Investing in Art: the Informational Content of Italian Painting Pre-Sale Estimates

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Abstract

As the size of the art market increases and a growing number of investors are attracted by the high returns, the amount and quality of information available to market participants becomes increasingly relevant, especially for less experienced investors. One of the most relevant information sources in the art market is the price estimate provided by auction houses, that is the price that auctioneers believe a piece of art might bring at auction. Auction houses are regarded as providing additional valuable information to market participants. Thus pre-sale estimates could be useful reference points in the art valuation process, driving operators' investment and divestment decisions. However, as the price of each unique artwork is affected by inconstant and intangible factors, estimates are usually expressed as a range within which the experts forecast the final price will fall. The informational content of such estimates can be examined along two dimensions: the uncertainty and the accuracy of estimates in predicting sale prices. We test for any systematic differences in predicting hammer prices using a sample of 1,975 sales of Italian paintings which were sold all over the world at least twice during the 1985-2006 period. Three results emerge from the empirical evidence. First, pre-sale estimates are not good predictors of final sale prices. Second, uncertainty and accuracy in price prediction decreases and increases, respectively, when Italian paintings are auctioned in Italy, thus revealing a "Country effect". Finally, the informational content of estimates is affected by past prices, thus revealing an "anchoring effect".

Keywords: *Art investment, Art prices, Pre-sale estimates, Anchoring, Italian paintings.*

JEL classification: *D*44, *G*14, *Z*10

1. INTRODUCTION(*)

The global art market has experienced an extraordinary growth worldwide over the last years, recording an estimated Euro 45 billion worth of sales in 2005 and achieving a growth in sales of 95 percent in terms of value and 24 percent in terms of transaction numbers over the previous 5 years (McAndrew, 2008).

At the origin of this growth is the vast global increase in art demand. Indeed, a new generation of buyers, both private and institutional, has come into the art market, attracted by the expected high returns and low correlations of art as investment.

As the art market becomes more important, the characteristics of art as investment have been extensively analyzed in the literature.

Most of the studies concern the development of art price indices and the evaluation of risk-return of art investment with respect to investment in traditional financial assets (Baumol, 1986; Goetzmann, 1993; Mei and Moses, 2002; Campbell, 2008). While results differ according to the methodology, the time period, and the art portfolio considered, the general conclusion has been that art has low correlation with financial asset classes but provides a lower average risk-adjusted return. Other works investigate the use of art as collateral for loan contracts (McAndrew and Thomson, 2007) and propose new credit derivatives for hedging credit risk of art-backed loans (Campbell and Wiehenkamp, 2008).

Another branch of art research focuses on the relationship between art prices and pre-sale estimates provided by auction houses together with other information on the artworks on sale contained in the catalogues published before each auction.

The rationale behind auction houses' estimates is to level the playing field between the wholesale and retail customers in the art market and attract individual collectors (Mei and Moses, 2005).

According to Sotheby's an auction estimate is "a price that the auction house's specialists believe a piece might bring at auction". Given the nature of their profession, auctioneers seem to be in the best position to predict the best possible estimate of the expected hammer price and artwork pre-sale estimates could be useful reference points for any art valuation process and should drive operators' investment and divestment decisions. Moreover, since the price of each unique artwork is normally affected by inconstant and intangible factors, estimates are usually expressed as a range within which the experts forecast the final price will fall.

From the point of view of an investor, it is crucial to understand the predictability power of pre-sale estimates. This is particularly true for inexperienced (albeit wealthy) individual investors, who are likely to be subject to behavioral biases (Mei, Moses, and Xiong, 2004).

This paper belongs to the second stream of research, since it aims at investigating the informational content of pre-sale estimates. We define the information content of estimates through two main dimensions: (1) the uncertainty and (2) the accuracy of estimates.

We consider the width of the estimate range as an indicator of the uncertainty in predicting sale prices (the greater the uncertainty, the wider the range). The prediction uncertainty may differ among auction houses, for instance because of their different policies in setting estimates or expertise in valuing artworks. The uncertainty may also depend on the specific attributes or the collecting category of the individual piece of art. Other elements may affect the auctioneer's confidence in setting estimates. Bidders' behaviours may be more predictable in some marketplaces/countries. Finally, further information on the artwork (*e.g.*, the item price history) may reduce the auctioneer's prediction uncertainty.

Possible measures of the precision (accuracy) of pre-sale estimates include: (1) the frequency of times the hammer price falls into the pre-sale estimate range; (2) the distance between the hammer price and a punctual estimate of the hammer price itself, as indicated by the average between the low and high estimates. Furthermore, pre-sale estimates may turn

out to be biased, when auction houses systematically either overvalue or undervalue hammer prices.

To our knowledge, we are the first to investigate the informational content of pre-sale estimates as defined above. The existing contributions from the relevant literature on auction prices only address particular aspects of the issue.

Most of the research on the informational efficiency of art auctions has been concerned with the biasedness of pre-sale estimates. In this respect, opinions differ widely. Ashenfelter (1989) claims that estimates are usually accurate, being highly correlated with the prices achieved, though estimates do not consider all the relevant information. Lourgand and McDaniel (1991), by analysing estimates and prices achieved by Sotheby's in New York, also find that auctioneers do not underestimate to a significant extent. Similarly, Abowd and Ashenfelter (2002), using Impressionist painting prices fetched at Sotheby's and Christie's in London and New York, show that pre-sale estimates are usually good predictors of hammer prices.

