

Understanding governance of public land sales: an experiment from Hong Kong

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ABSTRACT

For centuries, many governments in the Asia-Pacific region have owned all the land resources, and government land auctions were deployed as an essential channel to supply public land. While the government-led approach to land supply is often criticized for lacking sensitivity to changing market conditions, experiments have been conducted to remedy this defect by means of a market-led approach that relies on developers to reveal their demand for public land. However, under the market-led approach, public land would not be put on sale until a developer committed an irrevocable bid to initiate a land auction. This market-led mechanism, namely the land application list system (ALS) in Hong Kong, China, has typically created a problem of freeriding among developers and has led to the unintended consequence of an undersupply of land. By considering such land sales reform in Hong Kong, this study uses a simultaneous equation model to demonstrate that the ALS has caused a significant undersupply of land. Moreover, an ordinal generalized linear discrete-choice econometric model is used to confirm that developers are more likely to coordinate with each other in order to internalize freeriding problems. A transaction costs framework is then developed to explain that market- and government-led approaches are not mutually exclusive and should complement each other. A dual approach that integrates both mechanisms is discussed as a new policy option.

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INTRODUCTION

Neo-classical economics asserts that market price is determined by demand and supply. In the case of an urban property market, supply is constrained by the availability of developable land, often as a result of geographical factors (Saiz, 2010), land-use regulations (Gyourko & Molloy, 2015) and production lags (Peng & Wheaton, 1994). The role of the government in land supply is typically ignored. In many Asian countries such as China, India, Vietnam and Iran, the

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government owns virtually all the land; in Commonwealth countries, such as Australia, Canada and New Zealand, public (Crown) land ownership is also common. There has been a lot of research on how land supply is used as a policy tool to regulate the economy (e.g., Tian & Ma, 2009), but not much has been done to examine how governments choose different public land supply mechanisms.

Public land supply is not a decision made by a profit-maximizing firm. Governments commonly base their land supply decisions on a variety of objectives: (1) to provide themselves with a sustained source of revenue (Tse, 1998; Xu, Yeh, & Wu, 2009); (2) to tackle housing unaffordability problems (Murphy, 2016); and (3) to optimize the use and development intensity of land to support economic growth (He, Huang, & Wang, 2014; Sengupta, 2013). For instance, local governments in China use land-sales revenue as the primary means to finance their expenditures. In Hong Kong and Singapore, the government aims to improve home affordability by setting aside a land supply for subsidized housing (Haila, 2000). And in developing countries in South Asia, a primary objective of land supply policies is to consolidate fragmented land parcels for further community and property development (Niroula & Thapa, 2005).

When a government has substantial control over land supply, it inevitably faces the problem: How should public land be supplied to the market for development? Should the mechanism be government or market led? Essentially, this echoes the urban planning question of whether 'planning is for the market' (Wu, 2015, p. 202). State entrepreneurialism, a term used by Wu (2018) to describe a form of governance in China that combines planning centrality and market instruments, is a case in point. The land-supply mechanism matters because the supply decision has to be made when future property demand is still uncertain. In a free market, this risk must be borne by private landowners through the 'survival of the fittest' principle: the belief that the market will automatically punish poor decision-makers. However, when the government is the landowner and the officials are the agent to make the supply decision, risk is probably the last thing it wants. It can choose to set the level of supply irrespective of market demand (i.e., the government-led mechanism) or it can let the private developers reveal their demand first and can then supply accordingly (i.e., the market-led mechanism). This study examines and compares these two mechanisms through a transaction cost framework.

Hong Kong, as one of the world's most free economies, provides a compelling case because its government has experimented with both mechanisms (Hong, 1998). Initially, before 1999, it sold public land according to a predetermined supply schedule – a typical government-led mechanism. Based on Granger causality tests, Li, Wong, and Cheung (2016) have empirically shown that this mechanism is not responsive to changes in market conditions. They did not explain, however, why this was the case. Accordingly, this study borrows the transaction cost framework to argue that such unresponsiveness may be caused partly by the cost of obtaining demand information and partly by the cost of adjusting supply targets. Government officials tend to be conservative and will only revise supply targets after a new trend has been clearly established, or key stakeholders have been consulted (Hein, de Groot, & Soma, 2008). Under the government-led mechanism, public land supply is therefore unlikely to synchronize with demand.

In 1999, after the Asian Financial Crisis, the Hong Kong government sought to dispose of public land by introducing a market-led mechanism, known as the application list system (ALS). The guiding principle of ALS was to let property developers, before any public land auction would be held, apply for the land they wanted, hence revealing their interests. In theory, the market-led mechanism would help the government to estimate the market demand for public land and to respond more quickly to market changes. However, this mechanism was finally abolished in 2013, although Li et al. (2016) found that supply adjustments were actually more responsive to market conditions. Why did the government give up a more responsive mechanism? This study argues that the 'failure' of the market-led mechanism is that freeriding, arising from the disadvantage to the first mover by making an irreversible commitment of land purchase (see

