Economic Interferences AE

RESERVATION PRICES AND PRE-AUCTION ESTIMATES: A STUDY IN ABSTRACT ART

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Abstract

Using a sample of European abstract art we show that reservation prices constrain pre-auction estimates in such a way that we are more likely to observe overestimation relative to the midpoint of the estimation window. At the same time, we also find that the low pre-auction estimate is a more powerful, accurate and precise predictor of hammer prices than the high estimate.

Key words: *•Art Auctions, •Abstract Art, •Pre-auction Estimates, • Reservation Price, •Bias*
JEL Classification: *D440, G120, Z110*

Rezumat

În acest articol analizăm un eşantion de picturi abstracte de proveniență europeană şi descoperim că rezerva minimă de preț a colecționarilor care vând lucrările de artă la licitație constrâng evaluările şi prognozele specialiştilor. Ca urmare, este mai probabil ca prețurile realizate ulterior la licitație să fie în medie mai scăzute decât mijlocul intervalului de prognoză al specialiştilor. Mai mult, constatăm că limita inferioară a intervalului de prognoză anticipează cu o precizie mai mare decât limita superioară prețul de licitație realizat ulterior.

Cuvinte cheie*: • Licitații de artă • Pictură abstractă • Estimări de preț • Preț minim • Eroare de estimare*
Clasificare JEL: *D440, G120, Z110*

Composition VI is a large rectangular oil painting. The canvas measures 195 by 300 centimeters. The art critic of the time must have squinted in disbelief: It displays a tangle of abstract geometrical shapes and lines bathed by large evanescent streaks of blue, green, brown, and red. There are no trees, peoples, flowers, or any other figurative representation. On the lower right-hand corner the signature of the artist is scribbled inconspicuously: Vassily Kandinsky, year 1913.

Kandinsky was spearheading a radically new and bold approach to painting: abstractionism. Abstract forms and shapes were destined to replace the traditional landscapes and portraits. The painter knew very well that his art would become subject to controversy. And it did. Some art critics and fellow painters hailed him as a genius. Others were displeased and outraged by the aesthetic concepts that Kandinsky introduced to the world. In his native land, Russia, the Bolshevik party increasingly considered his art un-proletarian and reactionary. In Germany, the Nazi scorned him and called his art "degenerate." Only later did he become one of the most iconic abstract painters of all times.

Almost a century later, another type of scrutiny would revolve around the selling of Kandindky's artwork. The scholars would come this time from a different field of study – finance and economics; and they too espoused simplicity, symmetry, and elegance. Just like Kandinsky, these economists were about to learn that simplicity and elegance does not always rely on symmetry.

1. Introduction

There is a growing body of recent research preoccupied with the relationship between pre-auction estimates and hammer prices at art auctions. These studies draw heavily on financial and economics concepts such as market efficiency and unbiased estimators. A large majority of studies set out to determine whether the average of the low and high pre-auction estimates (the midpoint of the pre-auction estimation window) is indeed an unbiased estimator of realized (hammer) prices. The midpoint of the estimation interval emerged as a reference point following the theoretical work of Milgrom and Weber (1982). Moreover, the average of the low and high estimates has its own appeal because it stands for simplicity and symmetry. Many subsequent studies produced evidence supporting the following results: no bias at all, slight underestimation, and slight overestimation.

Here, we contend that the question of the midpoint of the estimation window is a red herring. In an ideal world it would most likely represent an unbiased estimator of hammer prices. Alas, there are plenty of market imperfections around to guarantee some sort of bias. We feel that it is more interesting to ask a different question: what are the most relevant constraints, and how do they influence the pre-auction estimates?

We argue that reservation prices probably have a strong influence in swaying the pre-auction estimates. This constraint is likely to induce the appearance of overestimation. Moreover, we should be able to detect a difference in how each individual estimate predicts the price. In the end, we find that the low estimate has a higher prediction power than the high estimate with respect to the hammer price.

Our paper is structured as follows: Section two briefly introduces to reader to the mechanism of art auctions. Sections three, four, and five discuss the literature on art auctions. Sections six and seven elaborate on the main hypothesis of our research. Sections eight and nine present the data, methodology, and results. Section ten concludes.

2. Art Auctions

The mechanism for the auctioning of art is straightforward: Each lot is sold to the highest bidder. A lot usually consists of one object or a group of objects sold as one. In the case of paintings, a lot consists of one painting.

The entire process starts when the owner of the artwork contacts the auction house with the intention to sell. The artwork is examined by specialists who determine its approximate worth. Based on this analysis, the auction house produces a low and a high estimate of the artwork's expected value. The breadth of the pre-auction estimate range can vary considerably, depending on many factors; among these factors, the minimum price that the owner is willing to accept –called reserve or reservation price – plays a particularly interesting role. For reasons that are obvious, the pre-auction estimate range is set above

the reservation price. The reservation price is mutually agreed upon by the owner of the artwork and the auction house. In negotiating the level of the reservation price, the auction house has to be persuasive, yet flexible. In the end, the owner will not agree to consign the artwork unless the seller guarantees a minimum price perceived as a fair compensation for parting with the artwork.

The pre-auction estimate, along with other pertinent information relating to the artwork is published well in advance of the auction date. Potential buyers can gather relevant information by subscribing to a catalog (featuring high quality graphics) or directly online, where more sellers provide increasingly better quality digital images. On the day of the sale, the artwork is brought in and becomes subject to bidding. The bidding price advances in increments, whose magnitude depends on the pre-auction estimate. The highest bidder (at the time when the hammer falls) is acknowledged as the buyer. If the artwork fails to reach the reservation price, it is bought-in and subsequently returned to its original owner.

Following a successful sale, the owner (consignor) receives the hammer price less the seller's commission; the commission represents a flat percentage of the hammer price or can be set on a sliding scale, depending on the auctioneer. The buyer pays the hammer price, a buyer's premium, and applicable sales or VAT taxes. The buyer's premium can also be applied as a flat percentage or as a sliding scale fraction of the hammer price.