In contrast, many authors have provided empirical evidence of the biasedness of pre-sale estimates. According to Beggs and Graddy (1997), overvaluations and undervaluations occur frequently. In their paper, they find that more recently executed Contemporary and Impressionist & Modern artworks are commonly overvalued. According to Ekelund, Ressler, and Watson (1998), estimates are biased. By studying the Latin American art market, they claim that auction houses tend to underestimate prices. McAndrew and Thompson (2004), looking at French Impressionist paintings sold by a large number of international auction houses, show that there is a tendency to underestimate hammer prices when considering only sold items. However, estimates turn out to be unbiased when all items (including unsold works) are included in the analysis. Bauwens and Ginsburgh (2000), by observing English silvery auctioned by Sotheby's and Christie's, show that estimates are slightly biased and that experts do not use all the information that is available to them when making their

estimates. Czujack and Martins (2004), on the basis of a data set of Picasso paintings sold at Christie's and Sotheby's, show that no significant differences exist between the two houses in predicting prices and that auction houses could not provide better estimates even using all available information. Sproule and Valsan (2006) reach similar conclusions using data from the sales of four abstract painters (Vassily Kandinsky, Juan Miro, Paul Klee, and Karel Appel): hedonic regressions do not seem to make pre-sale estimates more reliable. Finally, Mei and Moses (2005), by analysing a large data set of paintings sold by Sotheby's and Christie's at least twice, find that pre-sale estimates contain an upward bias for expensive paintings over a long period of thirty years.

Another question addressed by the literature on art auction prices is whether the width of the range affects the probability of sale. Ekelund, Ressler, and Watson (1998) try to understand whether a narrow range increases the probability of no-sale. According to the authors, if the range is narrow because of a high reserve price, the painting is likely to be overvalued. If buyers understand this, they might be less willing to bid for that particular painting. Results show that the "window" (*i.e.*, the difference between the high and low estimates) is negatively and significantly related to the likelihood of no-sale. Ashenfelter, Graddy, and Stevens (2002) observe the opposite phenomenon, since a larger estimate range should involve a lower probability of sale.

Some works on art auction prices focus on price differences across auction houses and geographical markets. In this respect, Pesando (1993) tests the "law of one price" by comparing Modern print prices realized in the United States with those realized in London and Europe. Differences are striking, since prices are much higher in the United States than in either London or Europe. Furthermore, prices are higher in London than in the rest of Europe. Pesando also observes some differences among auction houses. He finds that prices are on average higher at Sotheby's than at Christie's in New York, while no significant differences exist between the same auction houses in London. Mei and Moses (2002) also

analyse the law of one price. They show that return differences between the two major auction houses appear to be small. Although they provide some evidence that purchase prices are somewhat higher for Old Masters at Sotheby's, it appears that significant differences only exist between the two big auction houses and the minor ones. Higgs and Worthington (2006) provide the same evidence on the Australian market for Modern and Contemporary art, where prices at both Sotheby's and Christie's seem to be on average higher if compared with prices fetched at minor auction houses.

Another aspect investigated by the literature on auction dynamics is whether anchoring effects exist. According to Beggs and Graddy (2007), there is an anchoring effect for both sale prices and estimates, since the prices and the low estimates for second sales appear to be influenced by past prices. This may confirm that estimates are provided by auctioneers by using various sorts of information, including the prices fetched at previous auction sales.

In this paper we aim at answering three main questions: (1) Are the auctioneers good predictors of auction prices? (2) Which factors do affect estimate uncertainty? (3) Which factors do affect the accuracy in predicting auction prices?

To answer these questions, we employ a unique data set of Italian paintings which were sold by 15 auction houses all over the world at least twice over the period from 1985 to 2006.

Three main findings emerge from our analysis. First, pre-sale estimates are not good predictors of hammer prices. Second, the uncertainty and accuracy in price prediction decreases and increases, respectively, when Italian paintings are auctioned in Italy, thus revealing a "Country effect". Third, the informational content of estimates is affected by past prices, thus revealing some anchoring effect.

Our study complements the existing literature on art as investment and the relationship between auctioneers' estimates and prices along two main directions. First, in examining the pre-sale estimate predictability power, we consider both dimensions of informational content of auctioneers' estimates (*i.e.,* uncertainty and accuracy). Second, we directly investigate a

heterogeneous set of variables which might explain the differences in the informational content of the estimates provided by a large array of auction houses operating in different countries.

The paper proceeds as follows: section 2 presents the methodology of the empirical analysis; section 3 describes the data sources and summarizes the sample characteristics; section 4 presents the empirical results; section 5 concludes.

2. RESEARCH METHODOLOGY

The empirical analysis aims at testing for any systematic differences in estimate uncertainty and accuracy.

2.1. Uncertainty in prediction

To examine which factors affect the uncertainty in predicting prices, the following regression model is estimated:

$$\text{PRICERANGE} = f(\textit{Collecting Category}, \textit{Auction House}, \text{D\_Italy}, \textit{Sale Characteristics}, \textit{Control}) + \varepsilon \quad (1)$$

PRICERANGE is the ratio of the estimate range to the minimum of the pre-sale price range estimate, that is: (Maximum of the pre-sale price range – Minimum of the pre-sale price range) / Minimum of the pre-sale price range. We use this measure as a proxy for the auctioneer's prediction uncertainty, assuming that the auctioneer would increase the pre-sale estimate range as the hammer price becomes harder to predict.

Collecting Category is a set of dummy variables (D_CLASS, D_XIX_CENT, D_MODERN, D_CONT) which equal 1 if the painting belongs to the Classical, 19th Century, Modern, and Contemporary collecting category, respectively, and zero otherwise([1]). We suspect that the value of paintings belonging to some collecting categories

might be either easier or more difficult to predict. If so, by adding the Collecting Category dummy variables in the regression model, we should control for any differences in predicting hammer prices.

