Price Discovery in Real Estate Auctions: The Story of Unsuccessful Attempts

Authors

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Abstract

Little is known of the effects of the auction mechanism in relation to post-auction market sales. This empirical study of unsuccessful auctions shows that approximately half of these properties were eventually sold via private negotiations, at higher prices relative to last bids. The probability of a subsequent post-auction transaction is significantly higher for apartments and terrace houses and when auction turnout is high; and lower in the absence of any bid and in some years. In addition, downward revisions to the opening bid improve the probability of subsequent sale. Prices of subsequent re-auctioned and privately negotiated sales decline with time to sale, consistent with the search process explanation.

Introduction

Auctions have been extensively studied for many reasons, not the least of which is that the auction mechanism provides a close approximation to the Walrasian concept of market clearing and price discovery. Real estate auction, in particular, has an added attraction in that it provides a centralized platform for buyers and sellers in an otherwise highly decentralized real estate marketplace. However, the study of price discovery during and after the auctions, in particular the effects on post-auction prices and multiple auctions attempts, have been somewhat neglected in the literature.

Ashenfelter and Genesove (1992) is one of the few papers that has examined post-auction price behavior. The authors show that the auction prices for identical condominium units in New Jersey were 13% higher than the prices determined in subsequent face-to-face bargaining. This arose because of the unique institutional framework where the ''hammer price'' is not necessarily binding,[1] and an original auction sale could ''fall through.'' This paper complements the earlier work by using data from an institutional setup that binds hammer prices and auction sales. Under this alternative framework, it is clear that only genuine bidders participate at the auctions. However, unsuccessful sellers could seek out interested buyers after the auction and privately negotiate. It is not uncommon for auction houses and sellers to engage in subsequent negotiations when the auctioned object is unsold at its reserve price (Bulow and Klemperer, 1996; footnote 22).

Porter (1995) observes that oil and gas tracts that were not sold at auctions were re-auctioned subsequently at higher prices. Cassady (1967) and Ashenfelter (1989) also note that goods that were resold could be through another auction or through private negotiations, and suggest that this process is used by the seller to obtain a higher sale price. Horstmann and LaCasse (1997) offer an information signaling explanation as to why sellers in auctions with secret reserve prices choose not to sell when they have a resale option. Sellers attempt to communicate information to potential bidders by choosing secret reserve prices (announced reserve prices are easily mimicked) and voluntarily refusing to sell when their reserve prices are not met. The delay in sale becomes a costly signal to mimic for sellers of lower-value objects, and the refusal to sell becomes a profitable signaling devise. The Horstmann and LaCasse model predicts that the average price for goods that were re-auctioned should increase with time to resale under the information signaling theory. In contrast, average price should decrease with time to resale under the traditional auction search model as sellers search for a new set of buyers in the subsequent selling process.

This paper focuses on post-auction privately negotiated sales. This approach attempts to better understand the price discovery process after unsuccessful auction attempts and bridges the gap between auctions and negotiated sales. Hitherto, these two processes have been viewed as mutually exclusive modes of price discovery (Mayer, 1995; Bulow and Klemperer, 1996; Dotzour, Moorhead and Winkler, 1998; Mayer 1998; Allen and Swisher, 2000; and Quan, 2002). Bulow and Klemperer, for instance, show that English auctions with no reserve price are always preferable to negotiations when bidders' signals are independent[2] to the extent that auctions attract bona fide bidders. They demonstrate that the value of additional bidders (competition) at auctions dominates the value of negotiating skills.

The process of putting up a property for auction could provide valuable exposure for the property by making the property available to potential buyers. And, even though an auction is unsuccessful, either as a result of bids not meeting reserve prices or lack of buyer interest, the auction process could be used to identify potential buyers, and as such, could be viewed as an alternative or augmentation to the listing process.

The first objective of this paper is to examine the determinants that influence post-auction sales, the deviation in eventual sale price from opening bids and the time before a private sale is concluded. In addition, the interactive influence of market interest such as turnout, number of bids (or no-bids), auction houses, property type, state of the market and seller motivation is examined, as proxied by the number of previous attempts and distress versus non-distress sales, by utilizing a comprehensive dataset of all residential auctions in Singapore from 1995 to 2000.

Publicity exposure is deemed to have a positive price discovery effect if (a) a subsequent privately negotiated sale occurs and (b) the privately negotiated sale price is higher than some benchmark values determined at the time of the auction.

This study uses the opening bid and the last bid before the property is withdrawn from auction as the benchmark values to compute the price-bid differentials. In addition, the price-bid differentials are examined to observe how they change with the time taken to successfully negotiate a sale.

Reserve prices would have been preferred benchmark values to evaluate price changes, but are unavailable in the dataset. In this regard, real estate auctions in Singapore are no different from many auctions that are conducted with secret reserve prices (Bulow and Klemperer, 1996). Although the market values are estimated for auctioned properties, they are at best noisy estimates given uncertain market conditions, especially in a market downturn where transaction volumes are low. Thus, opening bids are used in this study as they provide an indication of seller information set and motivation.[3]

The second objective is to study whether repeat attempts affect the probability of sale and the subsequent price. In this regard, the study examines how revisions in the opening bids, conditioned on an unsuccessful auction attempt, influence the price discovery process. Specifically, a change in the opening bid is examined to see how the change affects the probability of a subsequent sale. In addition, the effects of the change in opening bids on the eventual transaction price is examined, and for completeness, the auction price as well.

The third objective of this paper seeks to test the empirical predictions of the Hortsmann and LaCasse (1997) information signaling model by utilizing post-auction data for both re-auctions and negotiated sales. In addition, the data allows an evaluation of the effect of bidders (Bulow and Klemperer, 1996) on the auction and subsequent negotiated sales.