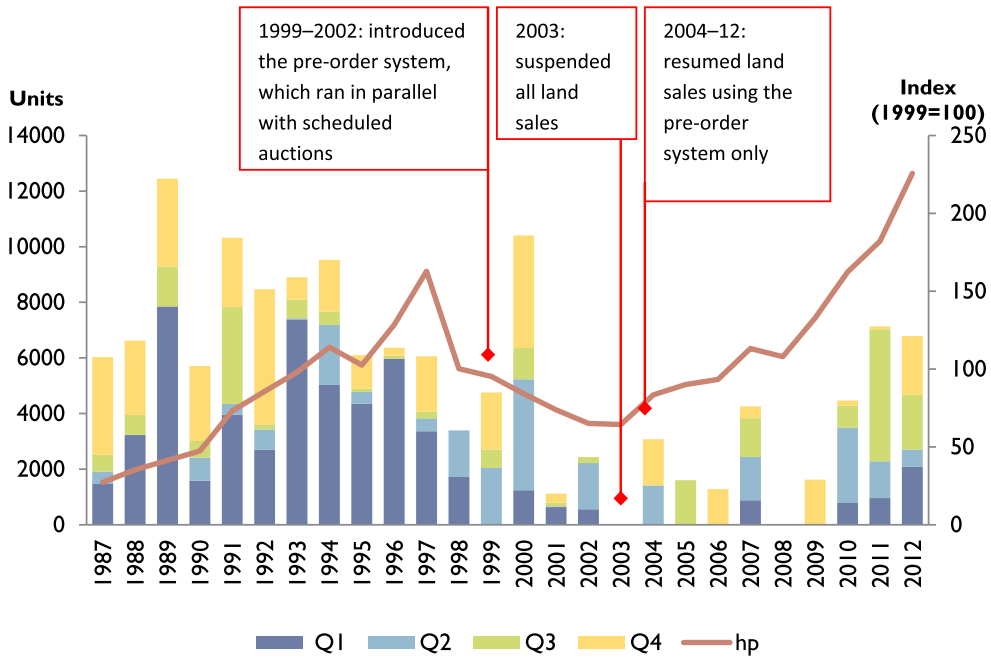


Figure 1. Land supply and housing prices, 1987–2012.

below), has resulted in an undersupply of land. As shown in [Figure 1](#), despite sustained and robust growth in housing demand and skyrocketing housing prices, the annual supply of new land through the market-led mechanism has actually dropped to its lowest level ever. [Figure 1](#), however, is not definitive because demand factors have not been controlled for, and the free-riding argument is yet to be tested. In this study, further tests based on a simultaneous equations model and a discrete choice model will be conducted.

The free-riding argument can be understood by considering an individual who takes advantage of others’ action without paying them. The market-led mechanism in Hong Kong works as follows: suppose a property developer is the first among all developers in the city who wants to buy a particular land parcel from the government. For the government to arrange a public land auction, the initiating developer is required to pay a deposit, a ‘booking fee’, to show his or her interest. However, other developers can freeride on the first developer’s payment and participate in the auction without paying any deposits. There is no guarantee that the initiating developer will have priority to obtain the land parcel. The first developer even has to guarantee, if no other developers submit a bid, to buy the land. An analogy is to a customer who is required to pay a deposit for an advance restaurant booking but ends up outside the restaurant waiting with newcomers for seats. Why should he trouble himself to make an advance booking in the first place? As the initiating developer cannot exclude rivals from bidding at the auction, the time and effort devoted to the process will be for nought. It is then natural for this developer to wait for others to initiate a land sale and freeride on their efforts. However, if every developer operates like this, who will initiate a land sale? Thus, a well-known consequence of freeriding is the undersupply problem. We will test this by examining whether developers are more likely to form joint ventures (to internalize the freeriding problem) under the market-led mechanism.

This study contributes to the existing regional urban planning literature in several ways. First, we use the Hong Kong experiment to demonstrate empirically that, due to freeriding, the market-led mechanism led to the undersupply of land. As suggested by [Li et al. \(2016\)](#), when the

property market becomes highly unaffordable, this drawback of the system probably outweighs the advantage of being more responsive to market conditions. Second, while most urban debates have rested on the virtues of formalizing land rights, this study conceptualizes the respective costs of using the government- and market-led land sales mechanisms in a transaction cost framework, thereby providing insights into overarching discussions of urban land and property development (Coase, 1965; van Noorloos, Klaufus, & Steel, 2018). Third, we contribute to the discourse of urban land sales governance and its potential unintended consequences for undersupply. Consistent with the argument of He and Lin (2015), we emphasize that urban land supply governance can be better understood by a critical analysis of how the state and the market could be balanced and could produce and consume urban spaces together. Governments should not be skewed toward a state- or market-only approach. Based on our findings, we generalize, in the final section, the conditions a government should consider in balancing the state- and market-led approaches, which is a pertinent issue in many regional development settings (Hu, 2014). Here, we emphasize that this paper does not aim to justify the use of either a market- or a government-led mechanism. Both approaches have their own merits and limitations. In conclusion, the market- and government-led mechanisms are shown to be complementary to each other and should be used in parallel.

BACKGROUND: FROM GOVERNMENT- TO MARKET-LED LAND SALES

Like many other jurisdictions in Asia, Hong Kong's government effectively owns all its land resources.¹ Determining public land supply is a fundamental land policy issue that confronts many cities across the globe, especially in the Asia-Pacific region,² and there is no exception to Hong Kong. What motivates the current study is our interest in the market-led land sale arrangement, namely the land application list system (or as is commonly known, the application list system – ALS), which was introduced in 1999.³ More specifically, before 1999, the government rolled out a schedule of land auctions or tenders at the beginning of a financial year. The actual timing and quantities of land scheduled for public disposal were determined solely by the government. During Hong Kong's colonial period when property developers planned their land purchases in accordance with the government announced land-sale schedule, this model worked quite satisfactorily. However, the unprecedented collapse of Hong Kong's housing market during the 1998 Asian Financial Crisis led many local developers and homeowners to blame regular land sales for further weakening the market demand. Immense pressure was applied to suspend this government-led system. In response, the government launched the market-led ALS land sales model in 1999, and from 2000 to 2003 this model ran in parallel with the government-led system. In 2004, the regular land sale programme was then abolished, and ALS was made the official and exclusive public land sale model at that time. This land sales market became 'business as usual', but in 2013, after around 12 years of trial, the ALS was abolished by the government, and the regular land sale programme (via tenders) was resurrected and made the only land sale model in the city.