In this entire process outlined above, we will focus on the reservation price, which plays a particular role, so far underestimated or ignored. As it will become clearer later, the reservation price represents one of the main constraints affecting the valuation of art.

3. Incentives to Underestimate

Many authors cite statements made by auction house professionals who claim that estimates are tweaked down in an attempt to lure more bidders [D'Souza and Prentice (2001), Lourgand and McDaniel (1991), Mei and Moses (2005)]. Obviously, too high an estimate would discourage a great many potential buyers.

Another conjecture proposes that artificially low estimates compel the seller to a lower reservation price, and thereby increase the probability of selling the artwork. This argument relies on the assumption that the auction house expert produces the high and low estimates independent of seller's expectations. This contention would weaken considerably if the seller were in a position to influence or negotiate the reservation price.

On a different level, underestimation will lead to a string of pleasant surprises for sellers, who see their hopes and expectations exceeded. This situation is akin to the earnings game played by some publicly held corporations that underestimate their current results in an attempt to surprise the market with better than expected results in the future.

Finally, big auction houses, such as Christie's and Sotheby's have a reputation to defend [Mei and Moses, (2005)], and therefore the image of respectably and wisdom is preserved and enhanced by erring on the side of caution and conservatism. These auctioneers might look foolish and careless if the artwork consistently failed to fetch the expected price.

Several studies already document the existence of this sort of bias. Bauwens and Ginsburgh (2000) find that

Christie's underestimates systematically, while Sotheby's underestimates expensive pieces. In the same vein, Chanel et al. (1996) find that the pre-auction estimates for jewellery auctions are systematically below hammer prices. D'Souza and Prentice (2001) produce similar findings from a sample that includes European and Australian art. Ekelund et al. (1998) find that in 18 years out of 20, the average price of artwork was larger than the average guess. The authors investigated Latin American Art auctions conducted by Christie's and Sotheby's between 1977 and 1996. Beggs and Graddy (1997) reveal that larger paintings - especially Impressionist Art -tend to be underestimated by the experts. This finding could reflect a purposeful strategy, or might simply reveal overestimation of the demand for Contemporary Art and underestimation of the demand for large pieces [Ashenfelter and Graddy (2006)].

4. Incentives to Overestimate

There are also reasons why experts could overestimate the value of art. First, a higher estimate would induce more sellers to consign their artworks. Too low an estimate would depress the reservation price and thereby discourage artwork owners from consigning their art. This argument relies heavily on the assumption that the determination of the reservation price is residual in nature.

Second, consider the seller's commission and the buyer's premium. Both are proportional to the price fetched by the artwork. If it is believed that higher estimates will result in higher hammer prices, overestimation will produce higher revenues for the auctioneers [Mei and Moses (2005), Ashenfelter and Graddy (2004)].

Some studies seem to confirm that experts' estimates are biased upwards. Beggs and Graddy (1997) find that recently executed Contemporary Art pieces tend to be overestimated. Bauwens and Ginsburgh (2000) find that Sotheby's experts overvalue some English Silver sold between 1976 and 1991. Mei and Moses (2005) find that high estimates are associated with subsequent adverse abnormal return for periods of up to thirty years. These authors conclude that auction houses overestimate expensive artworks in order to reap maximum commissions and premiums. Last but not least, Ekelund et al. (1998) find an overall mean bias of 2.7 percent, which suggests overestimation.

5. Honesty as the Best Policy

There is a case to be made for unbiasedness as well. These arguments largely fall in two categories: a) theoretical – based on economic rational behavior, and b) ad-hoc – based on intuition, common sense, and the preponderance of evidence:

a) There is a consecrated theoretical literature contending that in a world of rational economic agents the best policy of auction houses is to estimate artwork as accurately as possible; this is the "honesty-is-the-best-policy" argument [Milgrom and Weber (1982)]. One can easily extend the informational efficiency case to the art market [Lourgand and McDaniel (1991)]. Auction houses would lose business to the competition if they over- or underestimated the artwork. While small or temporary biases might exist here and there, rational learning would eliminate them in the long run [Mei and Moses (2005)].

b) For every economic incentive in favor of a positive bias there is another one supporting a negative bias. On one hand, auctioneers might underestimate in order to attract bidders, but on the other hand they could also overestimate to attract sellers. One cannot really know ex-ante the net strength of the influences discussed earlier; however, intuition and common sense suggest that the truth must lie somewhere in the middle. The most likely scenario is that expected prices equal realized prices. This intuition is reinforced by the peculiar alternating pattern of studies documenting both upward bias and downward bias (it appears, however, that the preponderance of evidence tilts marginally in favor of slight overestimation).

Sure enough, there is also a substantial body of empirical literature supporting unbiasedness. Abowd and Ashenfelter (1989) suggest that pre-auction estimates are better predictors of prices than hedonic price functions. Ashenfelter (1989) contends that experts' estimate are truthful in the sense that they are unbiased predictors of art prices. Lourgand and McDaniel (1991) research Sotheby's auctions of Americana and conclude that buyers and sellers participate in a fair game. Finally, Czujak and Martins (2004) investigate Sotheby's and Christie's auctions of Picasso paintings between 1975 and 1994; the authors find that pre-auction estimates represent good predictors of the subsequent hammer price.

6. Of Estimates and Prices: Ockham's Razor

Until now, the debate on art estimates has produced evidence that is ambiguous. This predicament is hardly unusual given the nature of scientific inquiry. Many studies present contradictory findings indeed: Ashenfelter and Graddy (2006) appear convinced that expert's estimates are truthful, although he acknowledges the legitimacy of studies that beg to differ. Lourgand and McDaniel (1991) declare art auctions a fair game, although they concede that some sort of bias might be present, which the authors dismiss as small. Ekelund et al. (1998) acknowledge that – although in a majority of observation cases the estimate is below the hammer price – the overall mean of the bias is in fact positive, at 2.7 percent. The most common answer to this empirical conundrum, unfortunately, is to declare any bias that might exist as insignificant. Alas, to accept this conclusion outright, without further questioning, requires a leap of faith.

