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Using Price Indices and Sale Rates to Assess Short Run Changes in the Market for
Impressionist and Contemporary Paintings

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In this paper we report on methods designed to measure the short run state of the market for Impressionist and Contemporary paintings. Our goal is to construct price indexes for broad movements in the market for these works of art at monthly intervals, a time period during which identical pictures will rarely, if ever, change hands. Constructing such price indices will require a considerably more detailed specification of the nature of the auction markets we study than is typically the case in the construction of price indices for financial markets where continuous trading in homogeneous goods is normal.

We apply these methods to study painting price movements over the period 1980-1982, which is considered by many market participants to have been a turbulent time for the art market. This period thus provides an ideal laboratory in which to test the ability of our model to capture short run price volatility and market movements. During 1980 many observers believe that prices rose considerably, while the period from mid-1981 forward is thought to have been a period of considerable price declines. We are especially interested in determining whether a formal statistical analysis of these data would confirm these anecdotal claims and, if so, whether the data would confirm the magnitude of the run-up and decline in these markets that is sometimes alleged to have occurred.

Measures of price indexes and of the return to holding non-financial assets are of considerable interest to many investors.¹ They are also of interest to economists concerned with the presence of speculative price bubbles² or in the general theory of asset pricing. The procedures currently used to provide measures of price movements in thin markets with heterogeneous assets of the kind we study fall into two categories: hedonic price indices and

¹ For example, Salomon Brothers' twelfth annual survey of the returns on 14 different assets is described by Jay Rohmer, "Hard Assets or Soft?" *Barron's*, June 15, 1987, p. 15.

expert appraisals. In this paper, we propose a method for constructing price indices that involves elements of both.

Hedonic price indices are constructed by assuming that a small number of observable characteristics summarize the most important determinants of differences in the prices of different assets. Price indices are then constructed by first estimating the “prices” of these observable characteristics in some base period and then comparing the observed price of an asset against the predicted price of the appropriate “bundles” in the base period.³ For the purposes of assessing short run changes in the market for heterogeneous goods, however, there are two serious problems with this method. First, the thin markets and heterogeneity in the quality of pictures we study do not permit precise estimates of average month-to-month price changes to be made. Apparently, the cross-sectional variability in picture prices remains so large even after control for many measurable characteristics (size, period, artist, etc.) that the time-series of auction-to-auction movements in prices cannot be untangled from the auction-to-auction movements in the composition of pictures sold.

A second problem with hedonic price indices is that they are constructed from data on the prices of pictures actually sold at auction. An important characteristic of art auctions is that many of the pictures put up at auction are “bought in,” that is, no buyer makes a bid that exceeds the seller's “reserve price,” so the picture is not sold. A reserve price, which is the minimum bid acceptable to the buyer, is set (but never announced) by the seller before the auction commences. The selling of pictures subject to a reserve price is nearly a universal feature of fine art auctions.

² See, for example, George Evans, *American Economic Review*, Sept. 1986, for a study of a speculative bubble in exchange rates.

³ The “price” of different models of automobiles is studied in this way by Z. Griliches, C. Kaysen, and F. Fisher, “The Cost of Automobile Model Changes Since 1949,” *Journal of Political Economy*, October 1962, LXX(5), 433-451.

In our data 32 percent of pictures consigned for auction are bought in, but this varies from a low of 3 percent to a high of 50 percent in the auctions we analyze over the period 1980-82. The hedonic price index procedure makes no use of this widely watched information on “buy-in” or sales rates to measure the pressure on prices in the market place. Moreover, since the average of observed trading prices includes only those pictures that find a buyer, this average is an upward biased measure of the mean of the distribution of offers to purchase within the buyer population. Naturally, the extent of this bias will vary with the buy-in rate; it will be greatest when sales are weak and the buy-in rate is high, while it will be small when sales are strong and the buy-in rate is low. It follows that the hedonic price technique may systematically lead to an understatement in the volatility of the mean of buyers' offers to purchase.

