incurred.

Finally, the details of the arrangement for price fixing revealed by Ms. Brooks suggest that great care was ensured to keep virtually all other employees of the auction houses from learning of the conspiracy. Taubman met solely with Tennant, and Brooks solely with Davidge in arranging the details of the conspiracy. Indeed, Brooks reported that at one point Taubman proposed that the auction houses collude in providing clients with similar estimates of the value of their art. Brooks reported that this was impossible because she could not simply tell Christie's departmental experts, who produce the estimates, to do a dishonest job.

7. The Law of One Price

The effect of the changes in sellers' commissions and buyers' premiums that occurred during the 1990's may provide an interesting subject for study by economists. Ashenfelter (1989) studied changes in buyers' premiums on the final price of wine at auction. In the spring of 1986, buyer's premiums were 10% at Sotheby's London (and at other locations), but Christie's in London had no buyer's premium. In the spring of 1986, prices at Sotheby's in London were 12% less than prices at Christie's in London, likely reflecting the difference in buyers' commissions. In the fall of 1986, Christie's had instituted a 10% buyer's premium in the London auctions. In auctions held in the fall of 1986, there was no difference in prices, while in an auction held in the spring of 1987, prices at Sotheby's in London were 5% higher than at Christie's, and in the fall of 1987, prices at Sotheby's in London were

4% lower than at Christie's. These results indicate that the incidence of the buyer's premium does tend to fall on the sellers.

Other authors have looked at price differences between auction houses and between different markets. Pesando (1993) focused on the sale of identical prints in different markets which occur within 30 days of each other for the period 1977-1992. For the entire period, he found that prices were 7% higher in New York than in London, and 10% higher in New York than in Europe. However, the difference was not statistically significant for the period 1977-1989, while it was statistically significant at 11% and 17% in comparisons of New York and London and New York and Europe, respectively, between 1989 and 1992. Pesando (1993) describes the trade explanation as being the presence of Japanese buyers in the New York market during that period, though one would expect any systematic price differences to disappear when buyers respond to incentives. Pesando also finds significant differences among auction houses. For the entire period, Pesando found that prices average 14 percent higher in Sotheby's in New York than at Christie's in New York, but there was no difference in the prices of prints at Sotheby's and Christie's in London.

Using a price index for all art, Mei and Moses (2001) find mixed evidence on the law of one price. When they do find price differences, these differences tend to be small. A summary of papers testing for the law of one price is presented in Table 4 below.

The Law of One Price

Author	Result
Ashenfelter (1989)	Differences in prices reflect differences in commission rates
Pesando (1993)	Prices average 14% higher at Sotheby's NY than at Christie's NY Prices were 7% higher in New York than in London Prices were 10% higher in New york than in Europe
Mei and Moses (2001)	Mixed evidence; price differences, when they exist, are small

8. Sales Rates and Reserve Prices

As we noted above, items that are put up for sale at auction often go unsold because the bidding in the auction does not meet the reserve price. Sale rates vary tremendously over time and they also vary systematically across different types of auctions. Table 5 shows sale rates in different departments at Christie's in London in 1995 and 1996 along with average value of a lot sold. As can be seen from the table, 96% of items put up for sale in auctions of arms and armour were sold, 89% of wine at auction was sold, and 71% of impressionist and modern art items were sold.