In this paper, we contend that, due to the ubiquitous nature of reservation prices, it is more probable to observe over- than underestimation. As a telltale sign, the low estimate should be a more powerful, accurate and lower variance predictor of the expected hammer price. Our conjecture is developed based on the following observations:

a)The case put forth by the theoretical work of Milgrom and Weber (1982) does not account for the existence reservation prices. Once we allow reservation prices, it is not clear whether we should continue to expect pre-auction estimates to remain an unbiased estimator of hammer prices.

b)The reservation price is not residual in nature; and the lower bound of the estimation interval is dependent on the reservation price negotiated with the seller. Ekelund et al. (1998) find that smaller estimation intervals increase the probability of "no sale." The authors speculate that the estimation interval

becomes smaller whenever the owner requires a higher reservation price. Their findings suggest that the art owner has bargaining power.

c)A substantial body of empirical evidence documents both underestimation and overestimation. These biases –small as they might be – appear to vary from one particular instance to the other. In the end, however, we feel that the preponderance of evidence points to overestimation.

Reservation prices are interesting for three reasons. First, they lead to an upward adjustment in the low estimate. When the seller seeks a reservation price higher than the experts' low estimate, the auctioneer might have to raise the low estimate if it has in place a policy requiring the reservation price be below the low estimate. The auctioneer would probably try to persuade the seller to lower the reservation price, but in the end the outcome of the negotiating process depends very much on conjectural factors, such as bargaining power. Once a compromise reservation price has been reached, the auctioneer has no choice but to increase its low estimate if the reservation price is above the original low estimate. If the expected price was originally centered on the mid-point of the best of experts'-knowledge estimation, after the adjustment, the expected price moves off-center, closer to the low estimate.

Second, reservation prices truncate the distribution of the observed hammer price. They ensure that we would not encounter instances of realized prices below the reservation price. If the competitive bidding process fails to reach the formal or informal reservation price, the painting would either be bought-in by the auctioneer, or re-purchased by its owner. Whether it goes unsold or is sold at the reservation price, the result is the same: the realized price would be precluded from descending below the limit set by the reservation price. Because reservation prices are close to the low estimate, the distribution of the observed realized hammer prices would be truncated about the low estimate. Intuitively, we then expect that the low estimate be a better predictor of the price than the high estimate.

Third, while reservation prices are hard to estimate with precision, their influence on the competitive bidding at art actions is not trivial. We thus have to rely on circumstantial evidence in order to isolate the influence of reservation prices from the influence of other factors. We need to conjecture the type of disturbances they are likely to induce in the observed art auction data and formulate testable hypotheses.

7. Development of Hypotheses

Let us assume an ideal world where the unbiased estimator of the expected hammer price is a weighted average of the low and high pre-auction estimates:

$$E(P) = \theta H^A + (1-\theta)L^A \quad (1)$$

Where:

E(P) = expected hammer price

L^A = the best of experts'-knowledge high estimate

H^A = the best of experts'-knowledge high estimate and $0< \theta < 1$

In the absence of reservation prices or any other ex-ante constraints on the estimation window we expect $\theta = 0.5$, hence:

$$E(P) = (0.5)(H^A + L^A) \quad (2)$$

Unbiasedness requires that the midpoint of the estimation interval equal the expected hammer price:

$$E(P) = M = (0.5)(H^A + L^A) \quad (2a)$$

Where:
M = the midpoint of the estimation interval

When the estimator is unbiased, the relative distance of the expected hammer price from the low estimate should equal in absolute value the relative distance of the expected hammer price from the high estimate. Moreover, the variance of the relative distance of the expected hammer price from the low estimate should equal the variance of the relative distance of the expected hammer price from the high estimate. This is to say that the expected price is an equally weighted-average of the low and high estimates. Hence, in the absence of any constraint, the following relationships should hold:

$$1 - L^A/ E(P) = H^A/ E(P) - 1 \quad (3)$$

$$VAR(1 - L^A/ P) = VAR(H^A/ P - 1) \quad (4)$$

In the presence of a reservation price, we infer that the expected hammer price cannot be lower than the reservation price:

$$E(P) = MAX[(0.5)(H^A + L^A); S] \quad (5)$$

Where:
S = the reservation price

However, we are not able to observe any hammer price lower than S. If the bidding process fails to reach S, the painting would be bought in. Recall that many auction houses, notably Sotheby's and Christie's have policies requiring that the low estimate be above the formal reservation price. If this is the case, the auctioneer will have to readjust the level of the low estimate upward. We would no longer be able to observe L^A, only L, which is higher than L^A such that:

$$S < L \quad (6)$$

and

$$L^A < L \quad (7)$$

Where:
L = the observed pre-auction low estimate

We believe that the adjustment ($L - L^A$) has to be minimal. It is very likely that after the adjustment L will be less than $(0.5)(H^A + L^A)$. If the observed low estimate were greater than the original mid-point, the expected hammer price would descend below the observed estimation window. It is hard to believe that an auction house that thrives on reputation for expertise would knowingly set the pre-auction estimates in such a way that it would expect the price to systematically end up below the low estimate. Thus, we expect that:

$$L - L^A < (H^A - L) \quad (8)$$

or,

$$L - L^A = k(H^A - L) \quad (8a)$$

Where:
$0 < k < 1$

Given (7), we now hypothesize the following:

$$1 - L / E(P) < H^A / E(P) - 1 \quad (9)$$

$$VAR(1 - L / P) < VAR (H^A / P - 1) \quad (10)$$

With reservation prices, we expect that the relative distance of the expected hammer price from the observed low estimate be less in absolute value than the relative distance of the expected hammer price from the high estimate. Moreover, the variance of the relative distance of the expected hammer price from the low estimate should be less than the variance of the relative distance of the expected hammer price from the high estimate. In other words, in the presence of reservation prices, we expect the observed low estimate to be a more accurate predictor of the hammer price than the high estimate. We also expect to find that the low estimate tends to be a lower variance predictor of hammer prices than the high estimate. We have assumed no constraints on H^A as a result of reservation prices. We contend that the best of experts'-knowledge high estimate will continue to be observable. In addition, we conjecture that the extent of overestimation, if any, increases with the width of the estimation window; this is not so obvious a result. To see how this is possible consider the following:

By substituting (6), (7), and (8) in (5), it follows that:

$$E(P) = MAX [(0.5)(1-k)(H^A + L) ; S] \quad (11)$$

and

$$E(P) - L = MAX [(0.5)(1-k)(H^A - L) ; (-R)] \quad (12)$$

Where:
$R = L - S$

Here, we conjecture that the observed lower estimate (L) is simply a linear transformation of the reservation price (S). Since (0.5)(1-k) is obviously less than 0.5, it follows that as $(H^A - L)$ increases, E(P) drifts more and more towards L, which is akin to saying that the extent of observed overestimation increases with the width of the estimation window.

Alternatively, we can re-formulate (11) in terms of $E(P) - H^A$:

$$E(P)-H^A = Max [-(0.5)(1+k)(H^A-L); -(H^A-L) -R] \quad (13)$$

Obviously, the interpretation of (13) is similar to that of (12) with one notable exception: we expect the width of the estimation window $(H^A - L)$ to have more explanatory power in equation (13) than in equation (12).

8. Data

We chose a relatively homogenous sample of observations in an attempt to control for subject matter. Our panel data consists of major modern European artists. The source of data is ADEC International, a Paris-based organization gathering and organizing auction data from around the world. The period covered ranges from 1986 to 2003. We require 150 valid observations to include a painter in our sample. Since we are convinced that subject matter is one of the least quantifiable determinants of art prices – we include only abstract (non-figurative) art. In the end, four painters have been selected: Vassily Kandinsky, Juan Miro, Paul Klee, and Karel Appel. All these four artists share

a strong stylistic and conceptual connection.

The Russian-born Vassily Kandinsky is considered on of the main pre-cursors of modern abstract expressionism. He founded the legendary group Der Blaue Reiter (The Blue Rider). Kandinsky wrote one of the first theoretical treatises on abstraction; he also held academic positions in Moscow, during and after the Bolshevik Revolution, and in Germany, where he taught at the Bauhaus. Both the Bolsheviks and Nazis regarded Kandinsky's unconventional art with deep suspicion. The Nazis included 57 of his paintings in the "Degenerate Art" exhibition. A vanguard of pure abstraction in art, Kandinsky paved the way for the ascent of abstract expressionism in the post-World War II era. He remains one of the most influential artists of the XXth Century.

The Swiss-born Paul Klee came from a family of musicians and almost became a musician himself. Eventually, Klee opted for a painting career; he joined Der Blaue Reiter, and later taught at Bauhaus in Germany, where he met Kandinsky and was influenced by his artistic concepts. Just like Kandinsky, he fled Germany in the wake of the Nazi rise to power, and just like Kandinsky he saw his paintings labeled as "Degenerate Art." Later Klee came down with a terrible disease – scleroderma - that forced him to reconsider his technique and eventually killed him. Klee is considered as one of the most achieved colorists of all times and one of the most celebrated abstract painters of the last century.

Juan Miro was born in Spain and his ascent to fame took place in the shadow of Pablo Picasso. His parents wanted him to have decent job, so he was trained to become an accountant, but eventually turned to painting. Just like Kandinsky and Klee, he was influenced by post-impressionists and fauvists. As a young artist he moved to Paris, where Ernest Hemingway bought one of his largest canvases. After an initial surrealist phase, Miro became increasingly interested in abstractionism and developed a unique style that is now widely recognized as the hallmark of the Catalan painter[1].

The Dutch-born Karel Appel was initially inspired by early abstract painting, but later became a major player in the rise of the modern European Abstract Expressionism. He influenced and was influenced by the work of Jackson Pollock and fellow countryman Willem de Koonig. He was also a founder of the European group CoBra. Sample statistics are presented in Table 1.

Table 1 - Sample statistics. All dollar numbers are per square inch.
M (Mid-point of the estimation window) = (L+H^A)/2

	Vassily Kandinsky	***Paul Klee***	***Juan Miro***	***Karel Appel***	***Total sample***
Number of paintings	*194*	*427*	*646*	*1,041*	*2,308*
Average low estimate	*$307,804.45*	*$157,325.61*	*$233,538.12*	*$21,609.06*	*$130,092.18*
Median low estimate	*$123,850.00*	*$60,000.00*	*$50,000.00*	*$10,000.00*	*$25,000.00*
Average high estimate	*$435,977.83*	*$214,621.08*	*$340,360.25*	*$29,324.25*	*$184,844.96*
Median high estimate	*$177,364.87*	*$81,900.00*	*$62,720.00*	*$13,820.80*	*$32,083.60*
Average hammer price	*$415,006.24*	*$180,403.74*	*$319,819.19*	*$25,591.02*	*$169,318.48*
Median hammer price	*$143,447.50*	*$70,000.00*	*$55,000.00*	*$11,647.00*	*$27,761.50*
P below L (%)	*26.29%*	*31.38%*	*28.33%*	*26.71%*	*27.99%*
P between Land H (%)	*40.21%*	*36.53%*	*38.85%*	*43.52%*	*40.64%*
P above H (%)	*33.51%*	*32.08%*	*32.82%*	*29.78%*	*31.37%*