Expert appraisals are the other widely used method for constructing measures of average prices in thin markets that contain heterogenous assets. In this procedure a fixed group of items is selected to form the basis for the price index, and then professional appraisers are asked to provide their forecasts of what each of these items would sell for if offered at auction. The price index consists of the time-series of these forecasts for the bundle of assets selected to represent the market. Sotheby's, the auction house, constructs indices measuring the average prices of a variety of items sold at auction, ranging from Impressionist pictures to ceramics and furniture. These indices are based on expert appraisals and were published weekly in *Barron's* until July 1987.

The obvious advantage of using expert appraisals to construct a price index is that a fixed group of assets may be continuously evaluated so that there is no “selection bias” in the determination of the items on which to base the price index. The obvious disadvantage of this procedure is that expert appraisals must, by definition, be based on the prices that assets have

fetched in prior sales. As a result, expert appraisals are always last period's forecast of this period's prices. Such forecasts (or appraisals), if they are unbiased, must always show less volatility than the price series being forecasted.⁴ Unexpected increases (or decreases) in such a price index, which is the source of much of the information of interest to market participants, is systematically ignored or recorded with delay.

In this paper we construct price indices that use information both from observed prices and from expert appraisals for over 2,000 pictures sold at auction over the period 1980-82. To do this we first set out our data collection methods, as these must inevitably influence our choice of statistical models. We then set out a statistical model of art auction sales. The empirical analysis that follows suggests that these models provide a very useful description of art auction sales and lead to very natural methods for characterizing the statistical results in these markets.

I. Data

The pictures whose prices we study are all the work of artists listed in Table 1. The precise phrase with which to describe an artist's school is sometimes a matter of dispute. These artists would generally be considered “Impressionist” or “Contemporary” painters. We selected the work of these artists for study for two reasons. First, these artists' pictures are generally sold together in the auction houses sales of “Impressionist and Contemporary Pictures.” Thus, the auction houses group the work of these painters together, and this is presumably a response, in part, to their substitutability. Second, we expected these artists' works to account for a considerable fraction of the Impressionist and Contemporary pictures sold at auction. As Table 1

⁴ We remain agnostic about another reservation with “expert appraisals” that has been indicated to us by some market participants. These individuals express reservations about the value of any index compiled by “experts” who may have some financial stake in the index movements. Auctioneers’ revenues are derived primarily from commissions on items sold at auction and obviously depend on the supply of such items.

indicates, in the three-year period we examined as many as 156 picture by one artist (Picasso) were put up for sale in the auctions we studied, although in one case we selected an artist (Laurens) responsible for only one of the pictures in these auctions.

Sotheby's and Christies' are the two major auction houses involved in the sale of Impressionist pictures and the data come exclusively from their auctions. Each auction house normally mounts a major Impressionist sale in the spring and in the fall in both New York and London. We have deliberately attempted to collect data from auctions scattered throughout the calendar year, but it should be obvious from the list of auction dates in Table 2 that these sales are concentrated in the spring and fall, as expected. . The period 1980-1982 is considered by many market participants to have been a turbulent one for the art markets, and this accounts for our selection of it for study. During 1980 many believe that prices rose considerably, while the period from mid-1981 forward is thought to have been a period of considerable price declines. We were especially interested in determining whether a formal statistical analysis of these data would confirm these anecdotal claims and, if so, whether the data would confirm the magnitude of the run-up and decline in these market that is sometimes alleged to have occurred.

