Market Sentiments, Winner's Curse, and Bidding Strategy in Real Estate Auctions

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Abstract

The objective of this study is to examine the effect of prevailing market sentiments in real estate markets on the stock market response to the outcomes of real estate auctions in Hong Kong. The reactions of stock market to the winners of the auctions have at least two interesting implications. On one hand, the success in acquiring a real estate implies that the developer has acquired a project with potentially positive net present value and the stock price of the developers should rise. Bids on real estate development projects are often based on the developer's estimate of potential costs and profits. These estimates, when conditioned on the current market information, may be highly influenced by the prevailing market sentiments. The complexity of estimating the development costs may cause the developers to arrive at different estimates and thereby different bids. The prevailing market sentiments in the real estate markets may also affect the bidding behavior of the bidders. During periods when the real estate prices are soaring, the bidders may bid more aggressively against each other. As a result, the successful bidder may be the victim of the "winner's curse". If this is the case, investors in the stock market should view this as a factor that negatively affects the stock price of the developer, thus discounting the stock price of the winning firm. The availability of the auction records and the stock prices in Hong Kong provides us an excellent opportunity to test the auction theory and allows us to examine how the stock market evaluates these two counteracting effects. Moreover, we can investigate how market sentiments in the real estate markets may affect the stock market response to the auction winners.

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I. Introduction

Ever since Riley and Samuelson's (1983) seminal article on optimal auctions, a lot of research have been conducted on the development and empirical and experimental testing of auction theory in art work, oil leases, failed banks, Treasury issues, wine, corporate takeovers, initial public offerings, as well as real estate. Quan (1994) provides a detailed survey of the types of auctions commonly employed in the sale of real estate.

The objective of this study is to examine the effect of prevailing market sentiments in real estate markets on the outcomes of real estate auctions in Hong Kong. In particular, we are interested in examining the how the prevailing market sentiments may affect the bidding strategies of the auction winners and in turn how the stock market responds to the winners of the real estate auctions. The contribution of this study is that we can empirically test the existence of winner's curse as predicted in existing auction theory using stock market and real estate transaction data. Many investors regard the Hong Kong stock market as more speculative than other major markets around the world. The result of this study will shed some light on how the speculative activities in the real estate market may directly impact the behavior of the stock market.

Real estate auctions are popular method of selling residential and commercial properties as well as government land sites in Hong Kong. The Hong Kong Government regularly conducts English auctions and first-price sealed bid auctions to sell land. Thousands of privately owned properties are disposed of in either public auctions or sealed-bid auctions every year. Many of the participants in real estate auctions in Hong Kong are companies publicly traded in the Hong Kong Stock Exchange. The reactions of stock market to the winners of the auctions have at least two interesting implications. On one hand, the success in acquiring a land site implies that the developer has acquired a project with potentially positive net present value. The stock market should view the acquisition favorably and the stock price of the winner should rise immediately following the successful acquisition of the land site. On the other hand, bids on real estate development projects are often based on the developer's estimate of cost and profit margin, which ex post may be identical for all developers. These estimates, when conditioned on the current market information, may be highly influenced by the prevailing market sentiments. Due to the complexity of estimating the development costs, developers may arrive at different estimates and thereby different bids. The prevailing market sentiments in

the real estate markets may also affect the bidding behavior of the bidders. During periods when the real estate prices are soaring, the optimistic market sentiment may induce the bidders to bid more aggressively against each other. A prediction based on existing auction theory is that the successful bidder may be the victim of the winner's curse. It is because if all developers have similar profit margins, the winner must be the one with the lowest cost estimate, or if all have similar cost estimates, the winner must be the one with the highest estimate for profit margin. In English auction, the bidding awards the bidder the land site only if the bidder has either underestimated the cost or overestimated the profit margin more than the rivals. If this is the case, the stock market should view this negatively and discount the stock price of the winner for the "winner's curse."