One of the most distinctive features of this market-led mechanism was its requirement for property developers to 'book' their land purchases in advance. This contrasted markedly with the heavy reliance on the government's judgment of public land demands. A schematic outline of this market-led system versus the government-led one is shown in [Figure 2](#).

The study focuses on the question: Did replacing the government-led land sale system with the market-led system make land supply more responsive to market changes? While the new system was initially well received by developers during the market trough, in the more recent years of market recovery it did not seem to function properly in response to the growing demand for land. During the 2003–13 period when ALS was adopted as the only land sale system, only 35% of the potential sales of available land sites on the government application list were successfully initiated

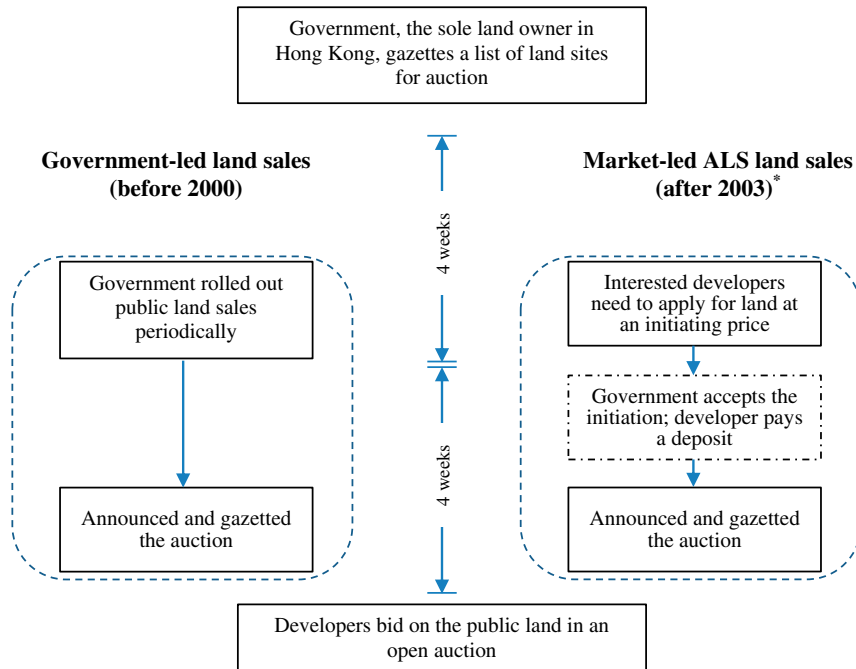


Figure 2. Schematic outline of the application list system (ALS).
 Notes: *Both systems ran in parallel from 2000 to 2003. Source: Authors’ compilation based on the Lands Department’s notes on ALS.

and sold.⁴ This was in stark contrast to the high success rates of two other quasi-government land supply channels, namely railway projects (68%) and redevelopment projects (98%). It is worth noting that the railway and redevelopment projects together accounted for a significant share (i.e., 30%) of the total land supply (in terms of housing units). This implies that after the implementation of the market-led land sales approach (i.e., the ALS), the public land supply from this source apparently failed, in comparison with alternative sources, to meet the growing market demand. Why did the land supply under the market-led land sale system run counter to common belief? Why was it insensitive to the growth in property demand?

DEVELOPMENT OF HYPOTHESES: TRANSACTION COSTS THEORY

Using the government-led approach to supplying public land is argued to be unresponsive to changes in market conditions. Li et al. (2016) empirically showed that the government-led land supply is not responsive to changes in market conditions. Government officials would only revise supply targets until a new trend of demand is established on the market. *The government-led approach* particularly entails two major transaction costs, namely: (1) the cost of adjusting the public land supply; and (2) the cost of estimating market demand. The cost of adjusting the public land supply can be viewed as the operational inefficiency of a government. Even if the market demand for land is easily known, it will still take time for an inefficient government bureaucracy to process and act on the information. By the time land is finally released, the market demand may have already changed. Such adjustment costs could be substantial, especially in a volatile property market. However, when the cost of estimating the public land demand is considered, the issue may be much more complicated. One may question why the government needs to estimate public land demand. In a well-functioning market, the quantity problem can be

‘solved’ by the ‘invisible hand’ – if a government supplies too much (little) land, the price will go down (up).

However, from the government’s perspective, because price instability can adversely affect other parts of the economy, especially for property owners and the banks that underwrite property-related loans, a market price adjustment is not necessarily the best solution. If a government relies strongly on public land sales revenue to finance its public infrastructure and social services, the unstable fiscal revenue may wreak havoc on fiscal budgets, requiring postponement of contracts for public services (Tao, Su, Liu, & Cao, 2010). Any failure to consider the land administration system in macroeconomic policy-making can result in suboptimal fiscal and monetary decisions (Tambuwala, Bennett, Rajabifard, Wallace, & Williamson, 2011). If the government has the dual objectives of maximizing revenue and stabilising the property price, the quantity problem is thereby made more difficult to solve. This implies an exorbitant cost for the government to estimate ‘accurate’ market demand. The more uncertain the market is, the higher the cost of evaluating the demand for land.

The market-led approach is also not free, and its inevitable operational procedures are also very costly. Conceptually, the market-led approach to managing the public land supply uses developers as ‘agents’. As developers are in the business of selling properties, any unfavourable changes in the land market may be detrimental to their profitability. Therefore, developers have the greatest incentive to gather the most accurate information possible on market demand. When using developers as agents to assess land demand, the government (principal) can save the cost of gathering the correct demand information subject to the agency cost involved. However, this is manifested as a misalignment of interests between the government and developers (Alchian & Demsetz, 1972; Jensen & Meckling, 1976).