For each auction the relevant auction house prepare a catalogue describing the list of items on offer. From the catalogue description we recorded (i) the name of the artist, (ii) the date of the work's production (iii) whether and how the artist signed the work, (iv) the medium in which the artist produced the picture (oil, pencil, water color, etc.), (v) the shape of the work, and (vi) whether an illustration of the picture appeared in the catalogue. We also recorded from the

catalogue the “low estimate” and the “high estimate” of the price at which it was expected (by the auction house) that the picture would be sold.⁵

The reserve price, set by the seller, below which bids will not lead to a successful sale, is not published in the catalogue or made known to buyers either before or after an auction sale. This practice, and the question of whether and when it is announced that a picture has been sold, raise some interesting problems for the collection of sale price data in these auctions. We have used the published price lists--which are always made available by the auction house following the sale--to determine whether a picture was sold and at what price. It is known, however, that the auction houses have occasionally reported sales, fictional prices, and even the names of fictional buyers on these price lists in the past. How, then, are we to regard these data?

Art auction sales take a form with which we believe frequent market participants are very familiar. Infrequent participants may be less well- informed. It is an auctioneer's job to ensure the “start” of the bidding without revealing the seller's reserve price. To do this, the auctioneer may take bids “from the chandelier.” Such bids are fictional statements by the auctioneer that are meant to induce the start of bidding from the auction floor. These fictional bids may begin at more or less than the seller's reserve or they may be unnecessary. Making these judgments is part of the auctioneer’s skill and since the auctioneer is acting on behalf of the seller (and receives a commission based on the sale price), they are intended to maximize the sale price. When an auctioneer has been unable to “start the bidding,” or when the bidding does not reach the seller’s reserve price, an item remains unsold. In the auction room, however, the participants

⁵ In some auction sales, the “estimates” are not provided with the catalogue and must be obtained by contacting the auction house directly. It is our impression that this procedure is used primarily for pictures for which the auction houses feel it is especially difficult to forecast sale prices and for pictures where the auction house's forecast might change between the date of the

may not know this is the case, as the auctioneer may “hammer down” a fictional price. It may only later be revealed that the item remains unsold.

It is our belief that the vast majority of the sales and prices recorded in our data reflect genuine transactions. The data for the auction where we know the price list to be inaccurate have been removed from our analysis.⁶

Table 2 summarizes the auction results by the date the auction was held. Table 3 summarizes the results by the medium. Finally, Table 4 summarizes the results by auction house and location. In all tables prices are stated in U.S. dollars. Pounds were converted to dollars using the average daily exchange rate in the month of the auction.

II. Methods

In what follows we assume that the logarithm of the highest price bid for the i^{th} picture in an auction in period t may be characterized in a familiar way as:

$$(1) \quad P_{it} = \alpha_i + \mu_t + v_{it},$$

where α_i is a fixed effect for the picture, μ_t is the price index we attempt to estimate, and v_{it} is a specific effect that is uncorrelated with α_i and μ_t . Equation (1) is familiar as the “market model” from the financial economics literature; it would be a simple matter to generalize this model in the usual way by allowing separate coefficients β_i on μ_t for each artist (or even

issuance of the catalogue and the date of the sale (which may be several months). We do not include the data for the small number of pictures that fall into this category in our analyses.

⁶ This is the Christies' auction of major Impressionist pictures on May 5, 1981. It is an interesting question why the auction houses are so secretive about these matters. Our impression is that there are two reasons. First, the auction houses are anxious to avoid criticism that they are responsible for, rather than reporters of, the price movements that occur in the art market. In this scenario the auction houses are trying to avoid being the messenger who was punished for delivering the bad news. Second, the auction house managers are clearly fearful that a small group (particularly of art dealers) may form a “ring” to collude and depress prices. A publicly-announced “reserve price” would serve as a natural focal point for such a ring, and perhaps the secrecy about its value is designed to lessen the collusive ability of effective rings.

picture). We also take the midpoint of the logarithms of the high and low estimates of the picture's selling price (\hat{P}_{it}) to be characterized in a similar manner:

$$(2) \quad \hat{P}_{it} = \alpha_i + \hat{\mu}_t + \varepsilon_{it}.$$

Here $\hat{\mu}_t$ is the forecast of μ_t based on information available at the date the catalogue is prepared.