The objectives of this paper are closely related in spirit to the work by Knight (2002) and Anglin (2004) where the focus is on changes in listing prices and re-listings. The distinctions are that this work focuses on auctions rather than Multiple Listing Service sales. Earlier it was noted that auctions provide a centralized platform for buyers and sellers, and by inference, auctions should provide better information on past attempts than listings do. In addition, the research differs in that the focus is on opening bids, which are non-binding lower bounds rather than listing prices, which are upper bounds set by sellers. The common thread with these papers is the motivation to better understand how properties transact.

Approximately half of the 963 unsuccessfully auctioned properties that were examined were eventually sold via private negotiations. The probability of a subsequent post-auction transaction is significantly higher for apartments and terrace houses and when auction turnout is high; and lower in the absence of any bid and in some years. The price to opening bid differential increases with the number of increments at the auction, but is lower for more atypical properties and decreases with time-to-subsequent sale.

The empirical results show that the probability of a subsequent post-auction transaction is significantly higher for apartments and terrace houses and when

auction turnout is high; and lower in the absence of any bid and in some years. In addition, downward revisions to the opening bid improve the probability of subsequent sale, although the empirical evidence indicates that numerous repeat attempts actually diminish the likelihood that the property would be eventually sold.

The price to opening bid differential increases with the number of increments at the auction, but is lower for more atypical properties and decreases with time-to-subsequent sale. Properties that did not receive any bids during the auction were eventually sold through private negotiations at a significantly lower price compared to the opening bid. This result is consistent with the prediction in Bulow and Klemperer (1996). The overall results also lend support to the hypothesis that the auction mechanism provides a positive price discovery effect, ostensibly from publicity and exposure at the auctions. This suggests that sellers could benefit from putting up their property for auction at least once even though it may not be successfully sold at the action. At the minimum, the auction process would provide a gauge of market interest and could increase the likelihood and price of subsequent privately negotiated transactions.

Last but not least, the empirical predictions in Horstmann and LaCasse (1997) are tested by analyzing the effect of time to re-auction on the auction price—previous auction last bid differential. Although the sample is small, a weakly positive relation consistent with the information signaling model postulated by Horstmann and LaCasse is found. The last bid in the previous auction that did not go under the hammer is viewed as an indication of the highest price buyers would pay. In contrast, time to re-auction has a negative effect on the auction price–previous opening bid, supporting the expectation that sellers use subsequent auctions as a search process for new bidders. To the extent that sellers of unauctioned properties that were subsequently sold through private negotiations could be viewed as engaging in a renewed search process, the empirical prediction is that the sale price should be lower with time to resale. The evidence shows that subsequent prices decline relative to the last auction bids as time to subsequent sale increases, reinforcing the notion that sellers engage in subsequent searches for buyers.

This paper is organized in five sections with a brief discussion of the auction market in Singapore presented first. Next, there is a discussion of the data, followed by a discussion of the findings and concluding remarks.

Auctions in Singapore

The dominant auction format in Singapore is the English ascending bid auction with a secret reserve price. Auctions have generally been regarded as a last resort method of disposal. The local sentiment toward auctions is similar to that of the United States, where auctions are associated with distress properties—foreclosure or mortgagee sales (Asabere and Huffman, 1992). Distress sales are typically put up by the mortgagee (banks/financial institution). There was a surge in auction

sales following the Asian Financial Crisis from 1998 to 1999. Although a good proportion comprises mortgagee sales, there has been a discernible increase in owner auctions, due to a diminution of the stigma associated with auctions. Even so, the number of properties put up for auction is very low, and reached a high of approximately 3.5% of the total number of property transactions in 1998 and 1999. There has also been a growing perception among potential buyers that auctions of distress properties provide a good avenue to acquire properties at bargain prices. Buyers and sellers have a better understanding and awareness of the efficiency of the auction system as a method of sale, and auction companies in Singapore have substantially increased the frequency of auctions held each month to meet the growing demand.

Bidders in Singapore are generally not aggressive. The success rate for each bidding session varies from 10% to 50%; while the percentage of successful post-auction private market transaction is higher. The low success rate has been attributed to the flagging performance in general, rather than the appeal of auctions itself. Another possible cause of the low success rates is that many owners use the auction process as a gauge of market interest in their properties. In addition, some buyers withhold from biding during an auction in the hope of securing lower transaction prices in post-auction private negotiations. Overly conservative bidding and the expectation that private negotiations are more likely to secure a sale may induce sellers to set unrealistically high reserve prices.

Data

The sample comprises 1,654 private residential properties that were put up for auction from 3Q1995 to 1Q2000 in Singapore. This sample covers all residential auctions over that period. Residential properties are typically classified into high-rise (apartments and condominiums) and low-rise (terrace, semi-detached, detached houses). The data set includes variables on the location, date of auction, number of turnout, auctioneer, distress sale versus by-owner sale, type of property, tenure, opening bid, last bid and number of bid increments during the auction. Properties that were put up auction more than once were omitted, reducing the sample size to 1,281 properties. Of these, 318 properties were sold at the auction. The remaining 963 properties that were not sold at auction form the focus of the analysis.

Property transaction data are extracted from the ReaLink for a period from 1975: Q1 to 2000:Q4, compiled by the Singapore Institute of Surveyor and Valuers (SISV). An estimated market value was computed for all properties put up for auction using either the last transacted price or comparable sales of other private residential properties that are of the same type and in the same estate, having very similar floor area and floor level.

Since the reserve price is secret (Vincent, 1995), a proxy measure called the *level of reserve price* (LRP) is developed (DeBoer, Conrad and Mcnamara, 1992),

which is defined as the difference between the property's estimated market value and the opening bid, divided by the opening bid. The estimated market value is the last transaction price for the auctioned property or the estimated market value of properties most comparable to the auctioned property if there is no previous transaction, adjusted by the price index (RPI). The adjustment uses the RPI from the quarter prior to the auction, as information on the contemporaneous price index is not available at the time of auction.