The availability of the auction records and the stock prices in Hong Kong provides us an excellent opportunity to test the auction theory and allows us to examine how the stock market evaluates these two counteracting effects. In addition, we can also examine whether the bidding behavior of the developers and the stock market response to the auction winners change with the prevailing market sentiments in the real estate markets around the auction.

II. Previous Studies

1. The theory of auctions and the winner's curse

In an auction where bidder's estimate of the reservation value of a commodity has a common component among the bidders, the phenomenon known as the "winner's curse" becomes an important issue. (See McAfee and McMillan (1987) and Thaler (1988).) In contrast, in a private value auction, such as that of paintings, where private reservation values are independent among the bidders, and that each bidder knows his or her own reservation price only, winner's curse is an irrelevant issue. Common value auctions include, say, auctions of offshore oil leases, highway construction contracts, and real estate development projects. A few examples in financial markets include treasury auctions and initial public offerings of equities. Since the value of a commodity is unknown to a prospective bidder, a bid based on an overestimating of its value is more likely to be accepted. Thus the bidder has certain disappointment in winning the bid since the winning bid may exceed the value of the commodity, so the bidder loses money.

Thus winning an auction is an informative event (Wilson (1977)), and failure to incorporate such conditional information this into the strategy will lead to over-bidding and subsequent losses; thus inviting a winner's curse. Once the bid is accepted, the bidder must revise (lower) the estimate of the value he or she has won. Wilson has shown that optimizing behavior requires that bidders to compensate for the potential bias by taking into account the expected strategies of other bidders to avoid the winner's curse. According to the theory, rational bidders take the winner's curse into account by adjusting to lower rates when there are greater uncertainties about other bidders' strategies. Also the theory predicts that lower rates should be accompanied by a larger number of competing bidders.

2. Evidence of winner's curse

There is considerable evidence reported from experimental studies that those who bid for commodities with uncertain value fall victim to the winner's curse. See, for example, Davis and Holt (1993) for a survey of recent experimental studies. While the theoretical implications of auction theory have been quite extensively examined in laboratory experiments, empirical tests using actual observations have been scarce mainly due to the unavailability of data. Previous empirical studies, however, provide mixed results regarding the existence of winner's curse in common value auctions. For example, Hendricks, Porter, and Boudreau (1987) report that the winner's curse does not exist in the auction for offshore oil leases. Also in the highway construction contracts, Thiel (1988) provides evidence that the winner's curse is not a significant problem, although the underlying auction model fits the data reasonably well. He concludes that bidders on highway contracts seem to "shave" their bids in order to avoid the winner's curse.

On the other hand, Gilberto and Varaiya (1989) investigate acquisitions of failed banks in FDIC purchase and assumption (P&A) auctions. In the sealed-bid auction, they find evidence that bid levels of all bidders (both winners and losers) increased with increased competition, which is consistent with bidder's failing to adjust for the winner's curse. Gilberto and Varaiya attempt to distinguish between common value auction and private value auction empirically, since it is difficult to classify real world auctions into either types a priori. According to auction theory, an increase in the number of competitive bidders increases the level of optimal bid in private value auctions but decreases in common value auctions. After classifying the

sample into two categories, they find that the number of competitive bidders positively affects the winning bid of both types, which is inconsistent with the theory. Therefore the result should be interpreted with caution.

3. Other empirical findings

In general, the empirical findings in the literature seem to support other predictions of the theory. For example, Simon (1994) finds that the quantity risk is at least as important as the winner's curse in treasury coupon auctions. Quantity risk is particularly important for dealers who face the risk of not winning the quantity from the auction since dealers typically bid at auctions with large short positions to cover. Using the data from the federal offshore oil and gas drainage lease sales, Hendricks and Porter (1988) test the case when it is possible to identify the agents with superior information, and to quantify the information available to them and to the other, relatively less informed agents. They find that the neighbor firms (that are adjacent to tracts on which a deposit has been discovered) are better informed about the value of a lease than non-neighbor firms, and that the former exploit this advantage by shaving their bids substantially below their expectation value of the tract. The non-neighbors account for their disadvantage by bidding conservatively. As a consequence, they do not suffer from the winner's curse.