Auction House is a set of dummy variables (D_CHRISTIE'S, D_FINARTE, D_SOTHEBY'S, D_OTHAUCTION) which equal 1 if the painting is sold by Christie's, Finarte, Sotheby's or by any other auction house, respectively, zero otherwise([2]). We use this set of variables to control for any differences in auction houses' confidence in predicting hammer prices. We expect that major auction houses may rely upon more expertise and a wider set of information on the artwork and/or the market (*e.g.,* bidders' behaviors). If so, a negative coefficient sign of the D_CHRISTIE'S and D_SOTHEBY'S variables on PRICERANGE is expected.

D_ITALY is a dummy variable that equals 1 if the painting is sold in Italy and zero otherwise. We suspect that there is a comparative advantage for auction houses in the valuation process when the "nationality" of the artwork (*e.g.,* Italian paintings) is the same as that of the auction house (*e.g.,* Christie's located in Rome or Finarte in Milan). Such effect would suggest a negative coefficient sign on PRICERANGE.

Sale Characteristics variables include:

D_PREVSALE – a dummy variable that equals 1 if there is at least one previous sale for the painting in the sample and zero otherwise. The anchoring effect argument would suggest that the outcome of past auctions will provide additional information to experts. We assume that it is valuable to know if a piece of art was bought-in in a previous auction or was sold at a certain price. This sort of information will make it easier for an auctioneer to predict the hammer price. Since our sample include only sold items, we only consider the anchoring effect due to the existence of past prices, as captured by the D_PREVSALE variable. We expect a negative coefficient sign.

Moreover, in order to test if the anchoring effect is stronger when many past prices exist, we use a different configuration for the D_PREVSALE variable, substituting it with the following set of dummy variables: D_2nd sale – a dummy variable that equals 1 if there is one previous sale for the painting in the sample and zero otherwise; D_3rd sale – a dummy variable that equals 1 if there are two previous sales for the painting in the sample and zero otherwise; D_4th sale – a dummy variable that equals 1 if there are three previous sales for the painting in the sample and zero otherwise. We would expect a negative coefficient sign for each of these variables.

LOWESTIMATE – low pre-sale estimate (in Euro – 2006 prices). We suspect that prices of more valuable paintings might be easier to predict. In this case, we would expect a negative coefficient sign on PRICERANGE.

Finally, in order to control for time specific effects, we include the following year dummy variables: D_1985, … , D_2006. Each dummy variable is equal to 1 if the sale observation refers to the corresponding year and zero otherwise([3]).

2.2. Accuracy in prediction

To examine which factors affect the accuracy in predicting art prices, we conduct two alternative analyses. First, we estimate the following regression model:

$$\text{ABSDISTANCE} = f(\textit{Collecting Category}, \textit{Auction House}, \text{D\_Italy}, \textit{Sale Characteristics}, \textit{Control}) + \varepsilon \quad (2)$$

where ABSDISTANCE is the absolute value of the ratio of the distance between the hammer price and the midpoint of the estimate range to the midpoint of the range. This variable is negatively correlated to the auction house's accuracy in predicting art prices. In fact, its minimum value, that is 0, would denote a perfect predictive ability.

In this analysis, the *Sale Characteristics* set of variables also includes the PRICERANGE variable. We assume that the greater the uncertainty, the lower the accuracy in predicting

hammer prices. Therefore, we expect a positive coefficient sign for this variable in the ABSDISTANCE regression.

Moreover, we estimate the following logit regression model:

$$\Pr(\text{D\_ONTARGET}) = f(\textit{Collecting Category}, \textit{Auction House}, \text{D\_Italy}, \textit{Sale Characteristics}, \textit{Control}) + \varepsilon \quad (3)$$

where D_ONTARGET is a dummy variable which equals 1 if the hammer price falls in the auction house's pre-sale estimate range and 0 otherwise.

3. DATA SOURCES AND SAMPLE CHARACTERISTICS

We use auction sales data of all Italian paintings which were sold at the salerooms of 15 auction houses all over the world at least twice from 1985 to 2006 (inclusive), as provided by the Gabrius database.

Our data set consists of 1,975 sales relating to 967 different paintings created by 457 different Italian artists. Each individual sale is considered as a unique point in our database. In particular, we end up with a sample of 927 double sales, 39 triple sales and one quadruple sale. Paintings in our data set come from four different collecting categories (Classical, 19th Century, Modern and Contemporary art).

Tables 1.*a* and 1.*b* show the number of sale observations for the major auction houses([4]), the four collecting categories, and the countries([5]) where the sale took place.

4. EMPIRICAL RESULTS

Descriptive and univariate analysis

Table 2 reports the number and frequency of correct pre-sale estimates (*i.e.*: if the hammer price falls into the pre-sale estimate price range), pre-sale underestimates (*i.e.*: if the

hammer price is above the maximum estimate), and pre-sale overestimates (*i.e.*: if the hammer price is below the minimum estimate). Values are provided for the entire sample and are also broken up into auction house, collecting category and country subsamples, in order to detect any interesting differences. The proportion of hammer prices that fall within the range is an overall 37% and varies between 33% for paintings sold by Finarte and 40% for paintings sold by Christie's, between 36% for Classical paintings and 42% for Contemporary art paintings, and between 34% for paintings sold in the US and 39% for paintings sold in Europe, apart from Italy.

The proportion of hammer prices that fall below the minimum estimate is quite high (20% overall), even if our sample includes only paintings which reached the reserve price set by the seller.