The state of the market (SOM) indirectly affects the sentiment of property buyers and hence affects the probability of a sale (Mayer, 1995). The SOM is a dummy variable given a value of zero if the auction occurred in a quarter following two previous successive quarters of negative growth in the RPI. Year dummy variables are also introduced to control for the timing of the auction (Vanderporten, 1992), along with a property type dummy variable to distinguish high-rise properties from low-rise properties—terrace, semi-detached and detached houses (*TERR*, *SEMID* and *DETACH*). The data set also allows an identification of properties that were auctioned with vacant possession (*VP*) and that were distress sales (*DISTR*). Properties that are identified as distress sales could mean that the sellers have a set of different bargaining powers as opposed to auctions put up by owners.

Control dummy variables for the auction houses are also created for the big four companies—Knight Frank (*KF*), Colliers Jardine (*CJ*), Jones Lang LaSalle (*JLL*) and DTZ Debenham Tie Leung (*DTZ*). Maher (1989) and Ong, Lusht and Mak (2005) show that the auction house may contribute to the probability of sale. In addition, there is information on the turnout (*TURNOUT*) at the auctions (Burns, 1985), as well as the number of increments (*INCREM*) during the bidding process (Ching and Fu, 2003).

In addition, the transactions for all the unsuccessful properties (until end 2000) were traced. There were a total of 445 post-auction transactions, indicating that close to half of the properties that were not sold at auctions were subsequently sold through private negotiations. Of these, 117 properties received at least one bid during the auction, and the remaining 328 properties did not receive any bid. The post-auction transactions prices of the 445 properties are used to compute the price-bid differentials using the opening bid and last bid before the property was withdrawn (TPOB and TPSB, respectively). The time between the subsequent sale and auction dates is the time-to-(subsequent)-sale (TOS). Exhibit 1 provides the variables. Exhibit 2 presents the summary statistics.

Analysis

Price-Bid Differentials

The preliminary evidence shows that properties that garnered some interest (bids) sell (when they do) at higher prices than the opening bids and in a shorter time

Exhibit 1 | Variables for Auction Data (3Q1995–1Q2000)

Variable	Description
DISTR	Distress sale = 1
LRP	Level of reserve price
PREVATT	Number of previous auction attempts
TURNOUT	Number of turnout
TERR	Terrace house
SEMID	Semi-detached house
DETACH	Detached house
TEN	Tenure: Freehold (>99 years) = 1; or leasehold (≤99 years)
NOBID	No bid received = 1
SOM	State of the market = 1 if real estate market did not experience two consecutive quarters of negative price change
INCREM	Number of increments
VP	Property with vacant possession = 1
COB	% Change in previous opening bid from current opening bid
DCOB	Change in opening bid = 1
TPOB	% Difference between subsequent sale price and opening bid
TPLB	% Difference between subsequent sale price and last bid
TOS	Number of days between auction and subsequent sale
D96, D97, D98, D99, D00	Year dummy variables for 1996 through 2000
KF, JLL, CJ, DTZ	Auction house dummy variables
SUBSALE	Subsequent sale = 1

compared to properties that received no bid. The average price-open bid differential (TPOB) is −2.08% for the sample of 448 properties that were subsequently sold. In comparison, the average TPOB for properties that were successfully auctioned is 8.20%. However, if these properties are segregated into those that received at least one bid (category 1) and those that received no bid (category 2), the average TPOBs are 1.53% and −4.38%, respectively. The differences are statistically different at 5% level (*t*-Stat = 4.089) (see Exhibit 3).

The average time-to-sale (TOS) is 108 days and 148 days for the two categories of properties, respectively (the difference is also statistically different at 5% level; *t*-Stat = 2.761). In addition, the average price-last bid differential (TPLB) for the 117 properties that were eventually sold is −0.52%. Although this is not statistically different from zero, it shows that some properties were negotiated at higher prices than the last bid at the auction.

Exhibit 2 | Descriptive Statistics

Variable	Mean	Std Dev	Min	Max	nob
SUBSALE	0.4930	0.5001	0	1	963
LRP	0.0559	0.3015	0	8.0917	963
SOM	0.5504	0.4977	0	1	963
VP	0.8847	0.3195	0	1	963
TENURE	0.8380	0.3686	0	1	963
TURNOUT	180.62	86.95	15	450	963
D96	0.0831	0.2761	0	1	963
D97	0.0415	0.1996	0	1	963
D98	0.4174	0.4934	0	1	963
D99	0.3946	0.4890	0	1	963
D00	0.0104	0.1014	0	1	963
PREVATT	0.2949	0.6609	0	5	963
COB	0.0105	0.0796	−0.3409	1.6071	963
DCOB	0.0966	0.2955	0	1	963
TOS	167.35	208.55	0	1603	469
INCREM	0.3853	1.2694	0	12	963
TPOB	−0.0169	0.1924	−0.5667	1.2941	469
TPLB	0.0001	0.1633	−0.4632	0.7094	128
KF	0.3427	0.4749	0	1	963
JLL	0.3022	0.4594	0	1	963
CJ	0.0914	0.2883	0	1	963
DTZ	0.2274	0.4194	0	1	963
TERR	0.1526	0.3598	0	1	963
SEMID	0.2264	0.4187	0	1	963
DETACH	0.1880	0.3909	0	1	963
NOBID	0.7456	0.4358	0	1	963
DISTR	0.4621	0.4988	0	1	963

Note: Definitions and descriptions of variables are provided in Exhibit 1.
COB = (previous OB − current OB) / current OB.