4. On empirical methodologies

As pointed out by Thiel (1988), one of the difficulties testing winner's curse is that the winner is cursed relative to the true value of the item at auction. However, estimating the true value is equally difficult for the econometrician as it was for the bidders. Thiel avoids the problem by developing a model of optimal bidding in which the winner's curse is measured in terms of parameters that are independent of the true cost of the project. Other studies that often use regression studies, for example Gilberto and Varaiya (1989), test the hypothesis indirectly by regressing the bids on various variables suggested from theory. Since the true value of the auctioned item is difficult to estimate, it is hence difficult to assess the actual economic impact of the winner's curse.

In this study, we plan to focus more on the economic significance of the winner's curse. We will also examine the effect that different market condition may have on the degree of winner's curse in both open- and sealed-bid auction. Instead of estimating the true value of the item in auction, and directly estimating the

value of the winner's curse, we obtain information from financial market prices in which relevant information of the auctioned item is believed to be impounded. To this end, we employ empirical methodology that is used in financial economics. The methodology is presented in the following section. A similar methodology is used, for example, by James (1987) where he investigates the impact of FDIC failed bank auction on the stock price of the acquiring banks. However the purpose of his study is to determine whether wealth transfers from the FDIC to the acquiring banks, and not necessarily to test the implications of the auction.

III. Data

The sample period we employ in this study spans from 1970 to 1994. We need to construct a data set that contains the transaction prices and the frequency of transactions of uncompleted properties in Hong Kong. These data are obtained from the transaction records registered with the Hong Kong Land Office. Real estate auctions in Hong Kong are organized by the Hong Kong Government and the private realtors. The winners and the successful bid prices in auctions organized by the Hong Kong Government will be obtained from the Hong Kong Land Office. The same kind of data from auctions organized by the private realtors will be directly obtained from the realtors that organize the auctions. The pre-auction forecasts of the value of the land sites can be obtained from the local newspaper in Hong Kong. The daily stock returns series of the winners and other developers who did not win as well as the stock market index are obtained from the PACAP Financial Data Tape from the University of Rhode Island. These data allow us to examine at least three interesting issues:

- How do developers form their bidding strategy in government land auctions?
- How does the stock market sentiment develop on the land auction outcome?
- Does the bidding strategy of the developer fully reflect the effect of winner's curse?

IV. Winner's Curse and Bidding Strategies

Three major conditions that affect the bidding strategy of a developer are uncertainty regarding the intrinsic value of the land site and the degree of competition among prospective developers for the development of the land site. The intrinsic value of the land site reflects the future prospects of the

market value of the residential buildings to be constructed on the land site. In many cases, the developers many collude and cooperate in their bidding. The extent of collusion will also affect the bids offered by the developers.

1. Effect of Valuation Uncertainty

Uncertainty in valuation induces two possible effects on the optimal bids of the developers. First of all, the winner's curse effect implies that developers should bid less relative to their value estimates of the land site as the degree of uncertainty increases. On the other hand, land is essentially a call option with buildings as the underlying assets. An increase in uncertainty about the future market value of the buildings will lead to higher land value, which will induce the developers to submit higher optimal bids. Therefore, the impact of valuation uncertainty on the optimal bids of the developers depends on how the winner's curse effect and the option pricing effect dominate each other. If winner's curse dominates, we would expect a significant negative relationship between optimal bids and uncertainty whereas if option pricing effect dominates, a significant positive relationship would be expected.

2. Effect of joint bidding:

Collusion among developers may lead to joint bidding. Joint bidding is an important tactic for small developers, who otherwise would be excluded from the auctions, to participate in auctions and to diversify risk among themselves. However, it is often argued that joint bidding reduces the number of competitors and hence reduces the auction revenue to the seller because the developers will submit lower optimal bids. DeBrock and Smith (1983) argues that allows the bidders to pool their private information on the unknown value of an asset and hence generate more accurate estimates of the unknown value. This change in information structure will enable them to bid more aggressively. As a result, the sale revenue to the seller should not be significantly reduced.