Our interpretation of equations (1) and (2) is that there is a fixed (that is, the forecastable) component of both the price fetched and the forecast of the price fetched for the i^{th} picture. The observed price (P_{it}) and appraisal (\hat{P}_{it}) differ from this fixed effect by an index of overall prices and of price appraisals.

Our interest in specifying (1) and (2) in logarithms is primarily a result of our empirical investigations. The log transformation brings these data fairly close to normality. In some of what follows we will depend heavily on the normality assumption, and it seems far more appropriate for the transformed price data.

The first question we ask is whether there is any evidence that price estimates are, on average, biased estimates of realized prices. A straightforward test of this hypothesis is offered by the data on the average deviation of the realized prices from the price estimates (called "ADEVIATL) contained in Tables 1, 3, and 4. The basic idea of the test is that these deviations should, if the average is taken over a long enough period, equal zero; otherwise, the price estimates are systematically biased and the bias is correlated with the artist (Table 1), the medium (Table 3), or the location of sale (Table 4). It is important in making these tests to guarantee that the observations are taken over along enough periods that no temporal market changes are captured by the estimates. This is most likely to be the case where there are significant data points for the calculations.

First, it is apparent from Table 4 that there are only very small average deviations of prices realized from price estimates when the data are stratified by auction house or location. As expected, however, the small deviations that do exist are positive—precisely as would be expected from the sample selection induced by the fact that price differences cannot be included in the calculations when an item does not sell. Second, it is also apparent from Tables 1 and 3 that, when there are significant observations on a painter’s work or a type of medium, that again price deviations are small. Taken together these results provide considerable evidence that the auction house price estimates are unbiased predictors of realized prices.

The next question we consider is whether the unexpected price shocks in the art market are related to the buy-in rates. A regression of the buy-in rate on the “unexpected price change” as measured by the deviation of the average price in the auction from the average estimate is (with standard error of the regression coefficient in parentheses):

$$\text{Buy-in Rate} = .322 - .689 \text{ Unexpected Art Price Change} \\ (.167)$$

$$N = 40, \quad R^2 = .31, \text{ Standard error of the equation} - .109$$

Large positive unexpected art price changes are statistically significantly associated with lower buy-in rates (higher sale rates). This relation would not appear if an expert appraisal index of art prices were used. Our model, which uses the average difference between the realized price and the auctioneer’s estimated price as an indicator of the state of the market, is consistent with a theoretical relation between price and sale rate that arises out of the structure of the auction process itself.

Based on this evidence it seems natural to examine the time series in order to determine what the average deviations of prices from estimates tells us about the short run movements in

art prices in the period 1980-1982. Table 2 indicates that the market was surging forward from March of 1980 until April of 1981, with every auction save one showing prices higher than expected. In May of 1981 prices appear to continuously decrease until they finally begin to stabilize around November of 1982. It is our impression that this is precisely what the public discussion in art circles suggested did happen to the market during this period. Apart from the data we analyze here, however, there would be no way to measure these movements empirically since the period we study is far too short to provide data on identical paintings sold in the relevant interval.

III. Conclusions

By using the difference between the realized auction prices and the expert appraisals as an index of unexpected changes in the art market, we have shown that the art market did rise and then fall during the period from January 1980 to December 1981. Unexpected increases in art prices are associated with unusually high auction sale rates. The reverse is true for unexpected decreases in art prices. These results indicate that the judicious combination of expert appraisals and observed price data provides a very useful way to gauge the short run movements in art auction prices.