Table 3 shows sample descriptive statistics for both price (*i.e.*, HAMMER) and estimation variables, including RANGEAVERAGE (*i.e.*, the midpoint of the pre-sale price range), PRICERANGE, DISTANCE (*i.e.*, the distance between the hammer price and the midpoint of the range, normalized by dividing it by the range midpoint), and ABSDDISTANCE. Again, statistics are provided for the entire sample and are also broken up into auction house, collecting category and country subsamples.

In Table 4 (Panels 1-3) we perform *t*-tests for equality of variable means of items sold in Italy vs. out of Italy, items sold by Christie's vs. Sotheby's, and items sold by Finarte vs. either Christie's or Sotheby's. In order to conduct this analysis we use three different samples. We use our entire sample (Panel 1) as we are interested in documenting any differences between sales that took place in Italy and out of Italy, regardless of the auction house involved in the sale. Conversely, we use two different subsamples to analyse Christie's vs. Sotheby's (Panel 2) and Finarte vs. either Christie's or Sotheby's (Panel 3).

By comparing items sold in Italy vs. those sold out of Italy (Panel 1), we document that artworks sold in Italy are less valuable. Not surprisingly, the midpoint of the estimate range

is lower for items sold in Italy. These results are consistent with the evidence that art prices are on average higher in the US and UK compared to other countries. For instance, since their launch in 1999, Italian sales in London have generated higher average prices than in Italy (see Kusin & Co., 2002). In this respect, it is worth saying that 48% of the observations in our sample refer to items sold either in London (28.2%) or in New York (19.8%) by Christie's (25.3%) or Sotheby's (22.7%). Interestingly, both PRICERANGE and ABSDISTANCE are lower for items auctioned in Italy, thus showing less uncertainty and more accuracy in predicting hammer prices. We might refer to this result as a sort of "Country effect", meaning the auctioneers' superior ability to value a collectible if they are based in the same country of provenance of the piece of art. Finally, items sold in Italy exhibit a lower (and negative) difference between the hammer price and the midpoint of the estimate range, therefore showing an overestimating tendency of Italian-based experts versus an underestimating tendency of other auctioneers.

As for the comparison between sales at Christie's vs. those at Sotheby's (Panel 2), we find that Sotheby's HAMMER, RANGEAVERAGE, and PRICERANGE are greater than those of Christie's and these differences are statistically significant. There is no significant difference in terms of DISTANCE and ABSDISTANCE.

By comparing the sales effected by Finarte vs. those realized by either Christie's or Sotheby's (Panel 3), we find evidence of the same phenomena as observed in Panel 1. In fact, since all of Finarte's salerooms are located in Italy, at this univariate stage of the analysis, the Country effect and the auction house effect are virtually undistinguishable.

Regression analysis

Table 5 shows the OLS regression estimates of Equations (1) and (2). For each of these equations we run different OLS regressions. In the regressions in columns 1, 3, and 5 we test the anchoring effect by including the D_2nd sale, D_3rd sale, and D_4th sale dummy

variables, whereas in those in columns 2, 4, and 6 we use a single dummy variable (D_PREVSALE).

As far as PRICERANGE regressions are concerned (columns 1 and 2), consistently with our expectations, we find that D_2nd sale and D_3rd sale (column 1) and D_PREVSALE (column 2) have a significant negative coefficient, denoting that the existence of a previous price makes the pre-sale estimate range narrower: in other words, it adds further information to the auctioneer, thus increasing his confidence in setting estimates.

The significant negative sign of the D_ITALY variable denotes that when an auction (of Italian collectibles) takes place in Italy, auctioneers are, on average, more confident in setting pre-sale estimates.

Auction houses behave differently, as proved by the significant coefficients of the D_SOTHEBY'S and D_CHRISTIE'S (positive) and D_FINARTE (negative) variables. On average, Sotheby's and Christie's set a wider pre-sale price range than Finarte.

The significant negative coefficient of the D_MODERN variable suggests that the auction houses' uncertainty in predicting painting prices increases when artworks belong to the Modern collecting category.

As far as ABSDISTANCE regressions are concerned (columns 3 to 6), we find that D_2nd sale (columns 3 and 5) and D_PREVSALE (columns 4 and 6) have a significant negative coefficient, showing that the existence of a previous price makes the midpoint of the pre-sale estimate range closer to the actual hammer price. Moreover, the significant negative sign of the D_ITALY variable indicates that when an auction (of Italian collectibles) takes place in Italy, auctioneers set pre-sale estimates which are, on average, closer to hammer prices. Thus, a "Country effect", or a "preferred habitat effect", would affect not only the confidence but also the accuracy of auction houses in predicting art prices.

Table 6 shows the logit regression estimates of Equations (3). Again, we run two regressions. In the first one (column 1) we test the anchoring effect by including the D_2nd

sale and D_3rd sale dummy variables, whereas in the second one (column 2) we use a single dummy variable (D_PREVSALE). The anchoring effect and the Country effect are still confirmed. Consistently with our expectations, the coefficient of the PRICERANGE variable is significantly positive, that is: the wider the PRICERANGE, the higher the probability that the hammer price will fall into the pre-sale estimate range.

5. CONCLUSIONS

Unlike financial assets, art assets are difficult to price. Thus, pre-sale estimates provided by auctioneers can be a useful informative tool for art market participants. This paper investigates the nature of the informational content of pre-sale estimates. We expected that uncertainty and accuracy of estimates might vary according to subjective (*i.e.*, auctioneers' characteristics) and objective (*i.e.*, artworks' features) differences as well as according to differences in the available information (*e.g.*, the history of previous sales).