Auction Date	**Land**	***Collusion***
3/25/97	Chung Hau St	3
3/18/96	Wydham St	2
3/18/96	Hung Hom Bay Reclamation Area	2
3/30/95	King's Park Rise	3
3/27/95	Chung Hau St	3

7/26/94	Area 30, Tai Po	2
5/26/94	Area 19, Luen Wo Hui	11
5/26/94	Fung Kam St	13
7/9/93	Town Park Rd South	3
6/22/93	Ma Ling Path	2
2/3/93	Lung Cheung Road	3

3. Effect of Competition

Riley and Samuelson (1981) demonstrate that in general the expected winning bid increases with the number of bidders in an auction.

Our empirical tests below focus on testing the effects of valuation uncertainty, joint bidding, and competition on the bidding strategy of the developers. The following table summarizes the testable hypotheses that we are going to investigate.

Variable	Possible Effects on Bidding Strategy	
Valuation Uncertainty	Option Pricing Effect Winner's Curse Effect	➔ (+) ➔ (-)
Joint Bidding	Information Pooling Reduction in Competition	➔ (+) ➔ (-)
Competition		➔ (+)

4. Empirical Methodology

The measure for the bidding strategy of the developer is taken to be the deviation of the winning bid from a reference price. It is calculated as follows:

$$B_{jt} = ln\left(\frac{p_{jt}}{p_{mt}}\right)$$

where p_{mt} is the reference price for the t-th land site and p_t is the corresponding winning bid price. To ensure robustness of our results, three measures of reference price are used for our analysis. The first one is the announced base price at the beginning of the auction. The second is the average pre-auction market forecasts made by the realtors and the real estate appraisers on the market values of the land sites. The third measure is the expected sale revenue based on the market forecasts as developed by Riley and Samuelson (1980):

$$n \int_{b_0}^{\overline{v}} (vF'(v) + F(v) - 1)\, F^{n-1}(v)\, dv$$

where b_0 is the announced base price, v is the reservation value of the bidders, n is the number of bidders, $F(v)$ is the probability that a competing developer draws a reservation value less than v. When determining the expected sale revenue, we use the market forecasts as the proxy for the reservation value of the bidders. We also assume that $F(v)$ follows a uniform distribution over the minimum and the maximum market forecasts.

Table 1
Distribution of Winning Bids over
Base Price, Average Market Forecasts, and Expected Sale Revenue

Range (%)	*Base Price*	*Average Forecasts*	***Expected Revenue***
>80	1		
70-80	1		
60-70	5		
50-60	9		
40-50	2	3	
30-40	11	3	1
20-30	8	7	5
10-20	4	10	7
0-10	4	12	9
-10-0	3	5	13
-20-10		5	8
-30-20		1	4
-40-30		0	1
< -40		2	
Total	***48***	***48***	***48***

To measure valuation uncertainty, we use the coefficient of variation (U) which is computed as the ratio of standard deviation to the mean of the market forecasts. The coefficient of variation is generally regarded as a superior proxy to the variance of the distribution.[1] To measure the degree of joint bidding (J), we use the number of bidders in the winning bid. To measure competition (C), we use the number of bids an auction takes to reach the winning bid from the announced base price instead of

[1] See P. Asquith (1983)

using the number of bidders as the competition variable. The reason is that two bidders may also compete intensely in their biddings for the land site.