Table 1

SUMMARY OF AUCTION RESULTS BY ARTIST

ARTIST	Number	APRICE	SPRICE	ADEVIATL	SDEVIATL	ANOTSOLD
Bonnard, Pierre	62	80,053	72,738	-9.21	50.54	33.87
Boudin, Eugene	114	41,943	59,811	7.77	46.56	23.68
Brauner, Victor	20	13,073	16,701	-11.52	25.41	45.00
Carrieres, Eugene	4	4,731	761	33.84	34.97	50.00
Cezanne, Paul	27	443,219	865,276	14.15	50.75	18.52
Chagall, Marc	86	125,587	117,378	-3.21	10.92	44.19
Corot, Jean Baptiste	4	82,848	83,101	26.52	19.35	25.00
Dali, Salvador	42	51,609	85,329	-7.42	39.00	33.33
Degas, Edgar	52	288,163	354,625	9.14	34.02	36.54
Delvaux, Paul	21	107,192	85,902	-5.06	16.77	42.86
Derain, Andre	35	7,885	10,528	-4.29	22.15	34.29
Dufy, Jean	11	11,208	21,818	-6.32	43.56	27.27
Dufy, Raoul	74	34,656	40,324	9.99	28.33	29.73
Ensor, James	13	109,826	160,380	3.24	37.80	69.23
Ernst, Max	45	43,835	41,809	-16.80	23.09	55.56
Erte, Roman,	5	na	na	na	na	100.00
Forain, Jean Louis	37	3,898	7,579	8.18	49.82	43.24
Foujita, Tsughou	32	19,759	20,728	9.87	43.84	18.75
Gauguin, Paul	20	344,802	741,114	12.07	45.25	25.00
Gris, Juan	18	133,800	116,016	-6.01	21.89	33.33
Grosz, Georg	32	9,905	7,870	14.57	34.59	43.75
Guillamin, Jean	33	17,133	13,885	-6.37	25.54	42.42
Helleu, Paul	5	19,195	36,428	51.89	82.98	16.67
Kandinsky, Wassily	34	163,639	307,332	-7.57	24.61	44.12
Khnopff, Fernand	4	7,513	3,124	-48.64	7.31	25.00
Kirchner, Ernst	15	66,452	74,698	12.66	36.04	26.67
Kisling, Moise	31	23,397	17,743	1.94	25.80	19.35
Klee, Paul	74	46,369	59,319	-17.09	26.49	32.43
Klimt, Gustav	19	5,484	2,151	-18.44	23.23	31.58
Kokoschka, Oskar	8	59,920	84,022	3.65	45.41	37.50
Laurencin, Marie	41	20,755	17,406	20.44	32.43	9.76
Laurens, Henri	1	1,900	na	9.25	na	0.00
Leger, Fernand	92	70,914	134,192	-4.53	30.19	38.04
Loiseau, Gustave	12	17,916	8,791	-5.02	26.51	41.67
Magriitte, Rene	41	94,279	115,515	8.13	23.64	53.66
Mane-Katz	28	11,087	12,017	-14.71	29.16	17.86
Manet, Edouard	11	150,568	218,567	-10.57	33.27	18.18
Matisse, Henri	67	65,578	113,980	-4.51	33.02	32.84
Miro, Joan	49	111,722	127,398	8.29	51.56	51.02
Modigliani, Amed	20	124,857	165,200	3.43	24.85	20.00
Monet, Claude	50	299,126	239,977	6.73	21.76	44.00
Morisot, Barthe	6	24,143	32,950	-50.06	26.35	65.67
Munch, Edvard	30	137,466	329,374	2.46	26.19	33.33
Picasso, Pablo	156	144,404	194,477	0.70	26.25	26.28
Pissarro, Camille	62	107,213	112,042	6.59	25.89	19.35
Renoir, Pierre August	125	199,448	268,585	5.60	31.63	23.20
Rousseau, Henri	4	72,031	40,096	30.50	68.34	25.00
Severini, Gino	14	39,930	63,531	-10.22	29.31	28.57
Signac, Paul	42	80,942	114,736	4.65	23.73	16.67
Sisley, Alfred	30	175,875	138,419	2.27	27.56	33.33
Toulouse-Lautrec	26	96,965	182,715	12.72	38.98	11.54
Utrillo, Maurice	95	41,003	23,862	5.89	20.32	20.00
Valtat, Louis	18	11,674	8,925	-8.87	15.66	33.33
Van Dongen, Kees	53	65,073	74,715	0.23	32.84	30.19
Van Gogh, Vincent	21	577,061	769,689	22.17	39.27	33.33
Van Rysselberghe	5	25,216	22,794	25.75	22.10	20.00
Vlaminck, Maurice	70	42,075	37,166	2.70	25.09	32.86
Vuillard, Edouard	65	64,197	71,175	15.86	36.74	33.85