Exhibit 3 | Analysis of Time-to-Sale

	At Least 1 Bid			No Bid			
	Mean	Std. Dev.	nob	Mean	Std. Dev.	nob	*t*-Stat
Panel A: Analysis of Time-to-Sale and Price-Bid Differences							
TOS	108.97	124.79	117	147.92	131.99	331	−2.761*
TPOB	0.0153	0.1258		−0.0438	0.1360		4.089*
TPLB	−0.0052	0.1178					
Panel B: Analysis of Price-Last Bid Differentials by Time-to-Sale							
TOS							
< 60 days	0.0361	0.1030	59	−0.0236	0.0795	107	4.159*
60–90	0.0538	0.0716	16	−0.0525	0.0867	40	4.343*
90–180	−0.0129	0.0776	21	−0.0367	0.1547	85	0.684
180–360	−0.0036	0.1872	14	−0.0486	0.1383	68	1.042
> 360	−0.1506	0.2186	7	−0.1048	0.2349	31	−0.471
Panel C: Analysis of Price-Last Bid Differentials by Time-to-Sale							
< 60 days	0.0084	0.0959	59				
60–90	0.0351	0.0633	16				
90–180	−0.0194	0.0814	21				
180–360	−0.0186	0.1714	14				
> 360	−0.0009	0.1728	7				

Exhibits 3 (Panel B) and 4 show the average price-open bid differentials (TPOB) for the two categories by TOS. Positive average price-open bid differentials are observed for properties that attracted some interest and that were subsequently sold within 90 days of the auction. In contrast, properties that received no bid were sold at discounts to the opening bids regardless of the time-to-sale. The difference in average TPOBs across these two categories for sales within 90 days are statistically significant. This evidence suggests that a positive price discovery effect occurred for properties that attracted market interest at the auction.

The negative TPOBs for category two properties could also be anecdotal evidence that the reserve and opening bids are set too high, and subsequent private negotiations yielded lower transaction prices. Unraveling the appropriateness of the opening bids would require an estimate of the market value, which is examined in the following section.

Positive average price-last bid differentials (TPLB) were also observed for properties sold within 90 days [Exhibits 3 (Panel C) and 5]. The eventual

Exhibit 4 | Distribution of TPOB by TOS

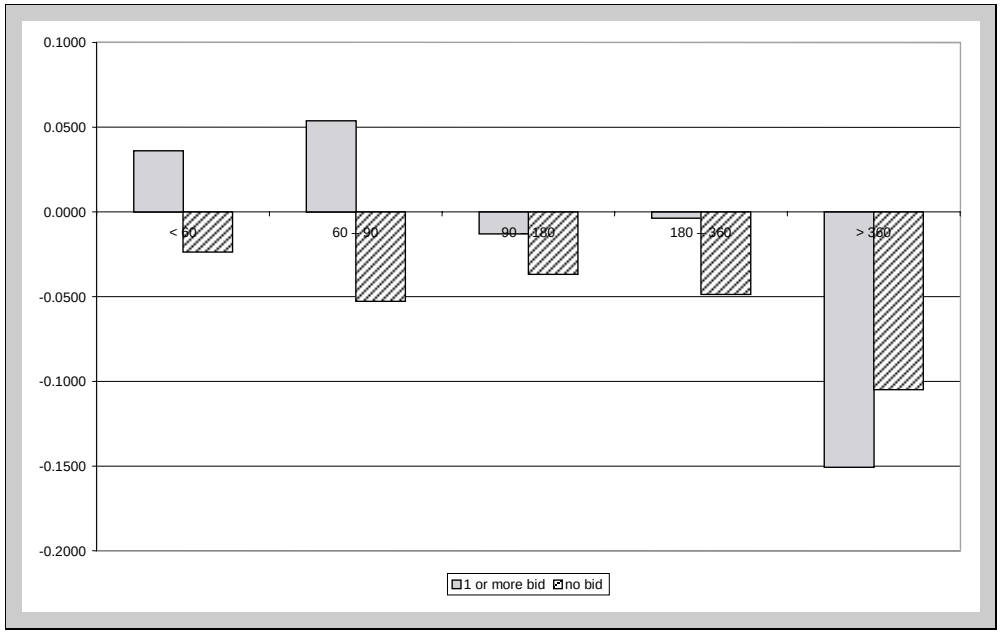
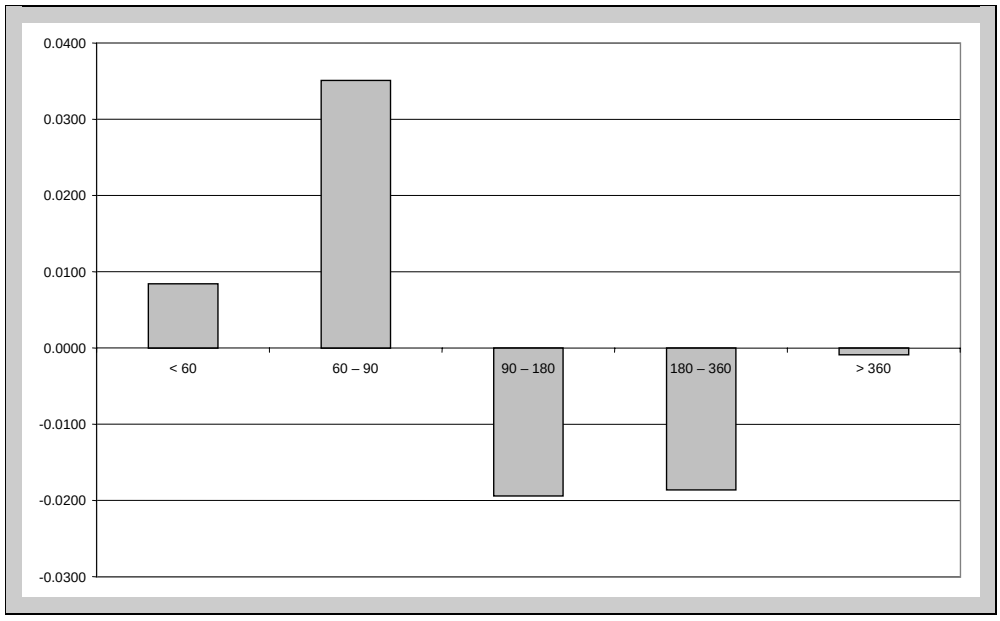


Exhibit 5 | Distribution of TPLB by TOS



transaction prices do not differ much from the last bid for properties sold within 60 days of the auction (less than 1% on average), suggesting that the last bids were close to the final prices. However, the average TPLB for subsequent sales concluded within 60 to 90 days is more than 3%. This suggests that sellers who take up to three months to negotiate and agree to the eventual sale price obtained, on average, higher prices.