Indeed, two major costs are involved in the market-led approach, namely: (1) the cost of verifying the information revealed by developers’ pre-orders; and (2) the cost of adjusting land supply to maximize the government’s land sales revenue. In fact, developers will not consider the dual objectives as the government does, and they might also have an incentive to cheat the government to acquire the land at a lower price. Thus, under the market-led approach, a government has to bear the cost of verifying whether developers’ pre-orders faithfully reveal their demand. One common way to prevent developers from delivering a false signal is by requesting them to commit a deposit for their pre-orders, but such a deposit system does not necessarily help to improve the situation and has the capacity to create the problem of undersupply. Furthermore, under the market-led approach, a government will be deprived of its ability to adjust the land supply. If a government relies heavily on land sales for its revenue, it becomes entirely passive in controlling land supply, and the market-led approach will thus impose a potential threat to its public fiscal finance.

The undersupply problem was caused by the transaction costs associated with the new deposit arrangement stipulated under the market-led system. Three transaction cost features of the market-led land sales system tend to magnify this freeriding problem, thereby exacerbating the public land shortage and forcing property prices up. First, under the market-led system, the initiating developer must pay a deposit amounting to 10% of the initiated price, subject to a cap of HK \$25 million (US\$3.2 million). Although the deposit is refundable if the final bid turns out to be higher than the government’s undisclosed reserve price, it is likely to exert a huge cash-flow pressure, especially on small and medium-sized developers. This reinforces developers’ incentive to stay on the sidelines and wait for others to initiate the public land auction. Second, the deposit will only be returned to the initiating developer when there is at least one bid in the auction, and the final bid must be higher than the undisclosed reserve price. Since the opening bid of an auction is usually 20% below the undisclosed reserve price, the initiating developer may still risk forfeiting the initiating deposit if the final bid remains below the reserve price. Third, the initiating developer will not receive any compensation if a competitor wins the bid.

Under the market-led system, where the effort of initiating a land sale may turn out to be totally unrewarded, there will be little incentive for a developer to pay a deposit to 'book' the sale. The best (but suboptimal) strategy of developers is to adopt a wait-and-see approach and freeride on a competitor's efforts. When every developer does the same, an undersupply of land will emerge. Therefore, we hypothesize that:

Hypothesis 1: Under the market-led system (i.e., ALS), the quantities of new housing supplied will be on average lower than the market equilibrium level.

In fact, this undersupply problem originating from the market-led system can be viewed as a type of agency cost, a cost that is caused by the government's attempt to 'appoint' developers as agents to manage market uncertainties. The agency theory in general (Alchian & Demsetz, 1972; Jensen & Meckling, 1976) has highlighted the role of agency cost in influencing the choice of organizational form. Since the only objective of developers is to maximize their own profits, they will avoid the freeriding problem by all means possible, albeit at the expense of generating a socially suboptimal land supply outcome. Such agency costs are inevitable under the market-led system, as the government (i.e., principals) cannot completely control the behaviour of the agents (i.e., developers).

One effective way to solve the freeriding problem, as pinpointed in the property rights literature, is to *internalize* such benefits by merging the market players, in the present case, the developers (Demsetz, 1974). To play safe under the market-led system, it is preferable for developers to coordinate with one another to initiate a land sale so that the risk of freeriding and the cost of deposits can be reduced. Under any circumstance, should the total benefit of joint bidding, including the cost of sharing the initial deposit and the increased probability of getting the desired site, exceeds that of bidding individually, two or more developers would have an incentive to coordinate and formulate a joint bid for a public land plot. The market players, therefore, would find a way to partly internalize such externalities.⁵

In reality, as pointed above, the freeriding problem cannot be observed easily because most property developers, in an *ex-ante* sense, have already internalized their freeriding activities. Fortunately, the implementation of the market-led land sale system in Hong Kong provided an exogenous policy change that enabled us to investigate how the market-led mechanism has altered developers' land purchase behaviours. A testable implication that can be drawn is as follows:

Hypothesis 2: Ceteris paribus, the implementation of a market-led land sale (i.e., ALS) would make developers more likely to coordinate among themselves to bid jointly on a land parcel, thereby internalising the freeriding problem.

EMPIRICAL TESTS AND RESULTS

To test our hypotheses of undersupply and freeriding problems, we adopt two complementary empirical procedures, namely: (1) a reduced form of simultaneous equation model; and (2) a discrete-choice regression model. More importantly, the two interrelated empirical tests provide evidence as to whether the market-led system has led to the undersupply of land and how the freeriding problem has changed the developers' bidding behaviour.