Notes: ARTIST is the artist who executed the painting. NUMBER is the number of paintings offered for sale at the auction. APRICE Is the average price of paintings actually sold in dollars. SPRICE is the standard deviation of the price of paintings actually sold in dollars.

ADEVIATL is the average percentage difference between the sale price from the presale estimate. SDEVIATL is the standard deviation of the percentage difference between the sale price and the presale estimate. ANOTSOLD is the percent of the paintings not sold.

Source: Authors' calculations based on Christie's and Sotheby's auction catalogues and post auction realized price lists for all auctions from January 1980 to December 1982.

Table 2

SUMMARY OF AUCTION RESULTS BY THE DATE OF SALE

SALEDATE	NUMBER	APRICE	SPRICE	ADEVIATL	SDEVIATL	ANOTSOLD
80-03-26	96	12,666	19,705	7.15	47.75	26.04
80-05-12	31	238,000	235,926	16.50	44.61	3.23
80-05-13	45	465,909	867,607	18.23	35.85	26.57
80-05-14	91	64,168	94,731	0.31	30.30	27.47
80-05-15	48	16,430	14,413	21.88	29.98	10.87
80-07-01	65	134,513	98,114	5.69	28.89	47.69
80-07-02	49	27,096	14,950	-4.52	30.52	36.73
80-10-21	52	137,155	227,992	7.91	26.80	26.92
80-10-22	60	373,113	437,073	24.30	37.93	11.67
80-12-03	47	147,777	208,402	5.16	25.17	25.53
80-12-04	52	26,333	12,878	5.54	33.87	17.31
81-02-25	36	17,232	17,231	8.11	33.37	22.22
81-02-26	41	31,984	17,264	2.87	25.50	21.95
81-04-01	62	222,153	286,794	9.05	24.72	14.52
81-04-02	69	16,666	16,620	14.77	34.34	17.39
81-05-19	26	138,571	96,585	-10.68	32.60	46.15
81-05-20	22	124,881	131,192	16.55	31.98	4.55
81-05-21	62	193,088	113,487	-1.37	23.75	17.74
81-06-30	72	205,747	283,106	-3.11	22.77	48.61
81-07-01	131	20,214	22,049	-4.23	40.05	43.51
81-11-03	35	148,444	122,917	-12.21	31.64	48.57
81-11-05	70	178,964	160,835	-5.77	31.18	40.00
81-11-06	78	31,095	31,306	-11.22	33.71	35.90
81-11-30	27	99,451	94,372	6.97	25.49	37.04
81-12-01	83	15,040	15,185	2.08	43.35	51.81
81-12-02	60	125,627	118,850	-2.35	21.15	31.67
81-12-03	56	22,087	11,977	-7.02	32.71	41.07
82-02-17	26	11,264	15,819	-22.41	25.96	23.08
82-03-30	13	7,118	5,002	-0.44	49.13	38.46
82-03-31	75	13,771	18,935	-8.40	23.86	34.67
82-05-19	28	227,067	291,359	7.67	27.57	46.43
82-05-20	168	63,078	87,653	-2.43	25.08	36.90
82-06-28	32	35,972	27,325	-0.37	51.31	50.00
82-06-29	7	3,996	1,741	-11.70	16.40	42.86
82-07-01	40	18,002	8,327	-11.52	31.16	35.00
82-11-03	46	246,068	301,805	8.97	28.40	17.39
82-11-04	50	69,319	69,720	-14.64	25.53	28.00
82-11-05	70	14,840	16,043	1.30	35.65	28.57
82-11-30	49	9,412	10,072	9.39	28.33	32.65
82-12-01	44	90,870	80,824	4.12	21.90	43.18