Descriptive analysis shows that pre-sale estimates are not good predictors of the realized prices, since the proportion of hammer prices falling within the pre-sale estimate range is only 37%. Nonetheless, such a small figure is similar to the results from other studies (*e.g.*, Bauwens and Ginsburgh, 2000) and might be explained by the biasedness of pre-sale estimates.

Furthermore, our results show that, on the one hand, estimates provided by different auction houses exhibit different degrees of uncertainty. On the other hand, there is no evidence of any differences among auction houses in prediction accuracy. In addition, we find that the auctioneers' uncertainty and accuracy in price prediction decreases and increases, respectively, when Italian paintings are auctioned in Italy, no matter which auction house is considered. A sound knowledge of the Italian art market (*e.g.*, investors' tastes and expense behavior) on the part of Italian-based auction houses rather than superior expertise

in valuing Italian art may be a possible argument for this Country effect. Finally, the empirical evidence confirms the relevance of past prices in setting estimates, thus revealing some anchoring effect.

Our research has left some interesting issues. While we have provided further evidence of the poor reliability of pre-sale estimates in general, one may wonder what causes the differences in the informational content of estimates among different geographic markets and/or different auction houses. Explanatory factors might be found in the auctioneers' strategy in determining pricing as well as in technical and structural elements of art markets. We will leave these for future research.

ENDNOTES

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(1) The D_CLASS dummy variable has been dropped to avoid collinearity in the data.

(2) The D_OTHAUCTION dummy variable has been dropped to avoid collinearity in the data.

(3) The D_1985 dummy variable has been dropped to avoid collinearity in the data.

(4) Even though the sales in our sample referred to 15 different auction houses (Artcurial Briest, Bukowskis, Bonhams, Bruun Rasmussen, Christie's, Doyle, Dorotheum, Finarte, Koller, Lempertz, Neumeister, Porro & C., Piasa, Sotheby's, Tajan), in both the descriptive and the regression analysis we classified sales, and hence observations, according to four classes: Christie's, Finarte, Sotheby's, and Other auction houses. This simplification occurred because the number of observations referring to other auction houses than Christie's, Finarte, or Sotheby's was negligible.

(5) Again, even though the sales in our sample refer to 11 different countries (Austria, Denmark, Finland, France, Germany, Italy, Switzerland, Sweden, the Netherlands, the UK, and the US), in our descriptive analysis we classify sales, and hence observations, according to three classes: Italy, Europe (ex Italy), and the US. This simplification occurs because the number of observations referring to other (European) countries than Italy or the US is negligible.

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Table 1.*a* – Number and Frequency (in Parenthesis) of Observations