Empirical evidence 1: undersupply with market-led approach

A reduced form of simultaneous equation model

To test Hypothesis 1, we need to benchmark the *actual* land supplied against a *predicted equilibrium* level. Our research design is a reduced form of simultaneous equation modelling in

economics, designed to estimate the theoretical equilibrium for the Hong Kong housing market. The method is not novel in urban studies, but it requires the researcher to give careful thought to crafting a set of simultaneous equations (e.g., DiPasquale & Wheaton, 1994; He et al., 2014). The demand and supply equations can be denoted as follows:

$$\text{Demand equation: } q_t^d = \beta_0 + \beta_1 y_t + \beta_2 i_t + \beta_3 p_t + u_{1t} \quad (1)$$

$$\text{Supply equation: } q_t^s = \alpha_0 + \alpha_1 c_t + \alpha_2 i_t + \alpha_3 p_t + u_{2t} \quad (2)$$

where q_t^d and q_t^s refer to the housing units (demanded and supplied respectively); y_t is the median household income; p_t is the residential housing price index; c_t is the construction and labour cost; and i_t is the mortgage rate. Equations (1) and (2) are simultaneous equations where the housing quantity $\{q_t^d, q_t^s\}$ and housing price $\{p_t\}$ are endogenous in the system. Indeed, we can estimate the reduced form of observed endogenous variables as functions of exogenous variables, as indicated as follows:⁶

$$p_t = \delta_0 + \delta_1 y_t + \delta_2 c_t + \delta_3 i_t + v_{1t} \quad (3)$$

$$q_t = \rho_0 + \rho_1 y_t + \rho_2 c_t + \rho_3 i_t + v_{2t} \quad (4)$$

By allowing a fraction ϕ of the price difference $p_t^* - p_{t-1}$ to adjust partially towards its equilibrium level p_t^* in each period, the adjustment path can be estimated with an autoregressive (AR) process of p_t with household income, construction costs and mortgage rates as exogenous variables, which can be expressed as follows:

$$\begin{aligned} p_t - p_{t-1} &= \phi(p_t^* - p_{t-1}) = \phi(\delta_0 + \delta_1 y_t + \delta_2 c_t + \delta_3 i_t) - \phi p_{t-1} \\ p_t &= \phi(\delta_0 + \delta_1 y_t + \delta_2 c_t + \delta_3 i_t) + (1 - \phi)p_{t-1} \end{aligned} \quad (5)$$

Likewise, we can apply the partial adjustment process for the quantities of housing q_t by allowing only a fraction θ of $q_t^* - q_{t-1}$ to adjust towards its equilibrium level q_t^* . The reduced form of the equation becomes:

$$q_t = \theta(\rho_0 + \rho_1 y_t + \rho_2 c_t + \rho_3 i_t) + (1 - \theta)q_{t-1} \quad (6)$$

Following the discussion in Greene (2012, p. 333),⁷ we have $f(\mathbf{Y}_t, \mathbf{X}_t, \boldsymbol{\beta}) = \varepsilon_t$, where \mathbf{Y}_t is a vector of our endogenous variables $\{p_t, q_t\}$; and \mathbf{X}_t is a vector of exogenous variables $\{y_t, c_t, i_t\}$. The full information maximum likelihood (FIML) estimator can be used to find the vector of parameters $\boldsymbol{\beta}$ by maximizing the likelihood function under the assumption where ε_t is a vector of i.i.d. multivariate normal random variables with covariance matrix Σ . Given a consistent estimation of the coefficients $\{\delta_0, \delta_1, \delta_2, \delta_3\}$ and $\{\rho_0, \rho_1, \rho_2, \rho_3\}$, the exogenous variables y_t , c_t and i_t are obtained simultaneously, while p_t^* and q_t^* are solved with the predetermined variables p_{t-1} and q_{t-1} .

Data and empirical results

The time-series data used in our SEM are the quarterly data from Q1 1995 to Q4 2013, sourced from the Census and Statistics Department of Hong Kong (HK C&SD), the Rating and Valuation Department of Hong Kong (R&VD), the Hong Kong Monetary Authority (HKMA) and the Building Department (BD). The housing price (HP) is the overall residential housing price index released by the R&VD, whereas the housing supplied (*SUPPLY*) includes both housing starts and new housing completions recorded by the BD. A reason why we use the housing starts together with the completions instead of directly using the land supply (in hectares) is to allow for adjustment for the construction time lags. The income data are the median household income of Hong Kong residents (*HHINCOME*), and the construction and labour cost (*BMC*) refers to the cost of labour and building materials index compiled by the HK C&SD. The mortgage rate (*MRATE*)

approximates the financing cost for both home buyers and developers. More importantly, our simultaneous equation model allows a partial adjustment mechanism to explain the demand and supply of the residential housing market. The demand for housing is explained by household income (*HHINCOME*), the mortgage rate (*MRATE*) and the housing price (*HP*). The supply of housing is explained by price and the cost of labour and construction (*BMC*), the mortgage rate (*MRATE*) and the housing price (*HP*). The results of the SEM are shown in Table 1.⁸

The interaction of demand and supply in the SEM sheds a light on the existence of the undersupply problem during the period of the market-led system. Table 2 exhibits the deviation between the actual and predicted equilibrium housing supplied ($q_t - q_t^*$) before and after the period of ALS implementation. As a confirmation of Hypothesis 1, the summation of ($q_t - q_t^*$) (or the mean of ($q_t - q_t^*$)) is *negative*, that is, -7205 (or -257) during the ALS implementation, while the standard deviation (SD) of ($q_t - q_t^*$), that is, 5212, is much larger during the government-led land sales. There are two caveats with this comparison. First, the model only tells the actual equilibrium supply with a 95% confidence level. Second, the results could be subject to the problem of anomalies (i.e., one extreme observation might lead to a distortion in such comparison) despite the difference between the predicted value and actual value being significant.

Empirical evidence 2: internalizing the freeriding problem

A discrete choice regression model

To test Hypothesis 2, we have to examine whether the developers became more inclined to form joint bids. To test the likelihood of joint bid decisions both before and after the implementation of ALS, a typical binary probit model outlined in equation (7) is used. In the latter part, we will discuss the heteroskedasticity problem involved. Basically, the dependent variable, *Y*, of the model is the dichotomous outcome of a joint bid (*JB*; i.e., 1 = winning bid in a joint bid; 0 = winning bid in a single bid).⁹ Hence:

$$\Pr(Y = 1|X) = \Phi(X'\beta) \quad (7)$$

where *Pr* denotes probability; and Φ represents the cumulative distribution function of the standard normal distribution. For the independent variables (i.e., the vector of regressors *X*), it

Table 1. Empirical results of the simultaneous equations model (SEM).