However, any agreement that takes more than three months is likely to result in lower transaction prices. Note that the average TPLB, regardless of time to sale, is negative (Exhibit 3, Panel A). To the extent that post-auction privately negotiated sales that occurred after 90 days represents a renewed search process[4] and that the last bid at the initial auction is an indication of the price buyers are willing to pay, the finding in Exhibit 3 (Panel C) is supportive of the prediction by Horstmann and LaCasse (1997) that the average price decreases with time to resale under the search model. Taken as a whole, the evidence suggests that sellers engage in a renewed post-auction search process for a new set of buyers as postulated by Horstmann and LaCasse (1997).[5]

Probability of Subsequent Privately Negotiated Sale

A probit model is estimated for the likelihood of a subsequent privately negotiated sale (*SUBOUT* = 1). Essentially the same set of explanatory variables that are used to examine the factors that influence sale *at* the auction is adopted. The results are given in Exhibit 6 (Model 1). Properties that received no bid (*NOBID* = 1) have a lower probability of sale (*p*-value = .0887), supporting the earlier results. The turnout at the auction (*TURNOUT*), however, is significant and positive. This result is also consistent with Ong, Lusht and Mak (2005). Surprisingly, distress sale[6], the level of reserve price, state of market, number of increments and number of previous attempts are not statistically significant.

Not surprisingly, the probability of a subsequent sale is reduced in 1999 and 2000, when the market is recovering. This suggests that post-auction price discovery is likely to be more useful under uncertain market conditions. Interestingly, some auction houses (*KF* and *CJ*) have a negative and significant effect on the probability of a subsequent sale. These two auction houses, in fact, have a positive effect on the probability of an auction sale (Ong, Lusht and Mak, 2005). Taken together, the evidence suggests that some tradeoff between at- and post-auction success rates for these auction houses. The evidence also suggests that some auction houses could provide a valuable screening mechanism for bidders—be it in terms of realistic reserve prices, desirability, etc. A property is not successfully auctioned by KF or CJ could be perceived by the market as a signal that the property is ''undesirable'' and hence a lower probability of subsequent sale is observed.

In Exhibit 6, Models 2 and 3 estimate the probit model of subsequent sale with two added variables: the percentage change in the opening bid (*COB*) and a

Exhibit 6 | Probit Model of Subsequent Sale

	1. No Adjustment for Change in Opening Bid		2. Percentage Change in Opening Bid		3. Dummy Variable Change in Opening Bid	
Variable	Coeff.	*p*-value	Coeff.	*p*-value	Coeff.	*p*-value
Constant	0.5237	0.1725	0.5779	0.1352	0.3949	0.3104
LRP	0.2155	0.3040	0.1310	0.4290	0.1723	0.2732
SOM	−0.2298	0.3830	−0.2516	0.3484	−0.3269	0.2254
KF	−0.4968***	0.0539	−0.5208**	0.0433	−0.4960***	0.0557
JLL	−0.4289	0.1011	−0.4717***	0.0716	−0.4189	0.1112
CJ	−0.6261**	0.0288	−0.6717**	0.0193	−0.6452**	0.0254
DTZ	−0.1877	0.4669	−0.1857	0.4717	−0.2263	0.3829
DISTR	0.0931	0.3479	0.1218	0.2328	0.0718	0.4839
TENURE	0.2087***	0.0903	0.2082***	0.0974	0.2765**	0.0302
TURNOUT	0.0015**	0.0158	0.0013**	0.0460	0.0014*	0.0410
D97	−0.3123	0.1817	−0.2781	0.2384	−0.2590	0.2717
D98	−0.3511	0.1840	−0.3592	0.1824	−0.4160	0.1253
D99	−0.8337**	0.0000	−0.7568**	0.0000	−0.8058*	0.0000
D00	−1.6832**	0.0035	−1.5300**	0.0050	−1.9909*	0.0035
TERR	0.2022	0.1263	0.1813	0.1769	0.1957	0.1528
SEMID	0.1072	0.3557	0.1157	0.3332	0.0707	0.5595
DETACH	−0.1025	0.4048	−0.1635	0.1992	−0.1544	0.2292
VP	0.1152	0.4068	0.1104	0.4331	0.1571	0.2707
INCREM	−0.0094	0.8110	−0.0039	0.9219	0.0121	0.7595
PREVATT	−0.0992	0.1437	−0.3471**	0.0001	−0.6926*	0.0000
NOBID	−0.1962***	0.0887	−0.1923***	0.1056	−0.0198	0.8674
COB			6.1929**	0.0000		
DCOB					2.0798*	0.0000

Notes: The dependent variable is *SUBSALE;* and nob is 963. Log-likelihood: No Adjustment for Change in Opening Bid = −601.95; Percentage Change in Opening Bid = −570.13; and Dummy Variable Change in Opening Bid = −552.59.

* Significant at the 1% level using a two-tailed *t*-test.