	Total	Christie's	Finarte	Sotheby's	Other Auction houses	Italy	Europe (ex Italy).	US	Classical	19th cent.	Modern	Contemporary
1985	12	0	7	5	0	9	0	3	0	4	8	0
	(0.006)	(0.000)	(0.013)	(0.009)	(0.000)	(0.012)	(0.000)	(0.007)	(0.000)	(0.009)	(0.013)	(0.000)
1986	31	4	22	5	0	22	5	4	0	12	19	0
	(0.016)	(0.006)	(0.042)	(0.009)	(0.000)	(0.029)	(0.006)	(0.010)	(0.000)	(0.026)	(0.030)	(0.000)
1987	55	17	28	10	0	28	15	12	0	34	19	2
	(0.028)	(0.026)	(0.053)	(0.018)	(0.000)	(0.036)	(0.019)	(0.029)	(0.000)	(0.073)	(0.030)	(0.010)
1988	68	12	38	18	0	38	22	8	0	38	25	5
	(0.034)	(0.018)	(0.072)	(0.032)	(0.000)	(0.049)	(0.028)	(0.020)	(0.000)	(0.081)	(0.039)	(0.026)
1989	61	18	39	3	1	40	10	11	1	29	31	0
	(0.031)	(0.027)	(0.074)	(0.005)	(0.004)	(0.052)	(0.013)	(0.027)	(0.001)	(0.062)	(0.049)	(0.000)
1990	197	44	92	48	13	101	58	38	48	37	85	27
	(0.100)	(0.067)	(0.174)	(0.086)	(0.057)	(0.131)	(0.073)	(0.093)	(0.071)	(0.079)	(0.134)	(0.141)
1991	141	39	54	38	10	73	51	17	56	25	48	12
	(0.071)	(0.059)	(0.102)	(0.068)	(0.044)	(0.095)	(0.064)	(0.042)	(0.082)	(0.054)	(0.075)	(0.063)
1992	122	50	35	29	8	39	57	26	45	25	39	13
	(0.062)	(0.076)	(0.066)	(0.052)	(0.035)	(0.051)	(0.071)	(0.064)	(0.066)	(0.054)	(0.061)	(0.068)
1993	111	42	17	44	8	34	49	28	43	20	36	12
	(0.056)	(0.064)	(0.032)	(0.079)	(0.035)	(0.044)	(0.061)	(0.069)	(0.063)	(0.043)	(0.057)	(0.063)
1994	105	36	20	34	15	26	53	26	45	27	29	4
	(0.053)	(0.055)	(0.038)	(0.061)	(0.066)	(0.034)	(0.066)	(0.064)	(0.066)	(0.058)	(0.046)	(0.021)
1995	117	40	23	37	17	38	50	29	16	25	34	12
	(0.059)	(0.061)	(0.044)	(0.066)	(0.075)	(0.049)	(0.063)	(0.071)	(0.024)	(0.054)	(0.053)	(0.063)
1996	139	51	31	38	19	59	55	25	55	28	41	15
	(0.070)	(0.077)	(0.059)	(0.068)	(0.083)	(0.077)	(0.069)	(0.061)	(0.081)	(0.060)	(0.064)	(0.078)
1997	81	33	17	21	10	23	35	23	33	20	20	8
	(0.041)	(0.050)	(0.032)	(0.038)	(0.044)	(0.030)	(0.044)	(0.056)	(0.049)	(0.043)	(0.031)	(0.042)
1998	104	41	31	25	7	40	48	16	35	29	39	1
	(0.053)	(0.062)	(0.059)	(0.045)	(0.031)	(0.052)	(0.060)	(0.039)	(0.051)	(0.062)	(0.061)	(0.005)
1999	92	25	18	33	16	22	45	25	34	21	27	10
	(0.047)	(0.038)	(0.034)	(0.059)	(0.070)	(0.029)	(0.056)	(0.061)	(0.050)	(0.045)	(0.042)	(0.052)
2000	88	39	10	26	13	32	39	17	36	13	29	10
	(0.045)	(0.059)	(0.019)	(0.047)	(0.057)	(0.042)	(0.049)	(0.042)	(0.053)	(0.028)	(0.046)	(0.052)
2001	105	41	9	38	17	34	46	25	53	16	19	17
	(0.053)	(0.062)	(0.017)	(0.068)	(0.075)	(0.044)	(0.058)	(0.061)	(0.078)	(0.034)	(0.030)	(0.089)
2002	80	30	10	27	13	29	35	16	34	8	24	14
	(0.041)	(0.045)	(0.019)	(0.048)	(0.057)	(0.038)	(0.044)	(0.039)	(0.050)	(0.017)	(0.038)	(0.073)
2003	91	38	14	12	27	33	47	11	44	20	16	11
	(0.046)	(0.058)	(0.027)	(0.021)	(0.118)	(0.043)	(0.059)	(0.027)	(0.065)	(0.043)	(0.025)	(0.057)
2004	90	25	9	42	14	30	36	24	33	18	27	12
	(0.046)	(0.038)	(0.017)	(0.075)	(0.061)	(0.039)	(0.045)	(0.059)	(0.049)	(0.039)	(0.042)	(0.063)
2005	74	29	4	22	19	19	37	18	34	17	16	7
	(0.037)	(0.044)	(0.008)	(0.039)	(0.083)	(0.025)	(0.046)	(0.044)	(0.050)	(0.036)	(0.025)	(0.036)
2006	11	6	0	4	1	0	5	6	5	1	5	0
	(0.006)	(0.009)	(0.000)	(0.007)	(0.004)	(0.000)	(0.006)	(0.015)	(0.007)	(0.002)	(0.008)	(0.000)
Total	1,975	660	528	559	228	769	798	408	680	467	636	192
	(1.000)	(0.334)	(0.267)	(0.283)	(0.115)	(0.389)	(0.404)	(0.207)	(0.344)	(0.236)	(0.322)	(0.097)

Table 1.*b* – Number and Frequency (in Parenthesis) of Observations

	Total	Classical	19th cent.	Modern	Contemporary
Italy	769	91	195	365	118
	(0.389)	(0.118)	(0.254)	(0.475)	(0.153)
Europe (ex Italy)	798	422	190	140	46
	(0.404)	(0.529)	(0.238)	(0.175)	(0.058)
US	408	167	82	131	28
	(0.207)	(0.409)	(0.201)	(0.321)	(0.069)
Total	1975	680	467	636	192
	(1.000)	(0.344)	(0.236)	(0.322)	(0.097)

Table 2 – Number and Frequency (in Parenthesis) of Correct Pre-Sale Predictions, Pre-Sale Underestimates, and Pre-Sale Overestimates

	Total	Christie's	Finarte	Sotheby's	Other Auction houses	Italy	Europe (ex Italy)	US	Classical	19th cent.	Modern	Contemporary
Correct prediction	733	267	175	210	81	280	314	139	247	171	235	80
	(0.37)	(0.40)	(0.33)	(0.38)	(0.35)	(0.36)	(0.39)	(0.34)	(0.36)	(0.37)	(0.37)	(0.42)
Underestimate	849	283	210	254	102	321	358	170	303	196	264	86
	(0.43)	(0.43)	(0.40)	(0.45)	(0.45)	(0.42)	(0.45)	(0.42)	(0.45)	(0.42)	(0.42)	(0.45)
Overestimate	393	110	143	95	45	168	126	99	130	100	137	26
	(0.20)	(0.17)	(0.27)	(0.37)	(0.20)	(0.22)	(0.16)	(0.24)	(0.19)	(0.21)	(0.21)	(0.13)

Table 3 – Sample Descriptive Statistics

Reported are mean and standard deviation (in parenthesis) of price and estimation variables.