To examine the relation between valuation uncertainty (*U*), joint bidding (*J*), competition (*C*), and bidding strategy (*B*), we estimate the following regression equation:

$$B_t = a_0 + a_1 U_t + a_2 J_t + a_3 C_t + e_t$$

Table 2 presents the empirical findings on how the bidding strategy of a developer would be affected by valuation uncertainty, joint bidding, and competition. First of all, the estimates of a_1 are not statistically significant, their signs are consistently negative, which indicates that the concern of winner's curse possibly does affect the bidding strategy of the developers. The estimates of the coefficient of joint bidding, a_2, are consistently negative. All of them are significant at 10-percent level and better. This finding leads to the interesting observation that although information pooling and reduction in competition are both possible effects of joint bidding, the later actually affects the bidding decision of the developers more and may lead to lower sale revenue to the seller, the Hong Kong government in this case. The estimates of a_3, the coefficient of competition, are all positive and significant at 1-percent level, which offers strong statistical support for the notion that competition will drive up the optimal bids of the developers and hence will lead to an increase in the sale revenue to the seller.

Table 2: Bidding Strategy

Three regression equations are estimated using the three measures of reference price used in the calculation of the bidding strategy variable (B). Equation 1 uses announced base price as reference, equation 2 uses average market forecasts, and equation 3 uses expected sale revenue calculated with Riley and Samuelson (1983).

There were 48 government land sites for the development of residential properties auctioned between March 1994 and March 1997. Eleven of the 48 land sites auctioned were successfully acquired by joint-bidders.

Variable	***Equation 1***	***Equation 2***	***Equation 3***
Constant	-0.0614 (0.1241)	-0.0899 (0.1141)	-0.1864 (0.1392)
Uncertainty (U)	-0.7521 (0.6499)	-0.4584 (0.5976)	-0.0184 (0.0729)
Joint Bidding (J)	-0.0172[a]	-0.0209[b]	-0.0200[c]

	(0.0097)	(0.0103)	(0.0093)
Competition (C)	0.1262[c] (0.0241)	0.0924[c] (0.0222)	0.0821[c] (0.0270)
Adjusted R-Squared F-Statistic	0.4155 10.28	0.4122 9.64	0.2486 4.85
The figures in parentheses are standard errors of estimates. [a]10 percent significance level [b]5 percent significance level [c]1 percent significance level			

V. Stock Market Sentiments

To investigate how the stock market responds to the bidding behavior of the developers, we examine the behavior of the cumulative average excess return to the winning bidder (CAR) around the auction date.[2] If developers' bidding strategies do not fully account for the winner's curse, then the winning bid, on average, overstates the true value of the real estate. As a consequence, the developers who win may earn a rate of return less than its cost of capital and the average excess rate of return to the winners would be negative.

[2] See appendix for the details on the estimation of the cumulative excess returns for the winning bidders.

1. Signalling versus Winner's Curse

Government land auction in Hong Kong may also serve as a vehicle for developers to signal the market their view about the growth prospect of the real estate market. The stock market may read the auction outcome differently from the winner's curse point of view. In particular, investors in stock market often construe the outcome of a land auction as a signal from the winning developer about the future prospect of property sale. Low winning bid may imply that developers who are better informed about the future prospect of the real estate market are pessimistic about future property price, which in turn affects the property price in the secondary property market right away. The developers who have newly constructed properties for sale would only be able to sell them at a lower price for lower profit. Therefore, the stock market may take a lower than expected auction outcome negatively.

How the auction outcome affects the way the stock market sentiment depends on the interplay of the winner's curse effect in land auction and the signalling effect to the stock market. To test how these two effects account for the stock market response, we perform the following regression:

$$CAR_{jt} = b_0 + b_1 \, B_{jt} + e_{jt}$$

where CAR_{jt} is the cumulative abnormal return for firm j from day -1 to day +2 around the t-th auction.

If the winner's curse dominates the effect of positive net present value of the acquired land site, the excess of the successful bid over the market consensus forecast should be reflected in the stock market response and hence β_2 should be negative. On the other hand, β_2 should be positive if signalling is the dominating factor because investors would regard a high winning bid as a good signal to the real estate market and therefore respond favourably to the winning developer. A common comment that many investors made regarding the Hong Kong stock market is that the market is overly speculative relative to other major stock markets around the world. The result from this analysis will shed some light on how the speculative activities in the real estate market may directly impact the behaviour of the stock market.