** Significant at the 5% level using a two-tailed *t*-test.

*** Significant at the 10% level using a two-tailed *t*-test.

dummy variable indicating a change in the opening bid (*DCOB*). The *COB* is measured as the percentage difference in the previous opening bid from the opening bid at the latest auction, so a positive *COB* is indicative of a reduction in opening bids. The likelihood of a subsequent sale increases in both *COB* and *DCOB* (both variables are statistically significant at the 1% level). So a downward revision in the opening bid, ostensibly reflecting revisions in the seller's reserve price, would be viewed positively by the market, and aids in the price discovery process.

As an aside, it should be noted that the number of previous attempts (*PREVATT*) became significant in Models 2 and 3. The negative sign on *PREVATT* indicates that the probability of a subsequent sale actually decreases with a higher number of repeat attempts. So while revisions in opening bids yield a positive effect, excessive attempts could result in the opposite effect.

Determinants of Price-Open Bid Differential

As discussed earlier, the negative TPOBs observed for properties that received no bids could be attributed to unrealistic reserve prices (as reflected by opening bids). To investigate this, a simple regression model is used to examine how the price-bid differentials are influenced by various explanatory variables; in particular, a control is introduced for the estimated market value by way of the *LRP* variable. The sample selection issue (for properties that were subsequently sold) is controlled for by way of estimating the inverse Mills ratio from the probit model from Exhibit 6.

Model 1 in Exhibit 7 reports the results only for properties that were subsequently transacted, while Model 2 is estimated for properties that were successfully auctioned to provide a comparison. The inverse Mills ratio is estimated separately for the two models, using only the sample of unsuccessful sales from a probit model (as reported in Exhibit 6) for Model 1. A separate probit model using all auctions but defining only successful auction sale is estimated for Model 2. For completeness, TPOB is also investigated for all properties sold, regardless of whether at an auction or through a subsequent private negotiation (Model 3). For Model 3, a probit model based on all auctions is estimated, but defining the dependent variable as 1 when the property is sold either at the auction or subsequently.

The results show that the price-open bid differential increases in the number of increments and turnout. This implies that the eventual sale price (relative to opening bid) is increasing in market interest, as proxied by turnout and bid increments.

The negative and significant coefficient on time-to-subsequent sale (TOS) is also consistent with the earlier result showing that the price-bid differential is higher when the sale is negotiated closer to the auction date. The findings indicate that TOS has a diminishing but insignificant marginal effect on the price-bid

Exhibit 7 | OLS Regression on Price-Open Bid Differential (dependent variable)

	Subsequent Sale		Auction Sale		All Sales	
Variable	Coeff.	*p*-value	Coeff.	*p*-value	Coeff.	*p*-value
Constant	−0.0048	0.9430	0.0588	0.5858	0.0065	0.8952
LRP	−0.0200	0.0909	−0.0011	0.9656	0.0013	0.9170
SOM	0.0542	0.2566	0.0620	0.1859	0.0054	0.8785
KF	0.0677	0.1522	0.0064	0.9537	0.0189	0.5105
JLL	0.0606	0.1438	−0.0307	0.7793	−0.0044	0.8790
CJ	0.1248	0.0254	−0.0185	0.8661	0.0129	0.6884
DTZ	0.0557	0.1342	−0.0154	0.8902	0.0140	0.6214
DISTR	0.0418	0.0700	−0.0063	0.6105	0.0312**	0.0100
TENURE	−0.0407	0.1445	0.0200***	0.0558	−0.0030	0.7899
TURNOUT	0.0002	0.1467	0.0001**	0.0147	0.0001**	0.0058
D96	−0.0637**	0.0521	−0.0083	0.9226	−0.0338	0.1843
D97	−0.1119	0.0093	−0.1955***	0.0514	−0.1259*	0.0010
D98	−0.0059	0.9211	−0.0118	0.8972	−0.0466	0.2601
D99	−0.0261	0.5417	−0.0839	0.2945	−0.0332	0.1189
D00	0.0979	0.3269	−0.0676	0.3375	−0.0082	0.8017
TERR	−0.0370	0.1158	−0.0221**	0.0156	−0.0118	0.2438
SEMID	−0.0750*	0.0006	−0.0167	0.1328	−0.0342*	0.0012
DETACH	−0.0133	0.6820	−0.0345*	0.0049	−0.0318**	0.0220
VP	0.0295	0.2487	−0.0011	0.9313	0.0106	0.4844
INCREM	0.0170	0.0256	0.0085*	0.0000	0.0106*	0.0000
PREVATT	−0.0061	0.7678	−0.0004	0.8998	−0.0040	0.4167
NOBID	−0.0214	0.3314			−0.0210**	0.0451
TOS	−0.0002*	0.0006			−0.0294**	0.0294
COB	−0.0280	0.7666			−0.0001*	0.0009
IMR	−0.0801	0.2251	−0.0418*	0.0030	0.0820	0.1220
R^2	0.1237		0.4656		0.3584	

Notes: All standard errors are heteroscedasticity robust; IMR (Inverse Mills Ratio) for Model 1 is obtained from probit model in Exhibit 6; IMR for Model 2 is obtained from probit model for successful auction sale. nob: No Adjustment for Change in Opening Bid = 448; Percentage Change in Opening Bid = 318; and Dummy Variable Change in Opening Bid = 767.

* Significant at the 1% level using a two-tailed *t*-test.

** Significant at the 5% level using a two-tailed *t*-test.

*** Significant at the 10% level using a two-tailed *t*-test.

differential. Lower differentials are observed for more atypical properties such as terrace, semi-detached and detached houses, although the reduction is statistically significant only for semi-detached houses that were subsequently sold.