	Total	Christie's	Finarte	Sotheby's	Other Auction houses	Italy	Europe (ex Italy)	US	Classical	19th cent.	Modern	Contemporary
HAMMER	35,065	34,786	18,842	58,079	20,593	19,399	30,256	73,997	29,640	22,127	51,709	30,611
	(200,547)	(68,309)	(22,758)	(367,148)	(39,232)	(26,474)	(62,523)	(429,024)	(63,749)	(49,089)	(342,773)	(57,132)
RANGEAVERAGE	33,509	35,667	33,509	51,273	17,677	20,370	27,974	69,102	26,793	20,928	50,790	30,661
	(150,915)	(85,398)	(150,915)	(265,622)	(26,533)	(27,609)	(59,817)	(316,800)	(48,623)	(45,563)	(255,897)	(51,564)
PRICERANGE	0.344	0.425	0.171	0.406	0.355	0.214	0.419	0.440	0.406	0.337	0.294	0.304
	(0.187)	(0.201)	(0.080)	(0.118)	(0.198)	(0.123)	(0.147)	(0.216)	(0.157)	(0.244)	(0.161)	(0.135)
DISTANCE	0.101	0.129	-0.056	0.184	0.184	-0.014	0.204	0.118	0.134	0.140	0.049	0.069
	(0.847)	(0.704)	(0.575)	(1.132)	(0.897)	(0.557)	(1.073)	(0.772)	(0.659)	(1.196)	(0.787)	(0.549)
ABSDISTANCE	0.376	0.409	0.222	0.449	0.456	0.247	0.469	0.436	0.407	0.418	0.336	0.297
	(0.765)	(0.586)	(0.532)	(1.054)	(0.792)	(0.499)	(0.985)	(0.647)	(0.535)	(1.129)	(0.713)	(0.466)

Variables are defined as follows:

HAMMER	the hammer price (Euro – 2006 prices)
RANGEAVERAGE	the midpoint (in Euro – 2006 prices) of the pre-sale price range
PRICERANGE	the ratio of the pre-sale estimate range to the low pre-sale estimate
DISTANCE	the ratio of the distance between the hammer price and the midpoint of the pre-sale price range to the range midpoint
ABSDISTANCE	the absolute value of the ratio of the distance between the hammer price and the midpoint of the pre-sale price range to the range

Table 4 – Bivariate Comparison of Price and Range Variables

	Panel 1 Entire sample		**Panel 2** Subsample of artworks sold by Christie's or Sotheby's		**Panel 3** Subsample of artworks sold by Christie's, Sotheby's or Finarte	
	Sold in Italy	Sold out of Italy	Sold by Christie's	Sold by Sotheby's	Sold by Finarte	Sold by either Christie's or Sotheby's
	[*t* statistic]		[*t* statistic]		[*t* statistic]	
HAMMER	19,399	45,055	34,786	58,080	17,298	45,468
	[-3.461]***		[-1.479]***		[-3.844]***	
RANGEAVERAGE	20,370	41,888	35,668	51,274	18,842	42,824
	[-3.841]***		[-1.425]***		[-4.322]***	
PRICERANGE	0.21446	0.42594	0.42473	0.40616	0.17102	0.41621
	[-31.639]***		[2.001]**		[-41.273]***	
DISTANCE	-0.0142	0.1752	0.1289	0.1844	-0.0564	0.1544
	[-5.460]***		[-1.044]		[-5.783]***	
ABSDISTANCE	0.2474	0.4583	0.4093	0.4492	0.2228	0.4276
	[-6.757]***		[-0.832]		[-6.149]***	

Reported are mean values of price and range variables of artworks sold in Italy, sold by Christie's, Sotheby's, or Finarte.
The value in square brackets is the *t*-statistic for testing the equality of variable means.
Variables are defined as follows:

HAMMER	the hammer price (in Euro – 2006 prices)
RANGEAVERAGE	the midpoint (in Euro – 2006 prices) of the pre-sale price range
PRICERANGE	the ratio of the pre-sale estimate range to the low pre-sale estimate
DISTANCE	the ratio of the distance between the hammer price and the midpoint of the pre-sale price range to the range midpoint
ABSDISTANCE	the absolute value of the ratio of the distance between the hammer price and the midpoint of the pre-sale price range to the range

***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Table 5 – Regressions of Price Range and Price Distance to Estimate on Sale Variables (Sale Location, Auction House, Collecting Category, and Existence of Previous Sales)

	(1)	(2)	(3)	(4)	(5)	(6)
	PRICERANGE	PRICERANGE	ABSDISTANCE	ABSDISTANCE	ABSDISTANCE	ABSDISTANCE
Intercept	0.270***	0.270***	0.477***	0.479***	0.509***	0.510***
	(6.176)	(6.161)	(6.865)	(6.909)	(9.235)	(9.974)
PRICERANGE	-	-	0.087	0.085	-	-
			(0.756)	(0.740)		
D_XIX_CENT	-0.0084	-0.0079	0.081*	0.080*	0.080*	0.079*
	(-0.890)	(-0.835)	(1.705)	(1.686)	(1.685)	(1.667)
D_MODERN	-0.0224**	-0.0217**	0.025	0.024	0.023	0.022
	(-2.503)	(-2.424)	(0.552)	(0.524)	(0.504)	(0.479)
D_CONT	-0.0192	-0.0184	-0.012	-0.013	-0.013	-0.015
	(-1.525)	(-1.461)	(-0.179)	(-0.202)	(-0.207)	(-0.229)
D_CHRISTIE'S	0.106***	0.106***	-0.04	-0.041	-0.031	-0.032
	(9.050)	(9.096)	(-0.654)	(-0.666)	(-0.519)	(-0.534)
D_SOTHEBY'S	0.0812***	0.0815***	-0.004	-0.004	-0.002	0.002
	(6.866)	(6.897)	(-0.063)	(-0.070)	(-0.040)	(0.031)
D_FINARTE	-0.0341**	-0.0340**	-0.126	-0.127	-0.131	-0.131
	(-2.082)	(-2.071)	(-1.566)	(-1.576)	(-1.625)	(-1.634)
D_ITALY	-0.128***	-0.128***	-0.109*	-0.108*	-0.120**	-0.119**
	(-11.632)	(-11.655)	(-1.884)	(-1.881)	(-2.144)	(-2.138)
LOWESTIMATE	-0.0000	-0.0000	0.0000	0.0000	0.0000	0.0000
	(-1.315)	(-1.307)	(1.593)	(1.591)	(1.574)	(1.572)
D_2nd sale	-0.0145*	-	-0.142***	-	-0.142***	-
	(-1.949)		(-4.089)		(-4.091	
D_3rd sale	-0.0440*	-	-0.091	-	-0.093	-
	(-1.828)		(-0.738)		(-0.760)	
D_4th sale	-0.162	-	0.129	-	0.120	-
	(-1.108)		(0.170)		(0.158)	
D_PREVSALE	-	-0.0156**	-	-0.140***	-	-0.140***
		(-2.089)		(-4.064)		(-4.070)
Adjusted R^2	0.388	0.388	0.225	0.256	0.225	0.256
N	1,975	1,975	1,975	1,975	1,975	1,975