Variable	ln(<i>HP</i>)	ln(<i>SUPPLY</i>)
Constant	2.711*** (1.124)	15.352** (7.863)
ln(<i>BMC</i>)	0.044 (0.048)	0.756** (0.344)
ln(<i>HHINCOME</i>)	-0.320*** (0.122)	-1.406* (0.816)
ln(<i>MRATE</i>)	-0.025* (0.015)	0.314*** (0.129)
AR(1)	1.055*** (0.042)	0.372*** (0.112)
Observations	72	72
Adjusted <i>R</i> ²	0.969	0.544
SE	0.059	0.411

Notes: The endogenous variables are the logarithm of housing prices ln(*HP*) and ln(*SUPPLY*). The exogenous variables are the logarithm of *BMC*, *HHINCOME* and *MRATE* with their corresponding AR process (*p*) that ensure the dynamic stability (i.e., the inverted roots are all strictly inside the unit circle). A full information maximum likelihood (FIML) estimator is used to solve the simultaneous equations.

*, ** and ***10%, 5% and 1% significance levels, respectively. Standard errors are shown in parentheses.

Table 2. Deviation of housing supplied from the predicted equilibrium.

Government led before the ALS was implemented, 1996–2002				Market-led pre-orders after the ALS was implemented, 2007–13			
Period t	q_t	q_t^*	$q_t - q_t^*$	Period t	q_t	q_t^*	$q_t - q_t^*$
3/1996	11,784	17,697	-5913	3/2007	5620	6366	-746
6/1996	11,134	16,492	-5358	6/2007	6251	6527	-276
9/1996	13,948	13,683	265	9/2007	7273	6404	869
12/1996	15,310	16,089	-779	12/2007	9208	6761	2447
3/1997	7546	16,441	-8895	3/2008	5621	7266	-1645
6/1997	18,844	11,898	6946	6/2008	1743	5201	-3458
9/1997	8,028	13,959	-5931	9/2008	2548	3052	-504
12/1997	12,928	12,120	808	12/2008	5856	3723	2133
3/1998	13,670	13,289	381	3/2009	1944	5354	-3410
6/1998	11,195	13,411	-2216	6/2009	2372	3456	-1084
9/1998	16,263	12,031	4232	9/2009	6339	4129	2210
12/1998	14,024	16,304	-2280	12/2009	3869	6652	-2783
3/1999	19,842	14,513	5329	3/2010	5508	5215	293
6/1999	19,284	16,982	2302	6/2010	3017	6172	-3155
9/1999	18,423	15,026	3397	9/2010	5741	4797	944
12/1999	27,486	14,868	12,618	12/2010	4536	5964	-1428
3/2000	18,372	18,679	-307	3/2011	4301	5395	-1094
6/2000	12,167	14,966	-2799	6/2011	3233	4992	-1759
9/2000	13,519	9695	3824	9/2011	6329	4170	2159
12/2000	19,566	10,816	8750	12/2011	6658	5344	1314
3/2001	18,315	12,249	6066	3/2012	6208	5692	516
6/2001	7360	11,371	-4011	6/2012	6401	5476	925
9/2001	6649	6711	-62	9/2012	6920	5437	1483
12/2001	13,610	6847	6763	12/2012	4947	5904	-957
3/2002	5176	8097	-2921	3/2013	2402	4839	-2437
6/2002	8609	6244	2365	6/2013	4924	3736	1188
9/2002	17,313	7175	10,138	9/2013	4486	4837	-351
12/2002	16,263	9900	6363	12/2013	6146	4743	1403
$\Sigma(q_t - q_t^*)$		39,076		$\Sigma(q_t - q_t^*)$			-7205
Mean of $(q_t - q_t^*)$		1396		Mean of $\Sigma(q_t - q_t^*)$			-257
SD of $(q_t - q_t^*)$		5212		SD of $(q_t - q_t^*)$			1770

Notes: Authors' compilation. The simultaneous equations model (SEM) estimation includes the quarterly data from 1995 to 2013. Compared are the actual q_t versus equilibrium q_t^* housing supplied in the selected period 1996–2002 against 2007–13.

ALS, land application list system.

includes both land- and developer-specific factors (Ong, Lusht, & Mak, 2005; Ooi, Sirmans, & Turnbull, 2011). For the land-specific factors, we adopted DeBoer, Conrad, and McNamara (1992) by including the land premium for purchasing the public land (*PREMIUM*) and the maximum permissible residential gross floor area (*DGFA*)¹⁰ to examine the auction outcomes. These variables are expected to increase the likelihood of a joint bid, as the larger is the scale of a land site, the more resources are required for the project. That increases the likelihood of a joint bid as a means to circumvent the cash flow constraint. The developer-specific factors (Ching & Fu, 2003) include such financial indicators as the market capitalization (*CAPITAL*) and gross profit margin (*GMARGIN*) of developers indicated in their company annual reports.¹¹ In addition, Anglin (2003) and Mayer (1995) suggest that the probability of sales are related to market conditions. Thus, we used the lagged housing price index as a proxy for

the developers' market expectation (*FORECAST*). In general, the higher the expected housing price level, the smaller is the probability of a joint development project because the revenues generated from home sales during an upmarket can more easily cover expenses on the cost side (or at least not incur unacceptable financial stress and cash flow problems for the developers).