Table 5
Average Sale Rates by Department

Department	Average Sold Lot Value		No. of Auctions in Sample	Sale Rate (% of Lots Sold)		% Sold by Value	
	1996	1995		Mean	Std. dev	Mean	Std. dev.
Impressionist	£122,820	£135,430	8	71%	(0.11)	80%	(0.10)
Old Masters Drawings	£50,670	£29,210	4	77%	(0.09)	89%	(0.08)
Contemporary	£36,820	£36,840	7	79%	(0.04)	87%	(0.06)
British Pictures	£29,710	£23,560	7	78%	(0.14)	83%	(0.17)
Old Master Pictures	£29,180	£6,560	11	73%	(0.15)	82%	(0.15)
Continental Pictures	£21,810	£10,450	7	72%	(0.11)	79%	(0.10)
Clocks	£14,340	£5,130	4	88%	(0.03)	89%	(0.07)
Jewellery	£12,190	£6,750	8	86%	(0.05)	89%	(0.04)
Furniture	£11,670	£8,220	25	85%	(0.09)	92%	(0.06)
Silver	£11,080	£5,910	10	87%	(0.11)	92%	(0.07)
Sculpture	£11,070	£6,340	5	78%	(0.21)	81%	(0.20)
Modern British Pictures	£10,340	£7,190	9	70%	(0.05)	81%	(0.05)
Victorian Pictures	£9,460	£8,400	6	66%	(0.13)	75%	(0.11)
British Drawings & Watercolours	£9,160	£3,400	14	72%	(0.14)	87%	(0.10)
Rugs & Carpets	£9,160	£3,700	8	80%	(0.17)	85%	(0.14)
Topographical Pictures	£8,640	£8,010	2	68%	(0.13)	81%	(0.00)
Islamic	£6,670	£6,950	5	68%	(0.22)	82%	(0.12)
Cars	£5,750	£7,610	6	71%	(0.16)	65%	(0.22)
Chinese Works of Art	£5,640	£6,400	8	70%	(0.19)	79%	(0.16)
Books & Manuscripts	£5,220	£4,270	15	81%	(0.12)	86%	(0.09)
Russian Works of Art	£4,490	£5,480	4	64%	(0.14)	69%	(0.15)
Japanese	£4,410	£2,840	5	72%	(0.04)	76%	(0.05)
Musical Instruments	£3,960	£4,110	5	77%	(0.05)	76%	(0.16)
Watches	£3,870	£2,190	6	71%	(0.09)	81%	(0.11)
Prints-Old Modern and Contemporary	£3,850	£4,230	8	81%	(0.12)	92%	(0.09)
Miniatures	£3,350	£3,260	2	82%	(0.05)	92%	(0.07)
Antiquities	£3,260	£3,640	3	57%	(0.08)	66%	(0.13)
Porcelain and Glass	£2,700	£2,600	14	76%	(0.12)	85%	(0.10)
Tribal Art	£2,650	£2,090	3	67%	(0.08)	75%	(0.19)
Photographica	£2,580	£1,660	3	61%	(0.27)	79%	(0.08)
Modern Guns	£2,510	£3,620	5	93%	(0.06)	94%	(0.04)
Garden Statuary	£2,120	£1,540	4	91%	(0.10)	91%	(0.11)
Arms & Armour	£1,890	£2,400	4	96%	(0.03)	99%	(0.01)
Frames	£1,800	£2,260	4	81%	(0.15)	85%	(0.14)
Stamps	£830	£650	22	78%	(0.13)	82%	(0.12)
Wine	£690	£580	37	89%	(0.09)	91%	(0.08)

Ashenfelter, Graddy and Stevens (2002) provide a study of sale rates across time in art auctions and across different types of auctions. Based on the observation that an item is bought-in if and only if it does not meet or exceed its reserve price, they develop a model of optimal reserve prices. The seller of a painting faces the following problem: if he participates in an auction the highest bid for the painting can

be regarded as a random draw from some price distribution. When a seller sets a reserve price, he must decide at what price he would be indifferent between selling now and waiting for the next auction. The optimal policy is to set a reserve price that is a constant proportion of the current expected price. Sale rates can then be modelled as being explained by price shocks and a constant, or "natural sale rate." This natural sale rate (which may vary across different types of auctions) depends only on the variance of log prices and the seller's discount rate. They estimate that the reserve price is generally set to be about 70 to 80% of the auctioneer's low estimate. Although reserve prices are generally secret, the available evidence suggests that this prediction is reasonably accurate.

Genesove (1995) tests a related, but somewhat different theory in the context of wholesale automobile auctions. He finds that on average sale rates in used auto auctions are actually quite low; between about 58% and 68% of automobiles go unsold. In his paper, he tests a result by Balvers (1990) that also states that an increase in variance decreases the probability of sale. He finds that an increase in the log-variance is associated with a lower probability of sale, and hence the "natural sale rate" is again dependent on variance of log prices.

Other authors have studied strategic reasons for setting reserve prices. For example, in the classic article by Riley and Samuelson (1981), the reserve price serves to extract a slightly higher price from the bidder with the highest valuation of the item on offer. The theory of optimal auctions indicates why, for strategic reasons, a seller should set a reserve price that is strictly higher than the minimum price for which they would sell the object. However, these models predict that sale rates should approach unity as the number of bidders increases and do not seem to be consistent with the low and persistent sale rates actually observed.

More recently, in a general auction model with affiliated signals, common components to valuations, and endogenous entry (all characteristics which can be applied to art auctions or other auctions of cultural objects), McAfee, Quan, and Vincent (2000) derive a lower bound on the optimal reserve price. They apply their computations to FDIC real estate auctions and find that the lower bound on the optimal reserve price for real estate to be about 75% of the appraised value.

9. Why Secret Reserve Prices?

In almost all auctions of cultural items, not only are there reserve prices, but these reserve prices are secret. Auctioneers generally do not reveal the reserve price and they make it as difficult as they can for bidders to infer it. A reserve price clearly contains information about the seller's valuation of an item; intuitively, revealing information matters if the items contain a common value component among buyers. While people buy art for enjoyment, there is an investment component to many buyers' motives; that investment component leads one to classify art as having common-value components. Thus, the fact that auctioneers tend to keep reserve prices secret has remained a puzzle since the publication of Milgrom and Weber's paper (1982), where it was shown that it is optimal for a seller of a good at a common-value auction to reveal their valuation.

One reason that has been suggested for secret reserve prices is that these may be used to deter collusion. As Ashenfelter (1989) suggests, when the turnout is low, some sellers may prefer that their goods be bought in and offered for sale at a later date rather than risk a collusive ring bidding to depress the item's price. If there is a ring operating, a secret reserve price might encourage bidders to bid higher than they would have otherwise.

Vincent (1995) has cleverly built upon (and overturned) the intuition from Milgrom and Weber's (1982a) original result. His explanation is based upon the inhibiting effect that the announcement of a reserve price may have on the participation of bidders in a given auction. This announcement could discourage some bidders from participating. As revelation of information is very important for increasing revenues in a common value auction, the fact that these bidders are not participating prevents their information from playing a part in the auction and may lower overall bids. Hence, there is a trade-off between the reserve price revealing the seller's information, and a reserve price discouraging participating which lowers total aggregation of information.

Horstmann and LaCasse (1997) provide yet another reason for secret reserve prices. If the seller in a common-value auction possesses information that cannot be directly transmitted to the buyers, then a seller can either attempt to signal his information via a reserve price announcement, or choose a secret reserve price. A secret reserve price could result in delay in sale. If the true information about an item is revealed over time, the delay in sale could be profitable for high value items, but costly for low value items, and hence sellers of high-value items will not be tempted to mimic sellers of low-value items. While this explanation may appear reasonable for oil leases, it appears less applicable to art auctions, though sellers of art are given access to professional valuation services provided by the auction house, which may provide an asymmetry of information. A summary of papers relating to secret reserve prices is presented in Table 6 below.

Table 6
Secret Reserve Prices

Author	Result
Milgrom and Weber (1982a)	Optimal for a seller of a good at a common-value auction to reveal valuation
Ashenfelter (1989)	Secret reserve prices deter collusion
Vincent (1995)	Announced reserve prices deter participants This deterrence could lower overall bids in a common-value auction
Horstmann and Lacasse (1997)	A secret reserve price could delay sale, allowing truthful information to be revealed over time.

10. Role of Estimates and Experts

Before an auction takes place, in their pre-auction catalogues, auction house experts provide a low and a high price estimate for each item. Determining the accuracy of these estimates raises some important questions for the study of the role of expert opinion in economic decisions.[5] Of especial interest is the motivation of the auctioneer in choosing the high and low estimates. The theoretical literature stresses that auctioneers should provide truthful information about the items being sold.

Ashenfelter's (1989) results generally show that auction houses are truthful; the average of the auctioneer's high and low estimate is very highly correlated with the price actually received. Furthermore, Abowd and Ashenfelter (1988) find that auctioneer's price estimates are far better predictors of prices fetched than hedonic price functions.

While the regressions in Beggs and Graddy (1997) generally uphold these results, they do find systematic under and over predictions. For example, they find that for Contemporary Art, more recently executed artworks are overvalued and longer and wider paintings are undervalued. For Impressionist and Modern art, they

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[5] Ashenfelter (2000) defines expert opinion as efficient if it incorporates all of the publicly available information that is useful in making predictions. He also provides one example of inefficient expert opinion.

find that wider, signed, and monogrammed paintings may be underestimated relative to their value. One explanation for these findings may simply be that auction houses are unwittingly overestimating consumer demand (and hence willingness to pay) for recent Contemporary Art, and underestimating consumer demand for size! Many people in the trade express surprise at the strong correlations that many economists have found between size and price (see Anderson (1974) and Beggs and Graddy (1997) for examples).

Other authors have also found that ex-ante valuations cannot be considered unbiased predictors of market prices, although it is our impression that biases are not quantitatively large when they are precisely estimated. Bauwens and Ginsburgh (2000) study 1600 lots of English silver sold between 1976 and 1991 by Christie's and Sotheby's. They find that Christie's has a tendency to underestimate systematically, while Sotheby's overvalues inexpensive pieces and undervalues expensive ones. Chanel, Gerard-Varet, and Vincent (1996) studied jewellery auctions, and found that experts have an ex-ante valuation that is lower than the hammer price for all types of jewels, except for some watches. They speculate that some strategic undervaluation is occurring. These results are interesting, in part because, as Milgrom and Weber (1982a) show, in general, for auctioneers, "honesty is the best policy."

If price estimates are biased, this raises some interesting questions about the reason for the bias. One possibility is simply that the "experts" make systematic errors because they are not as "efficient" as the linear predictors they are being tested against. Evidence in favor of this hypothesis would be the finding that observed biases are not stable and vary from one sample to another or from one time period to

another. Judging from the results reported above, there is certainly some evidence to support this view.

Another possibility is that auctioneers engage in systematic manipulation of the estimates for strategic purposes. The testimony of Diana Brooks, formerly President of Sotheby's, in the trial of Alfred Taubman noted above provides some anecdotal evidence on this issue. Her testimony suggests that, even when the two leading auctioneers were engaging in price fixing, they did not attempt to influence the art appraisers who worked for them to assist in the conspiracy.

A related question is, "what motivates the auctioneers when they determine the spread between the high and the low estimates that are published in the pre-sale catalogues?" One explanation of how the spread is determined is by the auctioneer's estimate of the uncertainty or possible variance in the price of the painting. In this case, the high estimate might reasonably be interpreted as the estimate of the mean price plus a multiple of the estimated standard deviation ($H=\mu+rs$). Likewise, under this interpretation, the low estimate would be the mean minus a multiple of the standard deviation ($L= \mu-rs$). With this interpretation the high estimate minus the low estimate divided by 2 is proportional to the estimated standard deviation ($(H-L)/2= rs$) and the average of the high estimate and the low estimate would be the estimated mean ($(H+L)/2=\mu$). A large difference in the high estimate and the low estimate would therefore signal a high estimate of price variance or a lot of uncertainty. However, as the seller's secret reserve price, by convention, lies below the low estimate, it is very likely that the spread between the high and low estimate is not simply a reflection of the auctioneer's uncertainty surrounding the possible price. If the seller wishes to set a high reserve price, the auctioneer may increase the low estimate. Ashenfelter, Graddy, and Stevens (2002) study the plausibility of these two

explanations with regard to sales rates in Contemporary and Impressionist Art Auctions. A summary of papers addressing the role of estimates is presented in Table 7 below.

Table 7
Role of Estimates

Author	
Milgrom and Weber (1982a)	Honesty is the best policy
Abowd and Ashenfelter (1988)	Auctioneer's price estimates are far better predictors of prices than hedonic models
Ashenfelter (1989)	Auction houses are truthful
Chanel, et. al. (1996)	Undervalue most types of jewelry, with the exception of some watches
Beggs and Graddy (1997)	Art: Recently executed works tend to be overvalued; longer and wider paintings are undervalued
Bauwens and Ginsburgh (2000)	English silver: Christie's systematically underestimates; Sotheby's overvalues inexpensive pieces and undervalues expensive pieces
Ashenfelter, et. al. (2002)	Examines whether spread between high and low estimate is indication of auctioneer's uncertaintly or reflects seller's wish to set a high reserve price

11. The Declining Price Anomaly

Since Ashenfelter (1989) showed that that prices are twice as likely to decrease as to increase for identical bottles of wine sold in same lot sizes at auction, there has been a tremendous amount of study of the declining price anomaly in many types of auctions.

Soon after publication of Ashenfelter's (1989) article, there were many theoretical papers written to explain declining prices. Black and deMeza (1992) claimed it was no anomaly; declining prices in wine auctions exist primarily because the winner of the first auction in a sequence has the option to buy the remaining objects at the winning price. However, this theory is unable to explain why the

anomaly continues to exist even where this option is not permitted. McAfee and Vincent (1993) showed that risk aversion could create declining prices. One unappealing feature of their explanation is that a pure-strategy equilibrium exists only when there is nondecreasing absolute risk aversion, which is usually thought implausible. Mixed strategy equilibria are ex-post inefficient, which is sometimes also thought to be weakness of this theory, but which may nevertheless be a correct characterization of the actual market. Von der Fehr (1994) shows that participation costs could create declining prices through strategic bidding. Engelbrecht-Wiggans (1994), Bernhardt and Scoones (1994), Gale and Hausch (1994), and Beggs and Graddy (1997) relate the price decline to heterogeneity of the objects for sale, Pezanis-Christou (2001) relates the price decline to heterogeneity among buyers, and Ginsburgh (1998) shows that the presence of absentee bidders can generate declining prices.

