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Market Sentiment, Winner's Curse, and Bidding Strategy in Auctions of Developable Land

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Abstract

The objective of this study is to examine the factors affecting bidders' bidding strategies in land auctions and how the stock market reacts to the bidding strategies. Many recent developments in auction theory remain untested or outcome of the tests are mixed. One of the problems of undertaking empirical tests is lack of good quality data. This research constructs a unique set of data from various sources in Hong Kong, which allows us to test auction theory empirically. The research is expected to yield important empirical insight into behavioural aspects of auction theory generally, which will be of specific interest to real estate development companies whose successes rely significantly on their bidding strategies in land auctions. The results should also shed light the directions of development of auction theory. In addition the outcome would also contribute to our understanding of how share prices of listed real estate companies reacts to one type of major event – land auction outcome. The results will be of interest to real estate practitioners and the governments which are sole owner of land or own a substantial amount of land for disposal to the public for development.

Keywords:

Auction, bidding, land, Hong Kong, winner's curse

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Introduction

In the land and real estate market most of the transactions exhibit some characteristics of auctions (see Quan, 1994 for a detailed survey of the types of auctions commonly employed in the sale of real estate). In the public sector, Hong Kong's leasehold land tenure system periodically generates a significant number of prime (re)development sites available for purchase by private sector developers, and as in many other jurisdictions with sale of publicly controlled assets, mechanisms for alienating this land is by private treaty, grant, or more typically by public auction. In the private sector, similarly, many private sales similarly take place every year in either public auctions or sealed-bid auctions.

The Hong Kong Government thus regularly conducts English auctions and first-price sealed bid auctions to sell long leases over prime development land. A majority of the participants in these auctions are large, well-capitalised, integrated real estate development companies publicly traded in the Hong Kong Stock Exchange, and functioning at a scale unappreciated by Western economists – Hong Kong is not a market where small, medium-sized or single-project developers prosper (Renaud, Pretorius and Pasadilla, 1997). The real estate market in Hong Kong is closely related to its economy. As could thus be expected, the whole sector is very keenly watched by the financial and mainstream media, investors and market traders, as are individual companies and their fortunes. This provides ideal circumstances for investigation of reactions in the stock market to selected real estate sector activities, such as competition for profitable projects and the role of open-bid English auctions in the competitive process . Bidding price for development land is typically based on the developer's estimate of project-specific cost and margins, which may be identical for all developers *ex post*. Individual developer estimates, however, when conditioned on current market information, may not be similar and be influenced significantly by prevailing real estate market sentiment. Due to the complexity of estimating future sales and costs, for example, developers may arrive at different net project revenue estimates and so generate different bids for the land offered at auction. Prevailing market sentiments may also affect the behavior of bidders – when current real estate prices are buoyant, optimistic market sentiment may induce aggressive bidding despite long project lead times and cyclical real estate markets. One prediction of auction theory under these circumstances is that successful bidders may be victims of the "winner's curse": if all developers have similar margins *ex post*, the winner must have the lowest estimate of development costs; or if all have similar estimates of development, the winner must have the highest estimate of the gross development value (GDV). In open-bid English auctions for development rights, it may thus be that the site is awarded to the bidder that has either underestimated cost or overestimated GDV most.

The objective of this study is to examine factors affecting outcome of auction for developable land. In particular, we would like to investigate (1) whether bidder have adjusted the bid prices for winners curse, (2) how joint venture between bidders affect bid prices and (3) the effects of market sentiment as measured by the degree of competition on bid prices. The availability of extensive media coverage of auctions *ex ante* and *ex post*, detailed open-bid auction records and real estate development company stock prices in Hong Kong provides us with an excellent opportunity to test hypotheses related the above objectives. Our study is organised into four sections. Section I examines selected auction theory principles and research relevant to our study, while Section II explains the data required for our empirical investigation. Section III presents the method and results of empirical tests. Section IV summarises findings and concludes the paper.

I. Auction Theory and Selected Literature

Since Vickrey's (1961) seminal paper, much research has been on auction theory and its applications in various markets have been undertaken. Auctions are typically classified into two (largely simplified) categories: common value auctions and private value auctions. In an auction where bidders' estimates of the reservation value of an asset or commodity is based on a common information set ("common value" auctions), the phenomenon known as the "winner's curse" becomes an important concern for bidders (see McAfee and McMillan, 1987; and Thaler, 1988). Since the "true" value of an asset or commodity is

unknown to a prospective bidder, bids based on an overestimate of value are more likely to be successful at auction. Thus a successful bidder at common value auctions is expected to pay more than necessary to secure the transaction, or there is at least doubt about the extent of benefits obtained from the transaction. Such common value auctions include auctions of offshore oil leases, contracts to provide public infrastructure and services, in financial markets it includes auctions of public debt securities and initial public offerings of equities, and it typically also includes auctions for alienation of publicly controlled land for future private sector real estate development projects. In contrast, in a "private value" auction, such as that of paintings or other works of art, where private reservation values are independent among the bidders and where each bidder knows her own reservation price only, the winner's curse is irrelevant. It may be argued that for certain assets where some information is common and some private, sealed-bid auctions also do display some characteristics of private value auctions; and thus that auction format is not entirely irrelevant. Nevertheless, success in common value auctions is an informative event, and failure to incorporate conditional information into bidding may invite a winner's curse. In this respect, Wilson (1977) has shown that optimizing behavior requires that bidders compensate for potential bias, by taking into account the expected strategies of other bidders to avoid the winner's curse. Accordingly, rational bidders thus take the winner's curse into account by adjusting bids downwards when there are greater uncertainties about other bidders' strategies. Also, the theory predicts that lower bids should be accompanied by a larger number of competing bidders.

The theoretical implications of auction theory have been quite extensively examined in laboratory experiments, and evidence suggest that those who bid for commodities with uncertain value do fall victim to the winner's curse (see Davis and Holt, 1993, for a survey of relatively recent experimental studies). Empirical tests using actual observations have been scarce, however, mainly due to the lack of appropriate data, and also provide mixed evidence on the winner's curse. For example, Hendricks, Porter, and Boudreau (1987) report no evidence of the winner's curse in research into auctions for offshore oil leases. Thiel (1988) further provides evidence that the winner's curse is not a significant problem in sealed bidding for highway construction contracts, but concludes that bidders seem to "shave" their bids in order to avoid the winner's curse and also that the underlying auction model fits the data reasonably well. On the other hand, Gilberto and Varaiya (1989) investigated acquisitions of failed banks in USA Federal Deposit Insurance Corporation (FDIC) purchase and assumption (P&A) auctions, and found evidence in sealed-bid auctions that bid levels for all bidders (winners and losers) increased with increased competition, which is consistent with bidders failing to adjust for the winner's curse. According to auction theory, an increase in the number of competitive bidders increases the level of optimal bids in private value auctions but decreases it in common value auctions. While it is difficult to classify unambiguously real world auctions into common value auctions and private value auctions *a priori,* Gilberto and Varaiya (1989) attempted to distinguish empirically between the categories, and after classifying their sample into two categories they found that the number of competitive bidders positively affected the winning bid of both auction categories. This is inconsistent with attempts to avoid winner's curse, and in the absence of further empirical evidence this result remains somewhat controversial.

In general, however, empirical findings seem to support other predictions of auction theory. For example, Simon (1994) finds that the quantity risk is at least as important as the winner's curse in auctions of US treasury securities. Quantity risk is particularly important for dealers who face the risk of not winning the desired quantity of securities at auction, as dealers who bid at these auctions typically have large short positions to cover. Further, using data from the USA Federal Offshore Oil and Gas Drainage lease sales, Hendricks and Porter (1988) test if it is possible to identify bidding agents with superior information at auctions, and also if the information available to them and to other, relatively less informed agents, could be quantified. They found that "neighbour" firms (those firms that own rights to tracts adjacent to those on which a deposit has been discovered) are better informed about the value of a lease than non-neighbour firms; and that neighbour firms exploit this advantage by shaving their bids substantially below their expectation value of the tract. Non-neighbours compensate for their disadvantage by bidding conservatively. As a consequence, neither appears to suffer from the winner's curse.

More recently, a number of papers have reported specifically on real estate auction research, broadly related in nature but different in detail, to what we propose in this study. Informed researchers know that free entry is not a *de facto* condition of Hong Kong's real estate development market, which led Ching and Fu (2003) to proceed to test contestability. They conduct an event study of Hong Kong land auctions, and find that when a development site is acquired at "below fair market value", the acquiring company's stock price exhibits a positive abnormal return (the positive net present value response); and further that this seems to increase with the size of the land parcel at auction – an indication that larger developers are further advantaged. Ooi and Sirmans (2004) set about to examine the effect of successful acquisition of development land at auctions on the stock price of a set of public real estate development companies in Singapore, following the expectation that success at auction may indicate a positive NPV project with a resulting positive effect on the acquiring company's share price. Different to Ching and Fu, though, they use a sealed-bid dataset, and explore if there are industry effects that influence positively individual company's performance, including (amongst other things) previous success with complex development projects over a longer term (an "experience effect"). Also using event study methodology, they show that there are positive gains to success at auctions, and that abnormal returns appear to accrue to experienced and focused private sector developers, as opposed to conglomerate bidders. Ooi, Sirmans and Turnbull (2006) report further results of research into first-price sealed bid land auctions in Singapore, draws on the modern land use economics expectation that competitive bidding amongst atomistic agents drives profits from projects to zero, and then set about to investigate the circumstance where the number of bidding agents is finite – the small numbers condition. In this respect, there is some similarity with the contestable nature of Ching and Fu's (2003) Hong Kong research. They then develop a sealed-bid auction model (which appears rather liberal, given the typically highly prescriptive nature of development rules attached to the land at auction in Singapore). Using hedonic price methodology, they show that public companies tend to submit higher bids than private companies, which suggests that private companies are expected to create more shareholder wealth from auction outcomes; but also that neither experience nor joint venture structures influences bid prices, contrary to expectations.

Our study differs from Ching and`Fu (2003), Ooi and Sirmans (2003) and Ooi, et. al. (2004) in several ways. It differs from Ching and Fu (2003) in that we are not concerned with contestability, and accept that real estate development in Hong Kong is a highly concentrated (some argue ologopolistic) industry and that incumbents are believed to have at least some pricing power; and that the size of land parcels offered at government land auctions often functioned as barriers to exclude small- and medium-sized developers, because this greatly increases particularly scale of finance required to acquire land at auction. We are therefore interested to observe how joint bidding at auctions, which could be a mechanism to overcome barriers to entry, affects market perceptions and company returns.

II. Data

Against this background, our study examines the winner's curse and the effect that different market conditions may have on the degree of winner's curse in open-bid auctions. As pointed out by Thiel (1988), one of the difficulties in testing for the presence of winner's curse is that the winner is cursed relative to the true value of the asset or item at auction, and estimating the true value of the asset, of course, is even probably more difficult for econometricians as for bidders. Thiel overcomes 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 of the winner's curse often use regression studies, for example Gilberto and Varaiya (1989), to test for the winner's curse indirectly by regressing the bids on various variables suggested from theory. However, a common finding in such studies is that since the true value of the auctioned item is difficult to estimate, it is similarly difficult to assess the actual economic impact of the winner's curse. Instead of following these approaches, or attempting to estimate the "true" value of the item at auction and directly estimating the value of the winner's curse, we plan to extract information from financial market prices in which relevant information of the auctioned good is believed to be impounded. To this end, we employ methodology comparable to that used by James (1987) where he investigates the impact of FDIC failed bank auctions on the stock market price of the acquiring banks,

but remaining mindful that that his purpose was to determine whether there were wealth transfers from the FDIC to the acquiring banks (and not necessarily to test directly the implications of auction theory as the object of study).

Our analysis required the construction of a data set that contains successful land auction prices and additional auction-related transaction information such as characteristics of the auctioned land, specialists' (appraisers/ surveyors) pre-auction estimation, number of bidders and the identity of the successful bidder. These data were obtained from transaction records of the Land Registry, Lands Department of the Hong Kong Government and archives of major newspapers in Hong Kong. The main characteristics of our sample lead us to conclude that the assets at auction are substantively common value assets, in that there is very little discretion left to developers to vary development scale, scope, density, or timing of development – all these details are practically prescribed. Intuitively, this suggests there is very little real option value in the auctioned land, adjustment for winner's curse, if any should be readily observable. Further, the sites are all very well-known and anticipated by the development community – it can safely be said that all developers will be extremely well-informed about the exact potential of the sites. In addition, whenever a significant site is offered at auction, financial and the general media interest prior to the auction is intense, and the event extensively covered, particularly before 1998.

Since the early 90's, major newspapers begun to conduct opinion surveys of surveyors on market value appraisals of the development sites to be auctioned, usually within two weeks before the auction date. Since different newspapers typically interviewed different appraisers, we searched through all newspapers in order to construct as complete a set of pre-auction market opinions as possible.[1] The number of opinions varied between four and twelve for each site, with an average of seven. The day after the auction, most newspapers also reported details of auction outcomes. Other than opinions about market values, we also extracted observations on (1) opening bid, (2) bid size, (3) change in bid size and the price level at which bid size changed, (4) the number of bidders, (5) the winning bid, and (6) the winner.

In principle our dataset covers the same time period at Ching and Fu (2003), but some market observation is informative to understand the context. The residential real estate market in Hong Kong peaked in 1993 and 1994. Due to anti-speculative measures adopted by the Government in June 1994, prices began to fall and declined by as much as 20% by end 1995. In 1996, a rebound began as a result of optimistic sentiments for the Hong Kong economy after return of sovereignty to China on July 1, 1997. In October 1997, the Asian financial crisis intervened and the real estate market, together with the overall economy, began to decline and continued to do so well into 2002.

III. Empirical tests and results

In this section we present the methodology and results of empirical tests of the effects of valuation uncertainty, joint bidding, and competition on bidding strategy. Any number of circumstances may influence individual bidders' strategies at auctions, but at land auctions similar to those in our sample there are concerns common to all bidders which include uncertainty about the intrinsic value of the development sites, and the degree of competition among prospective bidders for the right to develop the site. While the intrinsic value of the site reflects the present value of expected future market value of the properties to be developed on the site,[2] the expected degree of competition also reflects in the fact that

[1] The local newspapers from which we extracted details of the Hong Kong Government land auctions are Singtao Daily, Ming Pao, Apple Daily News, Oriental Daily News, Hong Kong Economic Times and Hong Kong Economic Journal.

[2] On the other hand, however, the modern view of purchase of a development site is essentially that it represents a call option with the developed property as the underlying asset, (see Titman, 1985; Capozza, Dennis, and Helsley, 1989). This view disaggregates the "value" of development land into two components, the "intrinsic" value of the completed development, plus the value of the option to time optimally the bringing to market of the development and possibly also selecting an optimally scaled

developers often may cooperate in bidding. The extent of cooperation between auction participants also may be expected to affect auction outcomes. We thus deal briefly with circumstances that typically surround these phenomena in land auctions in Hong Kong.

Uncertainty in site valuation is seen to induce two possible effects on optimal bids. Firstly, the winner's curse implies that developers should aim to bid less relative to their estimate of intrinsic value as the degree of uncertainty increases. Alternatively, uncertainty may also lead to joint bidding, an important tactic for smaller developers who otherwise might be excluded from auctions for larger, higher-priced development sites. However, it is also often argued that joint bidding reduces the number of competitors and hence reduces auction revenue, because bidders will submit lower optimal joint bids than individual bids. While this seems intuitively appealing, and Riley and Samuelson (1981) also demonstrate that in general the expected winning bid increases with the number of bidders, DeBrock and Smith (1983) argue that cooperation allows bidders to pool their private information, and hence generate more accurate estimates of asset value. While auctions remain effectively contested, however, this change in the distribution of information could enable cooperative bids to be more aggressive, and, as a result, the price fetched at auction should not be significantly reduced. Furthermore, in a highly concentrated land development market where entry barrier is high, joint venture between smaller developers is a means overcome this barrier and thus resulted in a increase in bid price. Table 1 summarizes the alternative hypotheses generated by auction theory under such different circumstances.

Table 1: Testable Hypotheses: Winner's Curse and Bidding Strategies

Hypothesis	**Variable**	**Possible Effects on Optimal Bidding on Price**
1	Valuation Uncertainty (*U*)	Winner's Curse Effect (-)
2(a)	Joint Bidding (*J*)	Information Pooling and Overcoming Entry Barrier (+)
2(b)		Reduction in Competition (-)
3	Competition (*C*)	(+)

The rest of this section explains methodology and reports results of empirical tests of the effects of valuation uncertainty, joint bidding, and competition on bidding strategy. To commence, our measure of the bidding outcome is taken as the deviation of the winning bid from a reference price, (B_{jt}), determined as follows:

$$B_{jt} = \ln\left(\frac{p_{jt}}{p_{mt}}\right) \qquad (1)$$

where p_{jt} is the corresponding winning bid offered by the *j-th* bidder for the *t-th* site and p_{mt} is the reference price for the *t-th* site. In order to ensure robust results, we deploy three measures of reference price in our analysis. The *first measure* is the announced opening bid at the beginning of the auction. The multiple of the winning bid over the opening bid is often used as an indicator of how successful the auction was, measured by how much the government generates revenue from land auction.

The *second measure* used for reference price P_{mt} is the pre-auction market opinions measured by thr mean value of the pre-auction estimates provided by specialists. The excess of the winning bid over the average market valuation of the site at auction is seen to reflect the premium the developer is willing to pay in order to acquire the site, and it serves to gauge how confident the winner is about the future price level. A

development (Quigg, 1993). In our case there is technically no expected option value, because the scope, scale and timing of the development are all prescribed conditions in the auction purchase agreement. In this respect our constraints differs from Ooi, et. al. (2006) in that they assume that developers do have some discretion.

problem with using market opinions as a forecast for land auction outcomes is that the *ex ante* market opinions reflect only the intrinsic value of the sites, and ignore the effect of how bidder's bidding strategies during the auction. More often than not, auction outcomes deviate from the market consensus. The size of the premium / discount is expected to be not only affected the reservation price of the developer but also the number of competing bidders in the auction, bidder's bidding strategies and uncertainty about the market value of the site.

The *third measure* of the reference price is the expected auction revenue based on market opinions and the result of the expression developed by Riley and Samuelson (1981):

$$n\int_{b_0}^{v_m}(vF'(v)+F(v)-1)F^{n-1}(v)dv \qquad (2)$$

where b_0 is the opening bid price announced by the auctioneer, v is the reservation value of the bidders, v_m is the maximum price the bidders are willing to pay, n is the number of bidders, and $F(v)$ is the probability that a competing developer-bidder draws a reservation value less than v. This measure takes into account the effects of number of bidders in the auction and the dispersion of the valuation distribution among the different bidders. As the number of competing bidders increase, the bidder will bid closer to his reservation value and the expected sales revenue thus increases. If there are fewer bidders, bidders will bid less. As the valuation dispersion among the bidders increases, the optimal bids will decrease, which leads to lower auction revenue.

When determining the expected auction revenue, we use the reported market opinions of site value as proxy for the reservation value of bidders. Since the number of market opinions for each site to be auctioned is small, we assume for simplicity that $F(v)$ follows a uniform distribution over some minimum (m) and maximum (M) market opinion. The expected revenue thus becomes

$$\frac{2m+(n-1)M}{n+1}+\left(\frac{b_0-m}{M-m}\right)^n\left[\frac{M(n+1)-2(m+nb_0)}{n+1}\right]. \qquad (3)$$

The minimum and maximum market opinions are to be estimated using the method of moments[3].

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[3] Assume the reservation values of the bidders follow a uniform distribution over the interval [m, M]. Then,

$$F(v)=\frac{v-m}{M-m} \text{ and } F'(v)=\frac{1}{M-m}$$

for $v \in [m, M]$. The expected auction revenue to the seller is obtained as follows:

$$n\int_{b_0}^{M}(vF'(v)+F(v)-1)F^{n-1}(v)dv = n\int_{b_0}^{M}\left(\frac{v}{M-m}+\frac{v-m}{M-m}-1\right)\left(\frac{v-m}{M-m}\right)^{n-1}dv =$$

$$\frac{2m+(n-1)M}{n+1}+\left(\frac{b_0-m}{M-m}\right)^n\left[\frac{M(n+1)-2(m+nb_0}{n+1}\right]$$

b_0 is the opening bid, n is the number of bidders, and v is the reservation value of the bidder. In our analysis, we take v as the average market opinion of the value of the site. In order to apply the expected revenue formula, we need to estimate the minimum (m) and the maximum (M) of the pre-auction market opinions of the value of each site to be auctioned. Let x_i ($i = 1\ldots n_j$) be the pre-auction market opinions for the *j-th* site to be auctioned. Using the method of moments, the estimates for m and M are obtained as follows:

$$\hat{m}=\bar{x}-s\sqrt{3} \text{ and } \hat{M}=\bar{x}+s\sqrt{3}$$

s is the sample standard deviation of the market opinions.

Table 2 presents the frequency distribution of the winning bids in our sample relative to opening bids, average market opinion, and expected auction sales revenue.

Table 2: Descriptive statistics of the auction outcome

Bidding Outcome (B_{it})	***Measure 1: Winning bid over Opening Bid***	***Measure 2: Winning bid over Average Market Opinion***	***Measure 3: Winning bid over Expected Revenue***
Mean	44.1%	17.5%	1.7%
Standard Deviation	27.1%	20.8%	20.0%
Median	44.7%	18.1%	-0.8%
Minimum	0.0%	-58.3%	-47.6%
Maximum	138.6%	56.8%	53.2%
Total	***83***	***83***	***83***

Source: The winning bids, market opinions, and opening bids are collected from MingPao Daily, Singtao Daily, Oriential Daily News, and Apple Daily. The expected sales revenues are determined using the result of Riley and Samuelson (1980).

To measure valuation uncertainty, we use the coefficient of variation (U), computed as the ratio of standard deviation to the mean of the market opinions (U is generally regarded as a superior proxy for uncertainty than variance of the distribution, see Asquith, 1983). To measure the degree of joint bidding (J), we use the number of joint bidders in the winning bid. To measure competition (C), we use the average number of bids per bidder that an auction takes to reach the winning bid from the announced opening bid, instead of simply using the number of bidders as a proxy for competition. The reason is that the number of bidder is already taken into account using the third meaure of reference price. Table 3 presents the characteristics of the data on valuation uncertainty, degree of joint bidding, and competition in terms of average, standard deviation, maximum, and minimum values.

Table 3: Summary Statistics for Uncertainty (U), Joint Bidding (J) and Competition (C)

	Uncertainty (U)	Joint Bidding (J)	Competition (C)
Mean	0.1242	1.9	4.9
Standard Deviation	0.0459	2.6	4.1
Maximum	0.1210	13.0	30
Minimum	0.0444	1.0	1

Recall that our measure of bidding outcome (B) is taken as the deviation of the winning bid from a reference price. To examine the relationship between bidding strategy and valuation uncertainty (U), joint bidding (J), competition (C), and bidding strategy (B), we estimated the following regression equation:

$$B_\tau = \gamma_0 + \gamma_1 U_\tau + \gamma_2 J_\tau + \gamma_3 C_\tau + \varepsilon_\tau \qquad (4)$$

The subscript t denotes the t^{th} auction. Three regression equations were estimated for the three different measures of reference price used in calculation of the bidding strategy variable (B), namely announced opening bid, average market opinion, and expected revenue based on Riley and Samuelson (1983). Table 4 presents the empirical findings of the effect of valuation uncertainty, joint bidding, and competition on developer bidding outcome.

The coefficients of uncertainty γ_1 are all negative but the results are only significant (at the 1% level) when opening bid is used as reference price, whereas the estimates based on average market opinion and expected revenue are not statistically significant. This, however, could be due to the possibility that winner's curse is already reflected in reference price. Further evidence, for example from event studies of performance of the share prices of the winning company, is needed to give a more conclusive answer.

Estimates of the coefficient of joint bidding, γ_2, are all consistently negative, and all are significant at 10-percent and better. The results imply that an increase of one more joint bidder will reduce the ultimate winning bid by as much as 2.6% relative to the opening bid and 1.83% relative to the average market opinion. This supports hypothesis 2(a), and leads to the interesting observation that although information pooling, overcoming entry barrier and reduction in competition are all possible effects of joint bidding, the last one appears to influence bidding decisions more and may lead to lower revenue to the seller.

The estimates of the coefficient of competition, γ_3, are all positive and significant at 1-percent level. The result offers strong empirical support for hypothesis 3, that competition drives up optimal bids and hence will lead to an increase in auction revenue. On average, an increase of one more competing bidder will increase the winning bid by 7.17% over the expected revenue and by 16.17% over the opening bid.

Table 4: Bidding Strategy-Empirical Results

Variable	***Announced Opening Bid: Measure 1***	***Average Market Opinion Measure 2***	***Expected Sale Revenue Measure 3***
Constant	-0.1868*	-0.1992***	-0.1805**
	(0.1122)	(0.0901)	(0.0472)
Uncertainty (*U*)	-1.4174***	-0.2204	-0.0945
	(0.5503)	(0.4420)	(0.4621)
Joint Bidding (*J*)	-0.0260**	-0.0183*	-0.0200**
	(0.0133)	(0.0107)	(0.0102)
Competition (*C*)	0.1617***	0.1116***	0.0717***
	(0.0236)	(0.0189)	(0.0198)
Adjusted R^2	0.432	0.3791	0.1868
F-Statistic	18.247)	14.84	6.21

***Significant at the 1 % level. **Significant at the 5 % level. *Significant at the 10 % level

VI. Conclusion

In this study we examined the effects of valuation uncertainty, joint bidding, and competition on bidding behaviour at land auctions in Hong Kong, as well as the effect of auction outcomes on stock market behaviour. First, our empirical results clearly suggest that competition did induce developers to bid higher. This is true even after adjustment for the number of bidders. Secondly, our dataset provides only very weak support for adjustment for winners curse. The effect of winners curse adjustment is only evidence when the opening bid is used as the reference price. For other two measures of reference price, there is no evidence of winner's curse adjustments. This, however, could be due to the possibility that winner's curse is already reflected in reference price. Further evidence is needed to give a more conclusive answer. Finally, joint bidding have two potential effects on bidding outcome. On the one hand, it leads to information pooling and helps to break entry barrier and therefore induces bidders to bid more aggressively; while on the other hand, it could reduce competition among the developers and even collusion in a highly concentrated market and thus depress auction price. Our empirical results indicate that the latter effect prevailed during the observation period. Given the highly concentrated structure of the real estate development industry in Hong Kong, this may suggest further evidence of the industry's pricing power, which merits more in depth study. The results of our study also provide some insights into the complexity of real world auctions.

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