Table 3 below shows behavior of the mean abnormal return 5 days before and 5 days after the auction dates.

Table 3
This table documents the daily abnormal return, the cumulative abnormal return, and the associated daily abnormal return test statistic for the portfolio of stocks of the winning bidders.

Event Date	Mean Abnormal Return	Mean Abnormal Return Statistic	Cumulative Mean Abnormal Return
-5	-0.519%	0.0038	-1.091%
-4	-0.006%	0.0021	-1.098%
-3	0.018%	0.0024	-1.079%
-2	-0.226%	0.0020	-1.305%
-1	0.026%	0.0022	-1.279%
0	-0.109%	0.0019	-1.388%
1	0.261%	0.0025	-1.127%
2	0.218%	0.0022	-0.909%
3	0.009%	0.0015	-0.901%
4	0.079%	0.0016	-0.821%
5	-0.011%	0.0015	-0.832%

Table 4 presents the empirical results on winner's curse effect versus signalling effect. All three measures of reference used in the calculation of bidding strategy variable (B) are used in the analysis. The three estimates of b_1 present consistent and significant evidence that the stock market takes the land auction outcome as a signal from the developers about their view on the future prospect of the real estate market. The three estimates are 0.0335 with 10 percent significance level, 0.0344 and 0.0430 both with 5 percent significance level. The result does not necessarily reject the winner's curse effect in the stock market sentiment. It's just that signalling seems to play a more significant role in the way land auction outcome influences stock market response.

Table 4: Winner's Curse versus Signalling

$$CAR_{jt} = b_0 + b_1 B_{jt} + e_{jt}$$

where CAR_{jt} is the cumulative abnormal return for firm j from day -1 to day +2 around the t-th auction. Three regression equations are estimated using the three measures of reference price used in the calculation of the bidding strategy variable (B). Equation 1 uses announced base price as reference, equation 2 uses average market forecasts, and equation 3 uses expected sale revenue calculated with Riley and Samuelson (1983).

There were 48 government land sites for the development of residential properties auctioned between March 1994 and March 1997. Eleven of the 48 land sites auctioned were successfully acquired by joint-bidders.

Variable	***Equation 1***	***Equation 2***	***Equation 3***
Constant	-0.00866 (0.00788)	3.7E-05 (0.00465)	0.0019 (0.0044)
Bidding Strategy	0.03351[a] (0.01882)	0.03446[b] (0.01742)	0.04303[b] (0.02131)
Adjusted R-Squared F-Statistic	0.085 2.68	0.047 2.89	0.083 3.72

The figures in parentheses are standard errors of estimates.
[a]10 percent significance level
[b]5 percent significance level

2. Further Analysis of Stock Market Sentiment

To investigate how the auction factors, namely, valuation uncertainty, joint bidding, and competition, that affect bidding strategy impact the stock market sentiment in real estate auctions, we perform the following regression:

$$CAR_{jt} = g_0 + g_1 U_t + g_2 J_t + g_3 C_t + e_{jt}$$

The winner's curse hypothesis implies that valuation uncertainty will induce the developers to bid less for a land site relative to their value estimates. Because of the call option nature of land, an increase in valuation uncertainty of the underlying asset (residential properties to be developed) leads to an increase in the value of land as well. This implies that the existence of winner's curse will induce the developers to underbid for a landsite which actually is worth more. As a result, the stock market should respond favourably to valuation uncertainty. The signalling argument however indicates that a lower than expected winning bid will send a negative signal to the market and the stock market would respond negatively.

The effect of joint bidding on stock market response to an auction outcome can be analysed from the perspective of pooling of information and reduction in competition. The information pooling argument implies that developers tend to bid more aggressively because of more accurate estimate of the unknown intrinsic value of the landsite. Without the signalling effect, the stock market should take this negatively as the developers would likely overbid in their joint bidding. With the existence of signalling effect, the response of the stock market to joint bidding should be positive instead. Similarly, the reduction in competition argument implies that developers tend to underbid. Without the signalling effect, the stock market should react positively. With the existence of signalling effect, the stock market should react negatively.

As discussed in the previous section, developers will bid more aggressively as competition intensifies. In the absence of signalling effect, the stock market is expected to react negatively to competition among bidders. If signalling effect exists, we would expect the stock market to respond positively.

The following table summarizes the empirical results implied by signalling hypothesis:

Auction Factor	**With Signalling Effect**	**Without Signalling Effect**
Uncertainty	$g_1 < 0$	$g_1 > 0$
Joint Bidding	$g_2 < 0$ *if reduction in competition is the dominant factor*	$g_2 > 0$ *if information pooling is the dominant factor*
Competition	$g_3 > 0$	$g_3 < 0$

Table 5 presents the empirical findings on how valuation uncertainty, joint bidding, and competition affect the cumulative abnormal returns on the winning bidders in land auction. The CARs that we use include 2-day, 3-day, and 4-day CARs inclusive of the auction day. The three sets of results are consistent without switching in the signs of the estimates. The estimates of valuation uncertainty are all positive. Two of them, est. $g_1 = 0.00604$ from using CAR2 and est. $g_1 = 0.16274$ from using CAR3, are significant at 10 percent level. As argued before, if signalling plays a more dominant role than winner's curse in valuation uncertainty, higher uncertainty will induce the stock market to react

negatively because lower than expected optimal bids would convey to the market that the future prospect for real estate prices is grim. On the other hand, if winner's curse plays a more dominant role than signalling, higher uncertainty will cause the stock market to respond positively because the winning developer has acquired a land site which is worth more than what the winning bid suggests. The positive estimates of g_1 provide strong evidence on the existence of winner's curse concern in the way the stock market reacts to the land auction outcome.

The estimates of g_2, the coefficient of joint bidding, are all negative and significant at 5- and 1-percent level. Since the empirical findings in Section IV indicate that reduction in competition affects the bidding strategy of the developers more than information pooling, the negative estimates of g_2 point to the conclusion that signalling effect also plays a key role in the way stock market interprets the land auction outcome.

The estimates of est. g_3, the coefficient of competition, are less significant. Only the one from CAR2 (est. g_3 = 0.1783) is significant at 10-percent level. However, the signs of all three estimates are positive, which indicates the existence of signalling effect of land auction on the stock market.

Table 5: Further Analysis of Stock Market Sentiment

The regression analysis of $CAR_{jt} = g_0 + g_1 U_t + g_2 J_t + g_3 C_t + e_{jt}$ uses 2-day CAR (CAR2), 3-day CAR (CAR3), and 4-day CAR (CAR4) all of which also include the auction day. There were 48 government land sites for the development of residential properties auctioned between March 1994 and March 1997. Eleven of the 48 land sites auctioned were successfully acquired by joint-bidders.

Variable	***CAR2***	***CAR3***	***CAR4***
Constant	-0.03083[a] (0.0182)	-0.00905 (0.0223)	0.00039 (0.0219)
Uncertainty (U)	0.00604[a] (0.0031)	0.16274[a] (0.0980)	0.11362 (0.1233)
Joint Bidding (J)	-0.00329[b] (0.0016)	-0.00685[c] (0.0020)	-0.00641[c] (0.0020)
Competition (C)	0.1783[a] (0.1073)	0.00234 (0.0042)	0.00075 (0.0042)
Adjusted R-Squared F-Statistic (signif. F)	0.44 2.16 (0.095)	0.54 3.82 (0.021)	0.53 3.44 (0.031)

The figures in parentheses are standard errors of estimates.
[a]10 percent significance level
[b]5 percent significance level
[c]1 percent significance level