The evidence on the number of previous attempts and no-bid situations is rather mixed. The coefficient on the number of previous attempts is negative and insignificant in both models, consistent with the earlier analysis that excessive repeat attempts may be detrimental to sale. No-bid is negative but is significant only for the entire sample (Model 3). The results in Model 3 imply that properties that did not receive any bids during an auction were eventually sold through private negotiations at a significantly lower price compared to the opening bid.

To the extent that Bulow and Klemperer (1996) view auctions as a more attractive option for sellers in identifying potential buyers, the complete lack of bidders at the auction observed *ex post* would indicate that auctions are not a good mechanism. As such, this suggests that the eventual sale price would be lower when no bids were received. The negative and significant coefficient on *NOBID* in Model 3 is consistent with the theoretical prediction in Bulow and Klemperer.

Information Signaling

The next series of test evaluates the information signaling theory postulated by Horstmann and LaCasse (1997). Recall that the information signaling theory model predicts that the average price for goods that were re-auctioned should increase with time to resale. Properties were identified that were unsuccessful in previous auctions that were subsequently sold through auction. Of the 328 successful auctions, 52 have been previously put up for auction. Of these, only 14 received bids in the previous auction.

A pertinent question is the reference value for the property at the previous auction. Clearly, the last bid received at the unsuccessful auction is a good indication of value. However, as demonstrated earlier, the opening bid as determined by the sellers and auctioneers is also another indication of the secret reserve price. As such, two tests are conducted. The first test examines the difference between the auction price and the last bid received in the previous auctions, while the second test looks at the differential between the auction price and opening bid from the previous auction. However, the lack of bids in the previous auction would *a priori* suggest that subsequent auctions are searches for new sets of bidders. The key variable is the time to re-auction (between the successful auction and the previous attempt[7]). The information signaling theory predicts that the differential would be increasing in time to re-auction (TOR). However, if no bids are registered in previous auctions, then the price–previous opening bid differential is expected to be decreasing in TOR, which is consistent with the search theory.

The average auction price differential from the last bid in the previous unsuccessful auction is 1.70%. If outliers for re-auctions more than one year were excluded, the average differential goes up to 4.77% for 13 observations. Further,

a regression (see Exhibit 8) of the auction price–previous last bid differential to time to re-auction (TOR) shows a positive but statistically insignificant coefficient, after controlling for distress sales and property types. This result provides some support for the Horstmann and LaCasse (1997) information signaling model, but acknowledge that the small number of observations is a cause for concern.

If the analysis to the price–opening bid is expanded from the previous auction differential, the mean difference is −6.03% excluding outliers where TOR is more than one year (for comparison purposes, the mean difference in opening bids from the previous auction is −7.28%). The price–previous opening bid differential is decreasing in time to re-auction (Exhibit 8, last column).[8] Although the coefficient on TOR is significant only at a *p*-value of .0577, the evidence is consistent with the search theory. Interestingly, the coefficient on the interaction variable between TOR and a dummy variable for auctions that received bids in previous attempts (LB) is positive and significant at a *p*-value of .0555. This result further provides support for the Horstmann and LaCasse (1997) information signaling model.

Exhibit 8 | OLS Regression on Re-auction Differentials

Dependent Variable	Auction Price − Last Bid from Previous Auction		Changes in Opening Bid		Auction Price − Opening Bid from Previous Auction	
Variable	Coeff.	*p*-value	Coeff.	*p*-value	Coeff.	*p*-value
Constant	0.1291***	0.0717	0.1945	0.1408	0.1996	0.4397
DISTR	−0.0995	0.1296	−0.2175**	0.0418	−0.2286	0.1146
TERR	0.0354	0.5417	0.0967*	0.0076	0.1119**	0.0138
SEMID	−0.2130*	0.0003	0.0069	0.8918	−0.0293	0.8847
DETACH	0.0282	0.4345	−0.0022	0.9510	−0.0202	0.9417
TENURE			−0.0147	0.7453	0.0169	0.9330
TURNOUT			−0.0001	0.6580	0.0000	0.6487
TOR	0.0001	0.9147	−0.0004**	0.0351	−0.0004***	0.0577
*TOR*LB*			0.0007	0.2118	0.1996***	0.0555
R^2	0.1496		0.3501		0.2188	
nob	13		48		48	

Notes: All standard errors are heteroscedasticity robust. *TOR* is the time to re-auction (*i.e.*, the number of days between the successful auction and the previous attempt. *LB* is a dummy variable for auctions that received bids in the previous attempts.
* Significant at the 1% level using a two-tailed *t*-test.
** Significant at the 5% level using a two-tailed *t*-test.
*** Significant at the 10% level using a two-tailed *t*-test.

Exhibit 9 | OLS Regression on Price-Last Bid Differential (dependent variable)

Variable	Coefficient	*p*-value
Constant	−0.0814	0.3624
LRP	−0.0058	0.3511
SOM	−0.0109	0.8580
KF	0.0115	0.8600
JLL	0.0452	0.4223
CJ	0.0983	0.2600
DTZ	−0.0053	0.9260
DISTR	0.0521**	0.0222
TENURE	−0.0073	0.7961
TURNOUT	0.0001	0.5799
D96	0.0928**	0.0419
D97	−0.0960	0.1985
D98	−0.0264	0.7374
D99	0.0372	0.4563
D00	0.0479	0.4323
TERR	−0.0407	0.1080
SEMID	−0.0427***	0.0977
DETACH	−0.0234	0.5045
VP	0.0647**	0.0358
INCREM	0.0089	0.2662
PREVATT	−0.0133	0.3952
TOS	−0.0001*	0.0078
COB	0.1268	0.3539
IMR	0.0371***	0.0644
R^2	0.2268	

Notes: All standard errors are heteroscedasticity robust; IMR (Inverse Mills Ratio) is obtained from the probit model in Exhibit 6. nob = 117.
*Significant at the 1% level using a two-tailed *t*-test.
**Significant at the 5% level using a two-tailed *t*-test.
***Significant at the 10% level using a two-tailed *t*-test.