Notes: SALEDATE is the date on which the auction was held in year, month day form. NUMBER is the number of paintings offered for sale at the auction. APRICE is the average price of paintings actually sold in dollars. SPRICE is the standard deviation of the price of paintings actually sold in dollars. ADEVIATL is the average percentage difference between the sale price from the presale estimate. SDEVIATL is the standard deviation of the percentage difference between the sale price and the presale estimate. ANOTSOLD is the percent of the paintings not sold.

Source: Authors' calculations based on Christie's and Sotheby's auction catalogues and post Auction realized price lists for all auctions January 1980 to December 1982.

Table 3

SUMMARY OF AUCTION RESULTS BY MEDIUM OF PAINTING

MEDIUM ANOTSOLD	NUMBER	APRICE	SPRICE	ADEVIATL	SDEVIATL	
Unlisted	145	251,155	521,181	7.11	30.57	21.38
Chalk	31	8,392	9,247	8.12	50.36	22.58
Charcoal	62	16,277	30,407	17.38	43.28	32.26
Crayon	33	11,676	16,779	-0.49	28.52	51.52
Gouache	140	55,679	131,222	4.08	29.90	27.86
Ink/Indian Ink	119	16,765	30,551	-2.81	32.90	31.93
Oil	1139	130,247	200,875	1.87	30.79	33.10
Other	30	53,352	47,869	0.61	30.44	30.00
Pastel	67	180,821	245,957	6.00	33.89	34.33
Pen	67	11,877	26,453	-6.76	24.45	31.34
Pencil	191	11,121	15,034	1.05	45.52	31.41
Tempera	7	46,446	28,169	-18.47	5.11	42.86
Wash	5	2,497	1,428	-17.07	19.34	20.00
Water Color	176	23,212	38,410	3.46	33.38	32.39

Notes: MEDIUM is the medium in which the painting was executed.
NUMBER is the number of paintings offered for sale at the auction. APRICE is the Average price of paintings actually sold in dollars. SPRICE is the standard deviation of the price of paintings actually sold in dollars. ADEVIATL is the average percentage difference between the sale price from the presale estimate. SDEVIATL is the standard deviation of the percentage difference between the sale price and the presale price. ANOTSOLD is the percent of the paintings not sold.

Source: Authors' calculations based on Christie's and Sotheby's auction catalogues and post Auction realized price lists for all auctions from January 1980 to December 1982.

Table 4
SUMMARY OF AUCTION RESULTS BY AUCTION HOUSE AND SALE LOCATION

HOUSE	LOCATION	NUMBER	APRICE	SPRICE	ADEVIATL	SDEVIATL	ANOTSOLD
Christie's	London	211	27,554	48,729	3.86	38.03	44.08
Christie's	New York	465	124,201	339,711	2.13	31.87	29.83
Sotheby's	London	918	71,829	147,404	1.54	33.13	33.66
Sotheby's	New York	617	137,059	211,225	3.55	33.25	26.26

Notes: HOUSE is the name of the auction house. LOCATION is the location of the auction. NUMBER is the number of paintings offered for sale at the auction. APRICE is the average price of paintings actually sold in dollars. SPRICE is the standard deviation of the price of paintings actually sold in dollars. ADEVIATL is the average percentage difference between the sale price from the presale estimate. SDEVIATL is the standard deviation of the percentage difference between the sale price and the presale estimate. ANOTSOLD is the percent of the paintings not sold.

Source: Authors' calculations based on Christie's and Sotheby's auction catalogues and post auction realized price lists for all auctions from January 1980 to December 1982.