	Vassily Kandinsky	Paul Klee	Juan Miro	Karel Appel	Total sample
Price above M (%)	49.48%	44.26%	49.85%	45.92%	47.01%
Average (1- L/ P)	11.41%	7.79%	13.54%	8.85%	10.18%
Median (1- L/ P)	11.00%	8.00%	14.00%	11.00%	11.00%
Average. (1- M/ P)	-5.74%	-10.06%	-2.69%	-7.61%	-6.53%
Median (1- M/ P)	-2.00%	-7.00%	-2.00%	-5.00%	-4.00%
Average. (1- H/ P)	-22.91%	-27.95%	-18.93%	-23.98%	-23.21%
Median (1- H/ P)	-16.00%	-21.00%	-15.00%	-20.00%	-19.00%

In total, the sample contains 2,308 artworks. Almost half of them, 1,041 are paintings by Karel Appel. Miro has 646 works, Klee 427, and Kandinsky only 194 artworks. Kandinsky also appears to be the most expensive painter, mostly because many of his canvases are very large. Karel Appel is the least expensive. In terms of dollars per square inch, Paul Klee is in fact more expensive than Kandinsky. Klee's artworks tend to be small in size. We note that the distribution of pre-auction estimates and prices tends to be rather skewed; in the case of each painter there is a handful of "masterpieces" that pushes the averages very high. As well, oil on canvas is more expensive, while watercolors on paper are less expensive – this fact provides a partial explanation for the skewness of the price distribution of our sample[2].

Ekelund et al. (1998) adopt two approaches to defining and measuring overestimation (or underestimation). The first one considers the relative frequency of hammer price outcomes below (or above) the estimation interval mid-point. The second one considers the distance of the hammer price from the estimation window mid-point, low, or high estimate. The overestimation that we document here is less equivocal than the one recorded by Ekelund et al. (1998). Overall, our sample shows that in 53% of cases, the hammer price was below the average of the high and low estimates. This pattern holds for each individual painter as well. The last six lines of Table 1 deal with the second approach to measuring overestimation – they show the relative price distance from the mid-point of the estimation window, low estimate, and high estimate. The relative distance from the mid-point of the estimation window is small, yet consistently and significantly negative, solidly placing our findings in the camp of overestimation. The relative distance of the hammer price from the low estimate (10.3%) is lower in absolute value than the the distance of the hammer price form the high estimate (23.16%) – as predicted by equation *(9)*. In addition, the standard deviation of the relative distance of the hammer price from the low estimate (49%) is lower than the standard deviation of the distance of the hammer price form the

high estimate (80.26%) – as predicted by equation *(10)*. These differences are significant at the 1% level.

9. Empirical Tests

The task at hand now is to estimate the coefficient of $(H^A\text{-}L)$ empirically. In keeping with the tradition of previous studies, we also include the estimation window midpoint. Hence, we use the following model specifications:

$$(P\text{-}L) = a_0 + a_1(H^A\text{-}L) + a_i\Sigma X_i + e \quad (14)$$

$$(P\text{-}M) = b_0 + b_1(H^A\text{-}L) + b_i\Sigma X_i + e \quad (15)$$

$$(P–H^A) = c_0 + c_1(H^A\text{-}L) + c_i\Sigma X_i + e \quad (16)$$

Where:

P= the observed hammer price

L = the observed pre-auction low estimate

H^A = the observed pre-auction high estimate

X_i = Dummy variables accounting for artist reputation, media, canvas orientation auction houses, location, and the years 1987 – 2003

Note that the model is specified in linear form so that we can interpret the coefficients a_1, b_1, and c_1. We are not particularly interested in the coefficients of the yearly dummies because we are not seeking art price indices. A log specification would allow us to estimate price indices, but it would render the interpretation of other coefficients intractable. If *M* is an unbiased estimator of *E(P)* we would expect a_1 to be equal to 0.5, b_1 to be equal to 0, and c_1 equal to -0.5. If, however, we expect *M* to overestimate *E(P)*, and this overestimation is increasing with the width of the estimation window, consistent with our argument illustrated by equations *(12)* and *(13)*, we predict a_1 to be less than 0.5, b_1 to be less than 0, and c_1 to be less than -0.5. Finally, we predict a_1 to be larger than 0.5, b_1 to be larger than 0, and c_1 to be larger than -0.5. Given the results in Table 1, we obviously expect overestimation.

*Table 2 Regression results. The absolute price distance from the low estimate (P-L), estimation window mid-point (P-M). and high estimate ($P\text{-}H^A$) is regressed against the observed width of the estimation window (H^A-L), and a series of dummy variables accounting for the identity of the painters (MIRRO, APPEL, KLEE), the medium used (DMED =1 for oil on canvas), the orientation of the canvas (ORIENTD =1 for landscape-oriented canvases, the years 1987 through 2003 (Y1987 – Y2003), the location of the auction (PARISD = 1 for Paris, NYCD = 1, for New York, LONDOND = 1 for London, AMSTERD = 1 for Amsterdam), and the auctioneer (CHRISTIE, SOTHEBYS). All regression coefficients are un-standardized. T-Statistics significant at the level of 5% and below are identified with *.*

	(P-L)			**(P-M)**			**($P\text{-}H^A$)**		
		Std. Error	*t*		*Std. Error*	*t*		*Std. Error*	*t*
Const.	*18.828*	*13.210*	*1.425*	*18.8*	*13.210*	*1.425*	*18.8*	*13.210*	*1.425*
MIRO	*-7.953*	*7.721*	*-1.030*	*-7.95*	*7.721*	*-1.030*	*-7.95*	*7.721*	*-1.030*
APPEL	*-29.865*	*7.965*	*-3.750**	*-29.87*	*7.965*	*-3.750**	*-29.87*	*7.965*	*-3.750**
KLEE	*-10.640*	*8.212*	*-1.206*	*-10.63*	*8.212*	*-1.206*	*-10.63*	*8.212*	*-1.206*
DMED	*9.984*	*4.633*	*2.155**	*9.984*	*4.633*	*2.155**	*9.984*	*4.633*	*2.155**
ORIENTD	*-2.720*	*3.922*	*-0.693*	*-2.720*	*3.922*	*-0.693*	*-2.720*	*3.922*	*-0.693*
Y1987	*-32.028*	*21.262*	*-1.506*	*-32.028*	*21.262*	*-1.506*	*-32.028*	*21.262*	*-1.506*
Y1988	*6.855*	*22.679*	*0.302*	*6.855*	*22.679*	*0.302*	*6.855*	*22.679*	*0.302*
Y1989	*12.332*	*23.452*	*0.526*	*12.332*	*23.452*	*0.526*	*12.332*	*23.452*	*0.526*
Y1990	*18.789*	*18.213*	*1.032*	*18.789*	*18.213*	*1.032*	*18.789*	*18.213*	*1.032*
Y1991	*9.705*	*32.380*	*0.300*	*9.705*	*32.380*	*0.300*	*9.705*	*32.380*	*0.300*
Y1992	*-18.532*	*15.816*	*-1.172*	*-18.532*	*15.816*	*-1.172*	*-18.532*	*15.816*	*-1.172*
Y1993	*-13.964*	*12.208*	*-1.144*	*-13.964*	*12.208*	*-1.144*	*-13.964*	*12.208*	*-1.144*
Y1994	*-14.871*	*11.885*	*-1.251*	*-14.871*	*11.885*	*-1.251*	*-14.871*	*11.885*	*-1.251*
Y1995	*-7.961*	*11.995*	*-0.664*	*-7.961*	*11.995*	*-0.664*	*-7.961*	*11.995*	*-0.664*
Y1996	*-2.211*	*11.755*	*-0.188*	*-2.211*	*11.755*	*-0.188*	*-2.211*	*11.755*	*-0.188*
Y1997	*-7.981*	*11.509*	*-0.693*	*-7.981*	*11.509*	*-0.693*	*-7.981*	*11.509*	*-0.693*
Y1998	*-4.954*	*11.197*	*-0.442*	*-4.954*	*11.197*	*-0.442*	*-4.954*	*11.197*	*-0.442*
Y1999	*3.486*	*11.338*	*0.307*	*3.486*	*11.338*	*0.307*	*3.486*	*11.338*	*0.307*

Y2000	*-10.370*	*12.044*	*-0.861*	*-10.370*	*12.044*	*-0.861*	*-10.370*	*12.044*	*-0.861*
Y2001	*5.675*	*11.826*	*0.480*	*5.675*	*11.826*	*0.480*	*5.675*	*11.826*	*0.480*
Y2002	*3.739*	*11.701*	*0.320*	*3.739*	*11.701*	*0.320*	*3.739*	*11.701*	*0.320*
Y2003	*-0.222*	*14.338*	*-0.015*	*-.222*	*14.338*	*-0.015*	*-.222*	*14.338*	*-0.015*
PARISD	*7.850*	*8.769*	*0.895*	*7.850*	*8.769*	*0.895*	*7.850*	*8.769*	*0.895*
NYCD	*-3.075*	*12.513*	*-0.246*	*-3.075*	*12.513*	*-0.246*	*-3.075*	*12.513*	*-0.246*
LONDOND	*-7.078*	*12.512*	*-0.566*	*-7.078*	*12.512*	*-0.566*	*-7.078*	*12.512*	*-0.566*
AMSTERD	*-7.160*	*13.372*	*-0.535*	*-7.160*	*13.372*	*-0.535*	*-7.160*	*13.372*	*-0.535*
CHRISTIE	*27.309*	*12.560*	*2.174**	*27.309*	*12.560*	*2.174**	*27.309*	*12.560*	*2.174**
SOTHEBYS	*12.008*	*12.832*	*0.936*	*12.008*	*12.832*	*0.936*	*12.008*	*12.832*	*0.936*
(H^A-L)	*0.249*	*.021*	*11.744**	*-0.251*	*0.2*	*-35.372**	*-0.75*	*0.2*	*-35.372**
Adj-R2	*0.091*			*0.06*			*0.36*		
F-statistic	*8.9**			*6.45 **			*46.2 8*****		

Regression results are presented in Table 2. The most straightforward result is that the coefficients a_1, b_1, and c_1 are less than *0.5*, *0*, and –0.5 respectively, which is consistent with an overestimation that is increasing with the width of the estimation window. Equation *(14)* shows the coefficient of *(H^A-L)* at 0.249 (the number is statistically different from 0.5), equation *(15)* shows the coefficient of *(H^A-L)* at -0.251 (the number is statistically different from *0*), and equation *(16)* shows the coefficient of *(H^A-L)* at -0.75 (the number is statistically different from *–0.5*). We interpret this as confirmation that *(P-L)* grows at a slower rate than *(H^A-L)*. In other words, our paintings tend to become overestimated to a greater extent (or underestimated to a lesser extent) as the estimation window widens. Since wider estimation windows are associated with more expensive pieces, we offer corroborating evidence to the findings of Mei and Moses (2005) that more expensive paintings tend to be overestimated to a greater extent.

The inclusion of Christie's in the sample causes the expected *(P-L)* to grow, thus decreasing the likelihood of overestimation; the same is true of paintings executed in oil on canvas: the coefficient of *DMED* is at 9.98 and is statistically significant. The orientation of the canvas (portrait or landscape) appears to have no bearing on our results, as the coefficient of *ORIENTD* is not significant. The inclusion of Appel in the sample appears to cause the expected *(P-L)* to shrink, thus increasing the likelihood of overestimation. While this result is consistent with the statistics presented in Table 1, we are surprised that the coefficient for Klee is not larger in absolute value and more significant than that for Appel. Artworks by Klee appear overestimated to a greater extent than those by Appel according to Table 1. It is thus puzzling why Appel alone shows a significant coefficient in this regression. It is also puzzling why he should be overestimated to a greater extent in relation to Mirro or Kandinsky, for Appel has the lowest market valuation of the four. This result is at odds with studies that suggest a tendency to overestimate expensive, prestigious pieces of art [Mei and Moses, (2005)]. For the remaining regressors, the standard error of the estimated coefficients is too large to draw any meaningful conclusions.