For our empirical test, we collected public land sale data from the Lands Department of Hong Kong. The land sale data covered about 200 public land sales over an 18-year period from 1993 to 2011. The years 1993–99 were the period with only the government-led approach, whereas the years 2004–11 were the period when only the market-led system (i.e., ALS) was implemented. Since both the government- and market-led systems ran in parallel from 2000 to 2003, we excluded those land sale results from our samples. After making all necessary adjustments, we were left with 88 usable land sale results for analysis.

Data and empirical results

Columns (1) and (2) in Table 3 summarize the results of the probit and logit estimates. Both confirm that the implementation of ALS increased the likelihood of a joint bid among property developers, as manifested by the significantly positive coefficients of the variable *ALS*. In addition, all other controlled covariates carry their expected signs, as discussed above. Although the results appeared to be affirmative, the heteroskedasticity variance problem is always a concern in such typical probit and logit estimations, which may, therefore, require further scrutiny. Technically speaking, in the case of linear regression, heteroskedastic errors lead the ordinary least squares (OLS) estimator to be inefficient, as the usual estimator of the covariance matrix is an

Table 3. More joint bids among developers under the land application list system (ALS).

	Dependent variable: Joint bid (Yes = 1, No = 0)			
	Probit (1)	Logit (2)	Hetero-probit (3)	oglm (4)
<i>PREMIUMX</i>	0.959** (0.011)	1.694** (0.015)	0.631*** (0.000)	1.171*** (0.000)
<i>MKTCAPX</i>	-0.039** (0.033)	-0.069** (0.039)	-0.053** (0.015)	-0.105** (0.025)
<i>GMARGINX</i>	0.214** (0.023)	0.383** (0.027)	0.135** (0.007)	0.258*** (0.010)
<i>FORECAST</i>	-0.041* (0.058)	-0.074* (0.065)	-0.017* (0.076)	-0.033* (0.062)
<i>ALS</i>	6.583** (0.013)	11.978** (0.018)	1.889*** (0.000)	2.036*** (0.000)
Constant	-10.297** (0.011)	-18.317** (0.014)	-6.680** (0.010)	12.425** (0.014)
(Pseudo)- <i>R</i> ²	0.751	0.749	–	0.482
Observations	88	88	88	88
Log-likelihood	-8.253	-8.314	-16.763	-17.159
Chi-square	49.805	49.684	22.871	15.335

Notes: The dependent variable is a binary variable indicating if the winning bid is from joint developers (Yes = 1; 0 if otherwise). Standard errors are shown in parentheses. Each unit of observation represents the result of one public land auction. *ALS* is the time dummy that represents the implementation of the ALS (1 = date after 2003 and inclusive; 0 if otherwise). The land sale results for the period 2000–03 were excluded from the estimation because the government-led and pre-order systems ran in parallel during this period. The total number of usable observations was 88. In all cases, if applicable, the standard error was corrected to account for possible heteroskedasticity in the indicator variable *ALS*.

*, ** and ***10%, 5% and 1% significance levels, respectively.

inconsistent estimator of the true covariance matrix. Consequently, if the standard errors of the coefficients are computed in the usual way, they will be the inconsistent estimators for the true standard deviations of the elements of in the covariance matrix. That breaks the classical assumption in the OLS that modelling errors are uncorrelated and uniform (i.e., unequal variances with the effects being modelled).

Specifically, upon the implementation of ALS, developers' choices in joint bids vary structurally owing to the differences in land auction rules between the two periods. Thus, we may not be able to observe some latent changes inherent in this structural difference. If the process is causing unequal variances in the variables that have not been accounted for in our empirical model, the model is unlikely to produce accurate results. This problem of unequal variances across observations is well known to econometricians as the heteroskedasticity problem. In the least-squares regression model, if the error is heteroskedastic, the estimator is unbiased and consistent, but inefficient. The typical estimate of the parameter covariance matrix would be inaccurate (Yatchew & Griliches, 1985).

To tackle such a potential estimation problem, as a robustness check of our results we tried to use the heteroskedastic probit and ordinal generalized linear models (also known as *oglm*; Williams, 2010). The advantage of these models is that they allow the residual variability to differ before and after ALS, which may provide additional information on the underlying latent variable. The results of the heteroskedastic probit and ordinal generalized linear models, once the heteroskedasticity problem has been taken into account, cannot rule out the affirmative results of our probit and logit models. In columns (3) and (4), both results remain confirmatory, indicating a higher likelihood that developers adopt joint bids in the ALS.

CONCLUSIONS: GOVERNMENT, MARKET OR BOTH?

The government-led approach has its strengths and weaknesses, as does the market-led approach. Specifically, while the government-led approach can be better used to satisfy the government's policy objectives, it always carries the inherent problem of a lagged response to changing market conditions. As a result, land supply will fail to reach the government's target, sometimes by a significant margin. On the other hand, even though the market-led approach fares better in terms of providing a timely response to market changes, the freeriding problem highlighted in our study can generate an unintended consequence of undersupply of land.

Generalizing from the Hong Kong experience, how do these relevant costs affect the choice between the government- and market-led approaches? When market demand is highly uncertain, which means it is very costly for the government to estimate an 'accurate' demand for public land, the market-led approach will be a dominant strategy for the government to manage its land supply. The rationale is that developers always possess superior information about land demand, and the government can exploit developers' information through their land purchases' booking in advance and save the cost of appraising market demand. However, when the government's fiscal finance is heavily reliant on land sales revenue, thus making it extremely costly for a government to relinquish its managerial role in public land supply, the government-led approach will probably be adopted. The theoretical framework can be well demonstrated by the useful yet straightforward matrix shown in Figure 3.