The declining price anomaly has also been documented in a number of different types of auctions with different auction structures. Buccola (1982) found it occurring in livestock auctions, Milgrom and Weber (1982b) for transponder leases, McAfee and Vincent (1993) and Di Vittorio and Ginsburgh (1994) confirmed Ashenfelter's (1989) wine findings, Thiel and Petry (1990) and Taylor(1991) in stamp auctions, Ashenfelter and Genesove (1992) and Venderporten (1992a, 1992b) for condominiums, Engelbrecht-Wiggans and Kahn (1992) for dairy cattle, Lusht (1994) for commercial real estate, Chanel, Gerard-Varet, and Vincent (1996) for gold jewellery; Pesando and Shum (1996) for Picasso prints; Beggs and Graddy (1997) for Impressionist and Contemporary art; Thurston (1997) for mink pelts, Pezanis-Christou (2001) for fish auctions, and van den Berg, van Ours and Pradhan (2001) for

Dutch flower auctions. Burns (1985) and Keser and Olson (1996) have set up experiments that have reached the same conclusions.

Several authors have also found increasing prices. Among them are Gandal (1997) for Israeli cable television licenses, and Donald, Paarsch and Robert (1997) for Siberian timber-export permits. Jones, Menezes and Vella (1996) found that prices could increase or decrease in sequential auctions of wool, as did Chanel, Gerard-Varet, and Vincent (1996) for watches; Milgrom and Weber (1982b) show theoretically that if bidders' valuations are affiliated, then prices will tend to rise over time in a sequence of auctions of identical objects. Deltas and Kosmopoulou (2001) find in a sale of library books that expected prices increase over the auction, but that probability of sale decreases. Natzkoff (2001) provides an excellent survey of papers on the declining price anomaly. A summary of papers addressing the declining price anomaly is presented in Table 8 below.

Conclusion

The empirical study of art auctions really has two purposes. On the one hand, the auction mechanism provides a very public report on the prices of art objects. As we have shown, because of the unique nature of many art objects, the interpretation of market prices requires great care. Nevertheless, this information is the primary way that art objects are valued and it provides us with our primary objective information on preferences regarding art. Although the market is surely not all that is important in the judgement of art and artists, it is certainly one of the key components of our understanding of what is good and bad

The empirical study of art auctions also has another purpose. Art auctions provide data that may be used to test and refine strategic models of behavior. Here

the object of study is the economic mechanism and it makes very little difference what object is for sale. It appears that a great deal of what we know about the operation of auction mechanisms may also lead to the rather happy study of objects of considerable interest in their own right.

The empirical study of art auctions and the price of art assets has been a growth field in the last decade and has resulted in an increasing sophistication in the questions being asked and in the empirical methods being used. It seems likely that this trend will continue into the future.

Table 8
Declining Price Anamoly

Empirical Work (Declining Prices)

Buccola (1982)	Livestock
Burns (1985)	Experimental results
Ashenfelter (1989)	Wine
Milgrom and Weber (1982b)	Transponder leases
Thiel and Petry (1990)	Stamps
Taylor (1991)	Stamps
Ashenfelter and Genesove (1992)	Condominiums
Venderporten (1992a, 1992b)	Condominiums
Engelbrecht-Wiggans and Kahn (1992)	Dairy cattle
McAfee and Vincent (1993)	Wine
De Vittorio and Ginsburgh (1994)	Wine
Lusht (1994)	Commercial real estate
Chanel, et. al (1996)	Gold jewelry
Pesando and Shum (1996)	Picasso prints
Keser and Olson (1996)	Experimental results
Beggs and Graddy (1997)	Art
Thurston (1997)	Mink pelts
Pezanis-Christou (2001)	Fish
van den Berg, et. al. (2001)	Flowers

Empirical Work (Increasing Prices)

Jones, et. al (1996)	Wool auctions
Chanel, et. al (1996)	Watches
Gandal (1997)	Isreali cable television auctions
Donald, et. al. (1997)	Siberian timber auctions
Deltas and Kosmopoulou (2001)	Library books

Theoretical Work

Black and de Meza (1992)	Declining prices in wine auctions are due to buyers' options
McAfee and Vincent (1993)	Risk aversion could create declining prices
Von der Fehr (1994)	Participation costs could create declining prices
Englebrecht-Wiggins (1994)	Relate price decline to heterogeneity of objects
Bernhardt and Scoones (1994)	Relate price decline to heterogeneity of objects
Gale and Hausch (1994)	Relate price decline to heterogeneity of objects
Beggs and Graddy (1994)	Relate price decline to heterogeneity of objects
Ginsburgh (1998)	Absentee bidders can generate declining prices

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