Another striking result is that equation *(14)* has a much lower explanatory power than equation *(16)*. The adjusted R-square for equation *(16)* is 36.5%, while the adjusted R-square for equation *(14)* is a meager 9%. Equation *(15)* is obviously a linear combination of the other two. This difference is consistent with our conjecture illustrated by equations *(12)* and *(13)*. We have

hypothesized that $E(P) - L$ is explained by the width of the estimation window only when the transaction takes place at a price above the reservation price. When the painting is sold at the reservation price, $E(P) - L$ should be explained only by an unobservable variable R, which is the difference between the observed low estimate and the reservation price S. In light of this argument, model *(14)* is obviously under-specified. By contrast, model *(16)* appears better specified: $E(P) - H^A$ is explained in all instances by the width of the estimation window, although when the painting is sold at the reservation price, R represents an additional unobservable explanatory variable. While one can argue that model *(16)* is also under-specified, it is, however, clear that is better specified than *(14)*. Our results fully confirm this contention[3].

We also estimate the following alternative model specification:

$$L/P = a_0 + a_1[(H^A - L)/P] + a_i\Sigma X_i + e \quad (17)$$

$$M/P = b_0 + b_1[(H^A - L)/P] + a_i\Sigma X_i + e \quad (18)$$

$$H/P = c_0 + c_1[(H^A - L)/P] + a_i\Sigma X_i + e \quad (19)$$

Here again, we expect that the specification in model (19) would have more explanatory power than the specification in model (17) for the same reasons discussed above. Model (17) is less well specified than model (19), because $(H^A - L)/P$ explains the dependent variable only when the transaction takes place above the reservation price. In model (19), even though R is still missing, $(H^A - L)/P$ continues to have explanatory power even when the transaction takes place at the reservation price. We also hypothesize that the coefficients of $(H^A - L)/P$ in all three equations should be positive.

*Table 3. Regression results. The relative price distance from the low estimate (L/P), estimation window mid-point (M/P). and high estimate (H^A/P) is regressed against the observed relative width of the estimation window (H^A-L), a series of dummy variables accounting for the identity of the painters (MIRRO, APPEL, KLEE), the medium used (DMED =1 for oil on canvas), the orientation of the canvas (ORIENTD =1 for landscape-oriented canvases, the years 1987 through 2003 (Y1987 – Y2003), the location of the auction (PARISD = 1 for Paris, NYCD = 1, for New York, LONDOND = 1 for London, AMSTERD = 1 for Amsterdam), and the auctioneer (CHRISTIE, SOTHEBYS). All regression coefficients are un-standardized. T-Statistics significant at the level of 5% and below are identified with *.*

	L/P			***M/P***			***H^A/P***		
		Std. Error	*t*		*Std. Error*	*t*		*Std. Error*	*t*
Const.	*0.885*	*0.067*	*13.308**	*0.885*	*0.067*	*13.308*	*0.885*	*0.067*	*13.308*
MIRO	*-0.0113*	*0.039*	*-0.294*	*-0.0113*	*0.039*	*-0.294*	*-0.0113*	*0.039*	*-0.294*
APPEL	*0.125*	*0.040*	*0.317*	*0.125*	*0.040*	*0.317*	*0.125*	*0.040*	*0.317*
KLEE	*0.02*	*0.041*	*0.502*	*0.02*	*0.041*	*0.502*	*0.02*	*0.041*	*0.502*
DMED	*-0.006*	*0.023*	*-0.279*	*-0.006*	*0.023*	*-0.279*	*-0.006*	*0.023*	*-0.279*
ORIENTD	*-0.015*	*0.020*	*-0.759*	*-0.015*	*0.020*	*-0.759*	*-0.015*	*0.020*	*-0.759*
Y1987	*0.08*	*0.107*	*0.754*	*0.08*	*0.107*	*0.754*	*0.08*	*0.107*	*0.754*
Y1988	*-0.027*	*0.114*	*-0.242*	*-0.027*	*0.114*	*-0.242*	*-0.027*	*0.114*	*-0.242*
Y1989	*-0.084*	*0.118*	*-0.710*	*-0.084*	*0.118*	*-0.710*	*-0.084*	*0.118*	*-0.710*
Y1990	*-0.0074*	*0.091*	*-0.081*	*-0.0074*	*0.091*	*-0.081*	*-0.0074*	*0.091*	*-0.081*
Y1991	*0.167*	*0.163*	*1.024*	*0.167*	*0.163*	*1.024*	*0.167*	*0.163*	*1.024*
Y1992	*0.146*	*0.080*	*1.831**	*0.146*	*0.080*	*1.831*	*0.146*	*0.080*	*1.831*
Y1993	*0.009*	*0.061*	*0.151*	*0.009*	*0.061*	*0.151*	*0.009*	*0.061*	*0.151*
Y1994	*0.114*	*0.060*	*1.907**	*0.114*	*0.060*	*1.907*	*0.114*	*0.060*	*1.907*