The transaction cost framework here enables us to rethink the traditional view that the government- and market-led approaches are necessarily mutually exclusive and shows that it is misleading to frame the choice between these two approaches as dichotomous. What if the costs of both accessing demand and adjusting supply are high? Many firms will use a mixed strategy to address their supply issues. The dual-track approach is a hybrid of the government- and market-led systems. The idea of using a dual-track approach is to use developers' information proxied

Costs of relinquishing the authority to adjust supply	Costs of revealing true market demand	
		Low High
	Low	Indifferent Market led
	High	Government led Hybrid

Figure 3. Choices of public land supply approach under different cost conditions.
Source: Authors.

by their pre-orders to assess the market demand more accurately while retaining a certain level of autonomy for the government to adjust the land supply so as to ensure its fiscal revenue.

The dual-track approach can work like this. Suppose seven parcels of land are demanded from the market. Neither the government nor the developers have an accurate assessment of this demand. When the government underestimates market demand and only places four land sites on the market under regular land sales, then the market-led system will serve as an alternative channel for developers to make up the shortfall. If the government overestimates market demand in the first place with an over-provision of public land relative to demand, no developer will resort to the market-led system for additional land. In this case, the effect would be the same as having only the government-led approach. However, with the coexistence of the two systems, the market-led system will play a complementary role by sending market signals to the government to adjust the pace and size of its scheduled land auctions. In any case, especially in markets with high transaction costs, using two systems together will offer a preferable (or at least equal) outcome to adopting just one system. This is not a novel idea. Even restaurants have used a dual approach to coping with shifting the demand for their seats by reserving a portion of their tables for pre-ordering customers and the remainder for walk-ins. A dual approach is always a plausible way to handle the urban land supply issue in many countries of the Asia-Pacific region.

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NOTES

¹ Hong Kong has four major sources of government-led residential land supply in the past years (2009–15), namely: land auction/tender, MTR (railways) projects, the urban renewal authority's (URA) redevelopment projects and the Hong Kong Housing Society (public housing). Government land sales are a significant source of public land.

² Public land ownership takes many different shapes and forms across the globe, and countries share similar issues in selling public land. In Commonwealth countries such as Australia, New Zealand and Canada, public land is referred to as Crown land. In Australia, Crown land comprises about 23% of Australian land, which is held in the right of a state. In Canada, the majority of land is held by governments. About 89% of Canada's land area is Crown land, which may either be federal (41%) or provincial (48%). In these countries, recent proposals to sell Crown land have been highly controversial. In France, land can be held by *communes*, *départements* or the central state. In Portugal, the land owned by the state is in two forms: public domain and private domain. The latter is owned like any private entity and may be sold on the market. In the United States, governmental entities including cities, counties, states and the federal government all manage land, which is referred to as either public land or the public domain.

³ For more details on the ALS, see the Background Notes on the ALS by the Hong Kong SAR government (https://www.devb.gov.hk/filemanager/en/content_69/press20080222_appendix2.pdf); the system was abolished from 2013/14 (http://www.news.gov.hk/en/categories/finance/html/2013/02/20130228_145244.shtml).

⁴ The land sales revenue for the government in the same period had risen from 8% in 2003 to 25% in 2013. In other words, per square metre, land sale price had gone up considerably during the period when ALS was adopted. This offers another convincing argument that the undersupply of land and the consequent escalation of housing prices would be in the best interests of big developers. In other words, big developers have every interest in maintaining a low supply of land in the market-led regime so that housing prices can escalate, as a guaranteed windfall for their businesses.

⁵ While the pre-order system causes negative externalities to developers that intend to pre-order public land sales (as a result of freeriding by competitors), this could, from the perspective of the freerider, be viewed as a positive externality.

⁶ While it is not the main concern of our SEM, we have fitted the vector error correction model (VECM) for equations (3) and (4) and performed the Johansen cointegration test (Johansen, 1991) to confirm that at least two cointegrating equations are significant at the 0.05 level; hence, a long-run equilibrium exists for the housing prices (p_t) and housing supplied (q_t).

⁷ Although the FIML and threestage least square estimation are asymptotically equivalent, the former is preferred to the latter in the finite samples and reduced-form model.

⁸ The concurrent coefficients for each variable presented in the simultaneous equation analysis seem to be counterintuitive. However, the coefficients should not be read on their own. The overall impact of each variable should be read with the autoregressive term (i.e., $AR(p)$) and, more precisely, with the corresponding impulse-response function analysis (with lagged variables involved). Since it is not the focus here to examine the exogenous shocks to our model, we do not present all the details.

⁹ Before the fitting of any probit or logit model, a McNemar's test was performed to examine the marginal frequencies of two binary outcomes (i.e., JB = joint bid or not). McNemar's chi-square statistic (72.32; $p = 0.000$) suggested a statistically significant difference in the proportions of joint bids before and after the system was introduced.

¹⁰ The locational value of the land is not included because the impact is largely captured by the land premium. The maximum permissible domestic gross floor area serves as a proxy for the scale

of the development projects that can be sold for profit. Usually, a large-scale project is beyond the financial affordability of small and medium-sized developers if they do not join hands with other developers in order to deal with the strain imposed on their cash flows.

¹¹ The data constraint is particularly serious for non-listed developers, for which very limited financial information can be found. The best that can be done is to employ the average positions of the listed developers as proxies for all, which means they are presumed to be ‘average competitors’ on the market. This is considered a fairly reasonable assumption for Hong Kong, where most medium-sized developers (e.g., Nan Fung Development and Chinachem Group) are of roughly similar size and, despite their non-listed status, are not too out of line with their bigger listed counterparts.

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