As an aside, a negative and significant relation is found between TOR and the changes in opening bids (second column of Exhibit 8). This is not surprising given the fact that a lack of bids is a strong signal that the opening bid is too high. However, the reduction in the opening bid is not statistically different across properties that were successfully re-auctioned and those that were not.[9]

The final test is to extend the search theory to subsequent privately negotiated sales and to evaluate the effect of time to subsequent sale (TOS) on the transaction price–last bid differential (TPLB). As mentioned earlier, the traditional search *auction* model implies that the average price should decrease with time to resale. The same relation is expected to hold for a search model for *negotiated sale*. The regression results in Exhibit 9 show a negative and significant coefficient on TOS, after controlling for other pertinent variables. This evidence further supports the finding that post-auction transactions via private negotiations are consistent with a search process.

Conclusion

This paper presents an examination of post-auction price discovery. The premise is that the auction process itself may provide positive publicity or exposure effects to the extent that sellers gather useful information even if no sale is made at the auction. About half of the properties that were unsuccessful at the auction were eventually sold via private negotiation. The majority of subsequent sales occur within 180 days of the auction.

The evidence is consistent with the market interest explanation—the higher the level of market interest, the more likely a subsequent private sale and the higher the price relative to opening bid. Interestingly, the number of increments received during the auction affects only the price differential and not the probability of subsequent sale. The results suggest that sellers could benefit from putting up their property for auction at least once even though it may not be successfully sold at the action. At the minimum, the auction process would provide a gauge of market interest and could increase the likelihood and price of subsequent privately negotiated transactions.

The findings indicate that revisions in the opening bids when earlier attempts were unsuccessful increase the probability of subsequent sale. There is, however, a tradeoff between bid revisions and excessive repeat attempts—excessive repeat attempts could have a negative price discovery effect. Interestingly, the probability of subsequent sale actually decreases with certain auction houses. The fact that these same auction houses are more likely to successfully auction properties suggests that they provide a valuable screening mechanism in the auction price discovery process. Properties that were put up for auction by these houses, and were unsuccessful at auction, could be viewed as ''undesirable'' and hence a lower probability of subsequent sale is observed.

Last but not least, the empirical predictions in Horstmann and LaCasse (1997) were tested by analyzing the effect of time to re-auction on the auction price–

previous auction last bid differential. There is a positive relation consistent with the information signaling model postulated by Horstmann and LaCasse (1997) albeit only in a small sample. The last bid in the previous auction that did not go under the hammer is viewed an indication of the highest price buyers would pay. In contrast, time to re-auction has a negative effect on the auction price–previous opening bid, supporting the expectation that sellers use subsequent auctions as a search process for new bidders. To the extent that sellers of unauctioned properties that were subsequently sold through private negotiations could be viewed as engaging in a renewed search process, the empirical prediction is that the sale price should be lower with time to resale. The evidence shows that subsequent prices decline relative to the last auction bids as time to subsequent sale increases, reinforcing the notion that sellers engage in subsequent searches for buyers.

Some questions remain unanswered. For example, the price differential for properties that were subsequently sold is lower on average than for auctioned properties, suggesting that (a) the process of auction generates higher realized transaction prices as auction theory would indicate (*i.e.*, the winner's curse) and/or (b) the opening bids for auctioned properties are lower in comparison to properties that were not sold at the auction. Unraveling these effects could be interesting in order to evaluate the information value of opening bids.

Also, how do prices for properties that were subsequently sold after the auction compare against those that were not put up for auction? While properties sold at auctions have higher price-open bid differentials compared to post-auction properties,[10] are post-auction *prices* significantly different from auction prices? How would prices differ when properties are re-auctioned? Future work will seek to address some of these questions.

Endnotes

[1] Thirty-seven percent of the sample in the Ashenfelter and Genesove (1992) study were not sold at the ''hammer prices.''

[2] he same result holds under certain conditions when signals are affiliated. To the extent that auctions attract bona fide bidders, Bulow and Klemperer (1996) show that English auctions with no reserve price are always preferable to negotiations when bidders' signals are independent. The insight is that auctions allow sellers to identify genuine buyers, and that an auction with $N + 1$ bidders dominates any negotiation with N bidders. The data allows identification of an auction that does indeed attract additional bidders in that property auctions that did not attract a bid can be separated out.

[3] Bidding starts at the opening bid. In some markets, it is not uncommon for an auctioneer to ''pick a bid out of the air.'' In Singapore, however, reserve prices are disclosed to the auctioneer only on the day of the auction itself, and auctioneers have to rely on appraisals and identify interested buyers during the open house viewings prior to the auction. Since auctioneers only know the reserve price for a property literally hours before the auction, they usually set a realistic opening bid that would convey useful information to interested bidders identified prior to the auction. Auctioneers have anecdotally verified that opening

bids are usually good indications of the reserve prices. This is particularly so over the sample period when the real estate market was ''soft.''

[4] The data does not enable a determination of whether the property is subsequently sold to a bidder who participated in the bidding during the auction.

[5] As a caveat, it should be noted that the Horstmann and LaCasse (1997) model assumes a second price auction to compare their information signaling re-auction model with a traditional search auction model. Expected revenues are, however, the same for first- and second-price auctions (Milgrom, 2004).

[6] Ong, Lusht and Mak (2005) find the distress sales variable to be significant in determining the outcome of successful auction.

[7] The date of the first unsuccessful auction is used when there is more than one previous attempt.

[8] The results remain unchanged when outliers are included in the regression.

[9] The mean change in opening bids for properties that were not successfully sold at re-auctions is −9.29%. The *t*-Stat for difference in means is 0.7344.

[10] This result could be attributed to differences in opening bids.

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