Y1995	*0.034*	*0.060*	*0.568*	*0.034*	*0.060*	*0.568*	*0.034*	*0.060*	*0.568*
Y1996	*0.093*	*0.059*	*1.566*	*0.093*	*0.059*	*1.566*	*0.093*	*0.059*	*1.566*
Y1997	*0.079*	*0.058*	*1.371*	*0.079*	*0.058*	*1.371*	*0.079*	*0.058*	*1.371*
Y1998	*0.033*	*0.056*	*0.594*	*0.033*	*0.056*	*0.594*	*0.033*	*0.056*	*0.594*
Y1999	*-0.047*	*0.057*	*-0.822*	*-0.047*	*0.057*	*-0.822*	*-0.047*	*0.057*	*-0.822*
Y2000	*0.068*	*0.061*	*1.120*	*0.068*	*0.061*	*1.120*	*0.068*	*0.061*	*1.120*
Y2001	*0.004*	*0.059*	*0.074*	*0.004*	*0.059*	*0.074*	*0.004*	*0.059*	*0.074*
Y2002	*0.021*	*0.059*	*0.351*	*0.021*	*0.059*	*0.351*	*0.021*	*0.059*	*0.351*
Y2003	*0.025*	*0.072*	*0.354*	*0.025*	*0.072*	*0.354*	*0.025*	*0.072*	*0.354*
PARISD	*-0.151*	*0.044*	*-3.424**	*-0.151*	*0.044*	*-3.424*	*-0.151*	*0.044*	*-3.424*
NYCD	*0.049*	*0.063*	*0.777*	*0.049*	*0.063*	*0.777*	*0.049*	*0.063*	*0.777*
LONDOND	*0.02*	*0.063*	*0.317*	*0.02*	*0.063*	*0.317*	*0.02*	*0.063*	*0.317*
AMSTERD	*0.043*	*0.067*	*0.636*	*0.043*	*0.067*	*0.636*	*0.043*	*0.067*	*0.636*
CHRISTIE	*-0.193*	*0.063*	*-3.053**	*-0.193*	*0.063*	*-3.053*	*-0.193*	*0.063*	*-3.053*
SOTHEBYS	*-0.147*	*0.065*	*-2.282**	*-0.147*	*0.065*	*-2.282*	*-0.147*	*0.065*	*-2.282*
(H^A-L)/P	*0.281*	*0.019*	*14.497**	*0.781*	*0.019*	*40.306**	*1.281*	*0.019*	*66.116**
Adj-R2	*0.1*			*0.42*			*0.665*		
F-statistic	*9.8**			*60.1**			*157**		

Results are presented in Table 3. The coefficients of (H^A –L)/P are indeed positive (0.281, 0.781, and 1.281) and significant. As predicted the explanatory power of equation (19) is much higher at 66.7%, compared to that of equation (17) at only 10%. The other coefficients are in general consistent with the previous specification. The coefficients for Christie's and Sotheby's are now both significant, indicating a lower likelihood of overestimation. It is conceivable that Sotheby's and Christie's bargaining position in dealing with art collectors is stronger than that of other lesser known auction houses; hence, their experts can resist the pressure to set higher reservation prices. Of course, the argument of conservatism cannot be completely dismissed, but the case for reservation prices is very strong.

Another interesting result is the lower chance of overestimation occurring in Paris. In the post-World War II era, the art hype has migrated from Paris to New York, where the bid-up of art prices has been amplified by the wealth flowing from the New York Stock Exchange and the proximity of Wall Street. Whether New York deserves its newfound status of art capital of the world remains an issue to be debated by art critics and historians. We simply speculate that this could be one possible argument explaining our results.

Conclusions

The question of whether the midpoint of the estimation interval is indeed an unbiased estimator of hammer prices at art auctions has elicited substantial attention lately. The results are mixed; some studies find an upward bias, some find a downward bias, and some other find no bias at all.

We produce here a new hypothesis that hopefully sheds more light on the existing empirical riddle. We argue that the key element to understanding the dynamic of pre-auction estimates and hammer prices is the reservation price. The existence of a reservation price sometimes forces the auction house to revise its lower estimate upwards (but not necessarily the high estimate, which is not subject to any particular exogenous constraints), hence creating the appearance of overestimation with respect to the midpoint of the estimation window. The extent to which the auctioneer will adjust the estimate depends on the bargaining power held by the owner of the artwork,

which in turn is a function of particular market conditions. We conjecture that the observed low estimate is a linear transformation of the secret reservation price. As a corollary, the low pre-auction estimate should be taken as a more powerful, precise and accurate predictor of hammer prices.

To test our hypothesis we utilize a panel data sample consisting of 2,308 abstract paintings by Paul Klee, Wassily Kandinsky, Juan Miro, and Karel Appel. We have purposely selected only abstract art in order to control for the hard-to-quantify influence of subject matter. Our results document unequivocal overestimation of abstract art. We also find that indeed, the low pre-auction estimate appears as a more powerful, accurate and a lower variance predictor of hammer prices than the high estimate. There is enough circumstantial evidence to suggest that what other earlier studies have observed could be due in part to the influence of reservation prices in the context of particular market conditions. For example, the findings of Mei and Moses (2005) can be interpreted in a new light. Artworks that are perceived to have a very high market valuation might appear overestimated simply because their sellers would require a high reservation price to match the clout and glamour of their paintings.

In the end, we have obtained these results using a relatively simple methodology and relying heavily on the results brought forward by previous studies. Yet we feel that our contribution is insightful. We believe that we are able to account for the incongruous findings observed so far in a better way than before. We hope that future research will confirm our view.

End notes

[1] Miro – considered one of the most original modern artists – is also known for proposing exotic concepts, such as *four dimensional painting*

[2] Oil on canvas pieces have always been considered somewhat more valuable than watercolors, tempera, and acrylics, *caeteris paribus*. Oil is the most versatile medium, adaptable to a dazzling array of techniques, methods, and artistic currents; an overwhelming majority of masterpieces are oil on canvas. In addition to being so flexible and artistically subtle, oil on canvas is also extremely durable; it is the most likely to endure the passage of time

[3] We also estimated a specification that accounts for the interaction between (HA-L) and the dummies representing Sotheby's and Christie's. Since the results are consistent with equation (17), (18), and (19) but do not add much in terms of explanatory power, we chose not to report them here

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