Reported are regression coefficients and *t*-statistics (in parenthesis). Variables are defined as follows:

PRICERANGE	the ratio of the pre-sale price range to the low pre-sale estimate
ABSDISTANCE	the absolute value of the ratio of the distance between the hammer price and the midpoint of the pre-sale price range to the range
D_ XIX_CENT	a dummy variable that equals 1 if the painting belongs to the 19th century collecting category and zero otherwise
D_MODERN	a dummy variable that equals 1 if the painting belongs to the Modern collecting category and zero otherwise
D_CONT	a dummy variable that equals 1 if the painting belongs to the Contemporary collecting category and zero otherwise
D_CHRISTIE'S	a dummy variable that equals 1 if the painting is sold by Christie's and zero otherwise
D_SOTHEBY'S	a dummy variable that equals 1 if the painting is sold by Sotheby's and zero otherwise
D_FINARTE	a dummy variable that equals 1 if the painting is sold by Finarte and zero otherwise
D_ITALY	a dummy variable that equals 1 if the painting is sold in Italy and zero otherwise
LOWESTIMATE	the low pre-sale estimate (in Euro – 2006 prices)
D_2nd sale	a dummy variable that equals 1 if there is one previous sale for the painting in the sample and zero otherwise
D_3rd sale	a dummy variable that equals 1 if there are two previous sales for the painting in the sample and zero otherwise
D_4th sale	a dummy variable that equals 1 if there are three previous sales for the painting in the sample and zero otherwise
D_PREVSALE	a dummy variable that equals 1 if there is at least one previous sale for the painting in the sample and zero otherwise

We also include year variables. We do not show these variable coefficients for ease of exposition.
***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Table 6 – Logit regressions of D_ONTARGET on Sale Variables (Sale Location, Auction House, Collecting Category, and Existence of Previous Sales)

	(1) D_ONTARGET	(2) D_ONTARGET
PRICERANGE	2.531*** (0.000)	2.553*** (0.000)
D_XIX_CENT	-0.385** (0.010)	-0.378** (0.011)
D_MODERN	-0.196 (0.163)	-0.188 (0.183)
D_CONT	0.155 (0.419)	0.165 (0.389)
D_CHRISTIE'S	0.037 (0.849)	0.042 (0.827)
D_SOTHEBY'S	0.278 (0.147)	0.283 (0.140)
D_FINARTE	-0.319 (0.210)	-0.312 (0.220)
D_ITALY	0.711*** (0.000)	0.710*** (0.000)
LOWESTIMATE	0.0000 (0.712)	0.0000 (0.717)
D_2nd sale	0.294*** (0.007)	-
D_3rd sale	-0.097 (0.813)	-
D_PREVSALE	-	0.279*** (0.009)
Pseudo R^2	0.269	0.264
χ^2	(0.000)	(0.000)
N	1,975	1,975

Reported are regression coefficients and *p*-values (in parenthesis). The dependent variable is a dummy variable which equals 1 if the hammer price falls into the auction house's pre-sale estimate range and 0 otherwise. Equations are estimated with standard ordered logit. χ^2 denotes the *p*-value of the chi-square test for the null hypothesis that all the coefficients jointly equal zero.

Explanatory variables are defined as follows:

PRICERANGE	the ratio of the pre-sale price range to the low pre-sale estimate
D_XIX_CENT	a dummy variable that equals 1 if the painting belongs to the 19th century collecting category and zero otherwise
D_MODERN	a dummy variable that equals 1 if the painting belongs to the Modern collecting category and zero otherwise
D_CONT	a dummy variable that equals 1 if the painting belongs to the Contemporary collecting category and zero otherwise
D_CHRISTIE'S	a dummy variable that equals 1 if the painting is sold by Christie's and zero otherwise
D_SOTHEBY'S	a dummy variable that equals 1 if the painting is sold by Sotheby's and zero otherwise
D_FINARTE	a dummy variable that equals 1 if the painting is sold by Finarte and zero otherwise
D_ITALY	a dummy variable that equals 1 if the painting is sold in Italy and zero otherwise
LOWESTIMATE	the low pre-sale estimate (in Euro -2006 prices)
D_2nd sale	a dummy variable that equals 1 if there is one previous sale for the painting in the sample and zero otherwise
D_3rd sale	a dummy variable that equals 1 if there are two previous sales for the painting in the sample and zero otherwise
D_4th sale	a dummy variable that equals 1 if there are three previous sales for the painting in the sample and zero otherwise
D_PREVSALE	a dummy variable that equals 1 if there is at least one previous sale for the painting in the sample and zero otherwise

We also include year variables. We do not show these variable coefficients for ease of exposition.

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively.