PACIFIC RIM PROPERTY RESEARCH JOURNAL
2019, VOL. 25, NO. 1, 39–48
https://doi.org/10.1080/14445921.2019.1598009

Developers land sale bidding strategy and house price expectation formation

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ABSTRACT

This paper studies developers' bidding strategy in Hong Kong's land sale market where aggressive bidding is commonly seen. Given that the difference between the submitted bid and the estimated land value can be explained by the developer's housing market outlook, the formation of house price expectation represents a tool to understand developers' bidding strategy. Different economic expectation models are tested. While the rational expectation hypothesis (REH) is rejected, the proposed adaptive implicit expectation model best describes developers' expectations. The findings in this paper provide land policymakers with insights on controlling the outcome of land sales as well as fill the gap of the house price expectation formation which remains little known.

ARTICLE HISTORY
Received 21 October 2018
Accepted 19 March 2019

KEYWORDS
Government land sales; bidding; tender; price expectation

Introduction

Observing in several land sale tenders the winning bid far above the upper estimate of the market, the Hong Kong Government recently implemented a new administrative arrangement in land sales that all unsuccessful bids are also published in order to enhance the transparency of the land market and to discourage aggressive bidding behaviour. Apart from providing developers with more market information, it is also of interest to search for other market cooling measures by examining developers' bidding strategy.

While the bid submitted by a developer is heavily referenced to the land value estimated using the residual method in which the intrinsic value of the land is the residual of revenue generated by the development and cost under current market conditions, it also takes into account the potential growth of such revenue in the future when the development is sold. In this respect, the submitted bid relative to the estimated land value should reveal the developer's outlook of the real estate market (Chau, Wong, Yiu, Tse, & Pretorius, 2010; Liu & Qu, 2015; Tse, Pretorius, & Chau, 2011). For example, an expected boom in the housing market allows the developed units to be sold at a higher price and the bid can be set higher in an attempt to secure the tender while profit can still be made. Therefore, in order to investigate developers' bidding strategy, it is important to understand how they form their house price inflation expectations and this is the objective of this paper.

In addition, despite of its importance in determining the dynamics of house price, there exists very little direct empirical evidence on house price expectations and our understanding

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on how they are formed remains limited (Armona et al., 2016). As such, findings of this paper aim to fill this gap. Finally, what drives the land price relative to the land value heavily depends on the structure of the market which varies between countries, as addressed by Qu and Liu (2012). This paper provides a partial answer to the case of Hong Kong.

The remainder of this paper is constructed as follows. The next section gives an introduction to Hong Kong's land sale market as well as a literature review. The data and the methodology used are outlined in the succeeding section. The results are presented and discussed after. The final section concludes.

The land sales market of Hong Kong

Under the leasehold system, the public land sales market in Hong Kong consists of the Hong Kong Government serving as the owner of all land in the city (with the exception of St. John's Cathedral in Central being the only freehold land in Hong Kong), while major developers and a small amount of land users represent the demand side of residential land, shaping the oligopolistic structure of Hong Kong's land sale market (Ching & Fu, 2003; Qu & Liu, 2012; Yue, Leung, & Fung, 2012).

Hong Kong's public land market has a long and complex history. The first land sale took place in June 1841 (Nissim, 2016), 5 months after the British procession of Hong Kong. More recently, public land was sold solely by the annual Land Sale Programme before 1999 where specific residential development sites were scheduled for auction on a regular basis. Following the Asian Financial Crisis that caused a decline in the housing market, the government supplemented the land sale programme with the Application List System in 1999, a demand-oriented system that enables the market to decide the optimal amount of land (Li, Wong, & Cheung, 2016). Under this system, the government published a list of sites available for sale and interested developers had to submit an application to the Lands Department with a bid for the site. An auction or a tender was held if the submitted bid met the government's reservation price.

However, the housing market continued to deteriorate largely due to the worldwide recession in the early 2000s. The government responded by scrapping all residential land sale programmes for a year in 2002. Seeing a number of passed-ins in the previous auction as well as the persistently weak housing market, the annual Land Sale Programme was suspended in 2004 with the Application List System became the sole method of public land disposal. Then amid the recovery of the housing market, the government aimed to turn the land market more supply-driven by restoring land sales by auction/tender in 2010, yet not on a regular basis. As most applications fell below the government's reservation price, the Application List System was abolished in 2013 and all residential land is now sold by tender. Then in 2018, the government started to publish the non-winning bids of a tender in order to enhance the transparency of the land market as well as discouraging aggressive bidding behaviour.

Given that auction/tender is the sole method of public residential land disposal, many studies of Hong Kong's land sale market largely focus on developers' bidding strategy. In particular, the oligopolistic structure of the market motivates studies done from a game theoretic approach. For instance, using a normal-form game, Yue et al. (2012) found that land being sold at a high price is the government's dominated strategy in revenue maximisation, taking into account the cost of providing lowincome families with housing subsidies. They suggested the use of windfall tax to discourage developers' aggressive bidding behaviour. By applying different theoretical models based on auction theory, Leung (2018) showed that the introduction of the new arrangement of publishing all non-winning bids can discourage aggressive bidding behaviour. In their study to confirm the winner's curse thesis in Hong Kong's land sale market by testing the hypothesis that increasing uncertainty leads to lower bids submitted by developers, Tse et al. (2011) assessed the land valuation uncertainty based on reference price suggested by auction theory. Using auction theory, Chang, Dasgupta, and Gan (2008) developed a working hypothesis for testing the toehold effect in Hong Kong's land sale market. They found that developers who already have a development project in the same geographical area as the site being tendered are likely to submit aggressive bids as it can help the developer sell the units at a higher price. Agarwal, Li, Teo, and Cheong (2018) observed similar findings in Singapore. Using the data from the Urban Redevelopment Authority, the Housing & Development Board and the JTC Corporation, they also found that bids are significantly higher when there was a site sold within 2 years and located within 4 km in distance. Moreover, they further argued that the developer is benefitted no matter if it loses or wins the bid. The developer can monopolise the local housing market by having another development in vicinity if it wins, while the units of current development project can be sold at a higher price if it loses. By developing a sealed-bid auction model as well as analysing the empirical data, Ching and Fu (2003) found a positive relationship between the public developers' bids and the expected abnormal returns of their shares.

Overall, many of these studies focus on the bidding behaviour of a particular class of developers or as a response to a particular situation, explaining the heterogeneity of land bids that stems from individual differences. In contrast, this paper investigates the general bidding behaviour of the developers in Hong Kong's land sale market by examining the house price inflation expectation formation as revealed by their bids. Moreover, it studies developers' bidding strategy from a completely different perspective by taking an expectation model approach.

Data and methodology

Literature in economics provides a variety of expectation models and statistical tests allowing us to see which of these models best describes forecaster's expectation formation. Generally speaking, these models can largely be classified as forward- and backward-looking. In a forward-looking model, expectation is driven by forward-looking information, while a backward-looking model sees expectation being formed using historical data. From an econometric perspective, these two types of models have the expectation positively correlated with the future realisation and the historical data, respectively.

Three candidate models are studied in this paper, with some modifications to accommodate the limitations of the available data. Invented by John Muth in his paper "Rational Expectation and the Theory of Price Movements" (Muth, 1961), the rational expectation hypothesis (REH) is one of the most commonly used expectation models in economic literature given its application of making use of multivariate time series models. Muth argued that firms' scratch work of forming expectations resembled the structure of the economy and that expectations are formed based on the relevant model describing the economy thus firms do not make systematic errors. This means that firms' expectation is the same as the mathematical expectation of the future inflation, conditional on all currently available information. Mathematically put, the inflation expectation of time t formed at $t-1(\pi_t^e)$ is given by,

$$\pi_t^e = E_{t-1}[\pi_t | I_{t-1}]$$

where E_{t-1} is the mathematical expectation operator at $t-1$ and I_{t-1} is the all information available at $t-1$. Lovell (1986) provided a simple regression model to test the REH and this is given by,

$$\pi_t = \beta_0 + \beta_1 \pi_t^e + \varepsilon_t \quad (1)$$

requiring that $\beta_0 = 0$ and $\beta_1 = 1$ where ε_t is the forecast error of expectation.

A similar expectation hypothesis called the implicit expectation hypothesis (IEH) was proposed by Mills (1962, pp. 35–44). In studies where data on expectations are not available, Equation (1) suggests that the actual inflation can be used as a proxy for expectation (Mills, 1957; Hirsch & Lovell, 1969, p. 177). Lovell (1986) then proposed the following econometric form of the IEH,

$$\pi_t^e = \beta_0 + \beta_1 \pi_t + \varepsilon_t \quad (2)$$

again requiring that$\beta_0 = 0$ and $\beta_1 = 1$. Lovell (1986) and Hirsch and Lovell (1969, pp. 73–74) provided an example that satisfies the IEH. In the context of a firm determining the future price, the firm can estimate the demand by surveying a random sample of customers. This demand, subject to sampling error, is then used to forecast the price. As a result, the predicted price is randomly distributed about the actual price. To conceptualise, an implicit expectation is formed if the following conditions are met,

(i) The information obtained by the firm is a random sample of all available information.
(ii) The information, including its samples, can predict the actual future price, implying that this information is forward-looking.

In the house price inflation expectation context, this suggests that developers form their expectations based on a random sample of some forward-looking information, such as supply and demand, that yields the actual growth in the house price in the future.

Unlike the above two hypotheses, the third one is backward-looking in nature. We propose the adaptive IEH (AIEH) by modifying condition (ii), allowing for backward-looking information so as to include a more adaptive approach to expectation formation. Given its backward-looking nature, this information should include current and historical prices, not just historical demand and supply. However, it may not predict the actual future price – a rather strict assumption. The focus of this hypothesis is the formation of expectation rather than the accuracy of developers' forecasts. As such, the AIEH requires condition (i) and the following,

(iii) The information, including its samples, is backward-looking and is used to predict the future price.

We then propose the following econometric form where the expectation is correlated with the historical observations.

$$\pi_t^e = \beta_0 + \beta_1 \pi_{t-1} + \varepsilon_t \tag{3}$$

requiring that $\beta_0 = 0$ and $\beta_1 = 1$.

Unfortunately, developers' house price expectation is not directly observable. Observing that developers' housing market outlook is reflected by the submitted bids relative to the land values estimated by surveyors, the percentage excess, the percentage the bid above/below the estimated land value, can be used as a proxy for house price inflation expectation. Then for Equations (1)–(3), π_t^e, the house price inflation expectation, is replaced with v_t^e, the percentage excess. However, it is important to note that the final bid submitted by a developer also takes into consideration of other factors such as the developers' willingness to pay and the number of bidders. Therefore, to enhance the explanatory power of these models as well as to reflect the theoretical finding that a more competitive land sale should result in aggressive bidding (Leung, 2018), the number of bidders, n_t, is included in all three models.

Another modification lies in the forecast horizon. For all land sales, while the building covenant requires the development to be completed within a certain period of time, the developer is allowed to sell the development up to 30 months before the completion provided that a pre-sale consent has been issued by the Lands Department. As such, sales plans and house price forecast horizons may vary among developers and even developments. To accommodate this uncertainty, we generalise the forecast horizon by replacing π_t and π_{t-1} with $\pi_{t+\Delta t}$ and $\pi_{t-\Delta t}$, respectively, where $\Delta t = 1, 2, \ldots$, $\pi_{t+\Delta t} = \frac{p_{t+\Delta t}}{p_t} - 1$ and $\pi_{t-\Delta t} = \frac{p_t}{p_{t-\Delta t}} - 1$. Consequently, the models for determining developers' formation of house price inflation are given by,

$$REH : \pi_{t+\Delta t} = \beta_0 + \beta_1 v_t^e + \beta_2 n_t + \varepsilon_t \tag{4}$$

$$IEH : v_t^e = \beta_0 + \beta_1 \pi_{t+\Delta t} + \beta_2 n_t + \varepsilon_t \tag{5}$$

$$AIEH : v_t^e = \beta_0 + \beta_1 \pi_{t-\Delta t} + \beta_2 n_t + \varepsilon_t \tag{6}$$

As addressed, the growth in house price cannot fully explain the percentage excess, we then no longer require $\beta_0 = 0$ and $\beta_1 = 1$. However, it is necessary that $\beta_1 > 0$, implying a significant positive correlation between v_t^e and π. Similarly, the requirement $\beta_0 = 0$ is no longer needed. All-in-all, we only require the null hypothesis $\beta_1 \leq 0$ to be rejected.

While π can be computed using the house price index published by the Rating and Valuation Department with availability from January 1993 to August 2018, the percentage excess needs to be obtained from different sources. Only until very recently, the Lands Department started to release all submitted bids including the non-winning ones. For consistency, we only consider the winning bid of each land sale for our analysis. With the exception of five sites on which the developments are not for sale, we consider all other 126 land sales by tender since 2011. Local newspapers usually report the range of land values estimated by different surveyors. Assuming that all developers are extremely well-informed about the exact potential of the sites (Tse et al., 2011) and hence have similar land value estimates, the mid-point of the reported range is used to compute v_t^e.

Results and discussion

The estimates of Equations (4)–(6) are reported in Tables 1–3, respectively. As demonstrated in Table 1, the REH is rejected with very strong evidence in all models as the null hypothesis of $\beta_1 \leq 0$ is not rejected. Moreover, with the exception of model $\Delta t = 1$, all other models in Table 1 have the β_1 negative. Similar results were found in other countries although different theoretical house price models were used as the basis for study. Using the US baby boom as an event study, Mankiw and Weil (1989) found that house price expectation is not forward looking. Gelain and Lansing (2014) rejected the REH where the US housing data for the period 1960 to 2013 were used to investigate

Table 1. REH (Equation (4)).

Δt	β_0	β_1	β_2	R^2	Sample size
1	0.753***	0.002	0.021	0.017	126
2	1.628***	−0.001	0.041	0.008	126
3	2.337***	−0.010	0.069	0.012	126
4	2.844***	−0.018	0.112	0.022	126
5	3.410***	−0.025	0.161*	0.027	125
6	4.109***	−0.029	0.186	0.026	125
7	5.097***	−0.036	0.188	0.025	125
8	6.311***	−0.036	0.173	0.019	123
9	7.872***	−0.045	0.131	0.022	122
10	9.142***	−0.048	0.096	0.023	121
11	10.508***	−0.051*	0.060	0.026	121
12	11.958***	−0.047	−0.001	0.024	120
13	13.325***	−0.050	−0.041	0.029	119
14	15.805***	−0.044	−0.184	0.041	118
15	17.219***	−0.047	−0.231	0.053	117
16	18.487***	−0.047	−0.270	0.061	117
17	19.488***	−0.044	−0.286	0.061	117
18	20.534***	−0.036	−0.320	0.059	117
19	21.388***	−0.032	−0.323	0.056	116
20	22.056***	−0.023	−0.308	0.045	116
21	22.296***	−0.021	−0.271	0.036	116
22	22.923***	−0.027	−0.272	0.042	113
23	22.752***	−0.031	−0.191	0.031	112
24	22.939***	−0.040	−0.152	0.033	111
25	20.829***	−0.099***	0.076	0.085	106
26	22.070***	−0.087**	0.002	0.080	104
27	22.456***	−0.088**	0.034	0.076	103
28	22.988***	−0.080**	0.032	0.063	101
29	24.056***	−0.080**	0.021	0.060	101
30	24.946***	−0.054	−0.055	0.037	98
31	26.612***	−0.018	−0.177	0.020	96
32	27.604***	−0.011	−0.164	0.012	96
33	28.859***	−0.001	−0.193	0.010	95
34	30.076***	0.002	−0.204	0.010	95
35	31.104***	−0.007	−0.174	0.009	95
36	31.981***	−0.014	−0.150	0.009	92

Significant at *10% **5% ***1%
Null hypothesis of $\beta_1 \leq 0$ rejected at ◦10% ◦◦5% ◦◦◦1%

Table 2. IEH (Equation (5)).

Δt	β_0	β_1	β_2	R^2	Sample size
1	−22.682***	1.133	2.814***	0.246	126
2	−21.604***	−0.173	2.852***	0.245	126
3	−20.051***	−0.722	2.876***	0.250	126
4	−19.103***	−0.860	2.897***	0.256	126
5	−20.230***	−0.739	3.050***	0.269	125
6	−20.218***	−0.618	3.047***	0.269	125
7	−19.642***	−0.596	3.034***	0.271	125
8	−20.694***	−0.486	3.139***	0.276	123
9	−18.673***	−0.480	2.948***	0.266	122
10	−18.242***	−0.460	2.929***	0.266	121
11	−17.763***	−0.444*	2.909***	0.267	121
12	−17.867***	−0.378	2.905***	0.266	120
13	−18.219***	−0.375	2.922***	0.278	119
14	−21.113***	−0.312	3.175***	0.292	118
15	−20.566***	−0.334	3.158***	0.297	117
16	−20.066***	−0.338	3.144***	0.297	117
17	−20.102**	−0.321	3.149***	0.296	117
18	−20.981**	−0.268	3.170***	0.292	117
19	−21.371***	−0.236	3.145***	0.289	116
20	−22.573***	−0.179	3.177***	0.287	116
21	−22.819***	−0.166	3.189***	0.286	116
22	−21.570**	−0.212	3.146***	0.280	113
23	−20.843**	−0.242	3.151***	0.282	112
24	−18.765**	−0.308	3.081***	0.276	111
25	−11.213	−0.703***	2.995***	0.353	106
26	−12.503	−0.652**	3.087***	0.355	104
27	−12.126	−0.652**	3.104***	0.356	103
28	−12.688	−0.59**	3.103***	0.348	101
29	−13.075	−0.551**	3.105***	0.346	101
30	−16.730*	−0.380	3.156***	0.341	98
31	−23.369**	−0.120	3.290***	0.350	96
32	−24.792***	−0.066	3.306***	0.349	96
33	−26.342***	−0.005	3.321***	0.350	95
34	−26.809***	0.011	3.324***	0.350	95
35	−25.480***	−0.032	3.315***	0.350	95
36	−22.809**	−0.065	3.106***	0.323	92

Significant at *10% **5% ***1%
Null hypothesis of $\beta_1 \leq 0$ rejected at ◦10% ◦◦5% ◦◦◦1%

housing investors' expectation formation. Using a reduced form model with imputed rents, Clayton (1996) rejected the REH based on the Vancouver data collected from 1979 to 1991.

The results in Table 2 show that the IEH has a better fit than the REH, according to the R-squared. In addition, β_2 is significant and positive for all Δt; in line with the theory that a more competitive land sale market results in aggressive bidding. However, similar to the results of fitting the REH model, all models (except for $\Delta t = 1$) have incorrect signs in β_1, suggesting that the IEH fails to describe developers' expectation formation.

Among all three hypotheses, the AIEH best describes developers' expectation formation. Not only $\beta_2$is significant, the null hypothesis of $\beta_1 \leq 0$is rejected at 10% level of significance in models $\Delta t = 1$ to 12, implying that developers form their expectations based on short-term house price dynamics. In particular, we consider model $\Delta t = 5$, the best fitted one. We further test $\beta_1 = 1$, a stricter requirement for the AIEH. The t-test statistic of 1.178 suggests that the null hypothesis is not rejected even at 1% level of significance.

Table 3. AIEH (Equation (6)).

Δt	β_0	β_1	β_2	R^2	Sample size
1	−24.247***	4.185**	2.687***	0.271	126
2	−24.915***	2.849***	2.622***	0.287	126
3	−25.3***	2.034***	2.627***	0.292	126
4	−25.262***	1.646***	2.607***	0.296	126
5	−25.952***	1.543***	2.588***	0.308	126
6	−26.382***	1.266***	2.647***	0.303	126
7	−26.875***	1.062***	2.721***	0.296	126
8	−27.421***	0.94***	2.77***	0.294	126
9	−27.497***	0.763**	2.82***	0.284	126
10	−26.753***	0.564**	2.843***	0.27	126
11	−26.096***	0.428	2.853***	0.261	126
12	−25.993***	0.357	2.871***	0.257	126
13	−25.848***	0.303	2.879***	0.254	126
14	−25.653***	0.253	2.887***	0.251	126
15	−25.697***	0.232	2.89***	0.25	126
16	−25.314***	0.19	2.886***	0.248	126
17	−25.044***	0.158	2.885***	0.247	126
18	−24.289***	0.11	2.88***	0.246	126
19	−24.061***	0.092	2.878***	0.245	126
20	−24.15***	0.088	2.88***	0.245	126
21	−23.997***	0.077	2.879***	0.245	126
22	−23.736**	0.063	2.875***	0.245	126
23	−24.657**	0.089	2.891***	0.245	126
24	−24.219**	0.071	2.883***	0.245	126
25	−23.886**	0.058	2.878***	0.245	126
26	−24.637**	0.075	2.892***	0.245	126
27	−25.244**	0.086	2.903***	0.245	126
28	−25.865***	0.098	2.911***	0.246	126
29	−26.444***	0.109	2.916***	0.246	126
30	−26.265***	0.101	2.909***	0.246	126
31	−26.78***	0.11	2.914***	0.247	126
32	−25.831***	0.086	2.899***	0.246	126
33	−24.611**	0.057	2.883***	0.245	126
34	−22.85**	0.019	2.859***	0.244	126
35	−22.844**	0.018	2.859***	0.244	126
36	−23.638**	0.032	2.87***	0.245	126

Significant at *10% **5% ***1%
Null hypothesis of $\beta_1 \leq 0$ rejected at ◦10% ◦◦5% ◦◦◦1%

In practice, the housing market in Hong Kong displays condition (i) and (iii), as assumptions of the AIEH. While transaction data in Hong Kong are publicly available (for example, EPRC), housing is a highly heterogeneous commodity and the determinants driving the transacted prices cannot be fully known. Although market analyses that aim to investigate such heterogeneity, such as those based on the knowledge of local markets, may help discover some of these determinants, the price information known to each developer remains a segment of all available information. Based on this information, market expectations are usually formed by extrapolating past market trends (Zhu, 2005).

Nevertheless, the R-squared of 0.308 as well as the significance of β_0 indicates that a certain portion of the variation in developers' expectation is not entirely explained by the independent variables. On one hand, the AIEH suggests that this is due to the sampling error. On the other hand, however, developer- or case-specific factors also play an important role. For example, the toehold effect (Chang et al., 2008) discussed earlier suggested that developers who already have a development project in vicinity are likely to submit higher bids as well as the finding by Shen, Pretorius, and Li (2017) that joint bidding results in higher land prices due to increased competition.

While the AIEH model cannot fully explain developers' expectation formation, it does shed some light on what the government can do to discourage aggressive bidding. As our result suggests that developers generally form their housing market outlook based on the house price dynamic over the previous 5 months, the government should take advantage of this expectation formation by selling the residential development land when house price drop is recorded over the preceding 5 months so as to lower the chance of receiving high bids.

Conclusion

High land prices are usually seen in Hong Kong's land sales market. While the government has taken an initiative that aims to discourage aggressive land bidding behaviour, it is also important to understand how developers form their bids. This paper studied developers' general land bidding strategy in Hong Kong by investigating their housing market outlook, as revealed by the difference between the estimated value of the land and the submitted bid. It also aimed to fill the gap of the limited understanding of the house price expectation formation.

Empirical data rejected the rational and IEH, suggesting that developers' expectations are not forward-looking. In contrast, a backward-looking model proposed in this paper best describes the expectation formation. This is largely due to the market practice that each market participant only has a segment of all backward looking information in the market and that the price expectation is formed using this information, subject to sampling error.

For policymakers who wish to prevent land being sold at a high price, the findings in this paper suggested that land sales should be conducted when the house price has declined over a 5-month interval, on average. In addition, this paper enhances our understanding of how developers form their house price expectations, contributing to the research in house price dynamics.

Disclosure statement

No potential conflict of interest was reported by the author.

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