VI. Conclusion

In this study, we have examined the effects of valuation uncertainty, joint bidding, and competition on the bidding strategy of the developers as well as on the stock market sentiment on the land auction outcome. Our empirical findings support the notion that winner's curse does exist and affect the bidding strategy of the developers and that signalling plays a crucial role in the way the stock market sentiment develops on the land auction outcome. First of all, because of the existence of winner's curse, an increase in valuation uncertainty will induce the developers to bid less for the land site which in turn will affect the stock market response negatively. Second, joint bidding creates information pooling and reduction in competition effects in bidding strategy. However, our empirical results indicate that it causes reduction in competition more than information pooling and hence induces lower optimal bids from the joint-bidders. This of course does not preclude information pooling. It's just that the effect of reduction in competition seems to override that of information pooling. The empirical finding on the relationship between joint bidding and stock market response also indicates that joint bidding tends to send a negative signal to the stock market about the future growth prospect of the real estate market. Finally, our empirical results lead us to believe that competition would induce the developers to bid higher and the higher winning bid would send a positive signal to the stock market about the developer's view on the future profitability in the real estate market.

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Appendix

Statistical tests of changes in individual developer stock returns associated with the auction dates, *net of the market-wide influence of changes in all equity returns*, are calculated over an 11-day window (t = -5...+5) surrounding the official day 0 auction date for each event. This window should be of sufficient length to allow for both pre- and post-auction investor anticipation and information dissemination effects.

To generate expected returns for each security, the market model is employed to estimate intercept and slope coefficients following a widely accepted procedure to control for the nonsynchronicity of trading of differing equity issues. Specifically, intercept and slope coefficients for security j, $\hat{a}_j$ and $\hat{b}_j$, respectively, are estimated for the period 220 through 21 trading days (event days t = -220...-21) prior to each auction event date (day t = 0), and are defined as:

$$\hat{a}_j = \frac{1}{198}\sum_{t=-219}^{-22} R_{jt} - \frac{1}{198}\hat{b}_j \sum_{t=-219}^{-22} R_{mt}$$

where R_{jt} is the actual equity return on developer j for event day t, R_{mt} is the actual return on the value-weighted market index for day t, and

$$\hat{b}_j = \left(\hat{b}_j^{-} + \hat{b}_j^{0} + \hat{b}_j^{+}\right)/(1 + 2\,\hat{r}_m)$$

where $\hat{r}_m$ is the estimated first order autocorrelation coefficient of the market index over the period t = -220...-21, and $\hat{b}_j^{-}$, $\hat{b}_j^{0}$, and $\hat{b}_j^{+}$ are ordinary least squares regression coefficients estimated from the following three regression equations, respectively.

$$R_{jt} = \hat{a}_j^{-} + \hat{b}_j^{-} R_{m\,t-1} + u_{jt}\,, \qquad t = -219,...,-21$$
$$R_{jt} = \hat{a}_j^{0} + \hat{b}_j^{0} R_{m\,t} + v_{jt}\,, \qquad t = -220,...,-21$$
$$R_{jt} = \hat{a}_j^{+} + \hat{b}_j^{+} R_{m\,t+1} + w_{jt}\,, \qquad t = -220,...,-21$$

The parameters will be estimated over event days from -220 to -21 rather than from -205 to -6 simply to avoid any biases in the parameters due to the possibility of information leakage, if any, prior to event day -5. This estimating procedure has been previously shown to reduce parameter estimation biases resulting from the non-synchronicity of daily stock returns (Scholes and Williams(1977)). To detect abnormal firm returns in response to an auction, an event-time methodology is employed. The abnormal return for security j for event day t, AR_{jt}, is defined as:

$$AR_{jt} = R_{jt} - \left(\hat{a}_j + \hat{b}_j R_{mt}\right).$$

Cumulative abnormal returns for firm j from event day t_1 to t_2, CAR_j, are defined as:

$$CAR_j = \sum_{t=-5}^{+5} AR_{jt}\,.$$

The mean cumulative abnormal return for a sample of N firms, $\overline{CAR}$, is given by:

$$\overline{CAR} = \sum_{j=1}^{N} CAR_j/N.$$

Statistical tests of the abnormal returns for each event interval are based on the Z-statistic developed and outlined in detail by Mikkelson and Partch(1988) and are not reproduced here due to space considerations.