Does an Oligopolistic Primary Market Matter? The Case of an Asian Housing Market[♦]

Edward Chi Ho Tang, Hong Kong Shue Yan University

Charles Ka Yui Leung, City University of Hong Kong[♣]

Joe Cho Yiu Ng, City University of Hong Kong

This version: Jan 2015

Abstract

Unlike United States, Hong Kong primary housing market is of an oligopolistic structure, where a few real estate developers dominate. This paper first explains how this typical market structure is formed, and then attempts to link this with the real housing prices. Typically, our results suggest that the stock prices of real estate developers have a feedback relationship with real housing prices. It concludes by providing policy implications.

Keywords: Oligopoly, market share, Herfindahl index, granger causality, VECM

JEL Classification: E30, L13, L85, R31

♦ Acknowledgement: We thank Pohan Fong, Steve Malpezzi, Tim Riddiough, Abdullah Yavas for helpful comments. Part of this research was conducted when Leung visited University of Wisconsin-Madison, whose hospitality is gratefully acknowledged. The usual disclaimer applies.

♣ Tang: Department of Economics and Finance, Hong Kong Shue Yan University, Hong Kong, chtang@hksyu.edu; Leung: Dept of Economics and Finance, City University of Hong Kong, Kowloon Tong, Hong Kong, kycleung@cityu.edu.hk .

…The extremely large number of homebuilders nationwide certainly makes the construction industry look competitive. The 1997 Economic Census reports almost 140,000 firms in the single-family construction business. There is concentration in the industry, but it is not dominated by only a handful of companies, as there were over seventeen hundred firms with revenues in excess of $10 million annually. There are many fewer builders of apartment complexes, but the same data source indicates over seventy-five hundred firms in the sector. At least for big cities such as New York, there is no evidence of control by a few firms….

Edward Glaeser and Joseph Gyourko, Rethinking Federal Housing Policy, 2008, p.52

…In particular, to the extent that construction firms have some degree of monopoly power, we will mistake monopolistic price setting for government-created barriers to entry. However, all the available evidence suggests that the housing production industry is highly competitive… The multifamily housing industry is only slightly less concentrated. In 1997, there were 7,544 establishments in this industry and more than 1,000 in New York State alone. According to County Business Patterns, over 100 such establishments were headquartered in Manhattan, with another 329 elsewhere in New York City. Nearly two-thirds of the multi-family builders in Manhattan were relatively small enterprises with fewer than 10 employees; nearly three-quarters of all such enterprises in New York City have fewer than 10 employees. Because this is not an industry controlled by a few large firms, it is highly unlikely that there is any monopoly power with which to set prices….

Edward Glaeser, Joseph Gyourko and Raven Saks, Why is Manhattan so Expensive, 2005, p.337.

1. Introduction

Does an oligopolistic market matter? For non-durable goods, the Economics literatures have provided much theoretical works and evidence that it does (for instance, Tirole, 1988; Waldman and Jensen, 2012). In the case of durable goods, the situation may be a little different. First, since goods are durable, we need to separate the primary from the secondary market. We also need to recognize that the primary market buyers could re-sell their goods in the secondary market. In other words, *from the perspective of a primary market seller, customers today could become competitors tomorrow*. Would the potential "threats" of the secondary market constrain the pricing, and potentially other behaviors, of the primary market producers? In a seminal paper, Coase (1972) argues that it is the case and that leads to a large theoretical literature on the topic.

Clearly, to empirically test the importance of an oligopolistic primary market, we need to address several questions. First, we need to identify goods with an oligopolistic primary market. Second, we would ask why the primary market is oligopolistic in the first place. Third, we would like to take into consideration that factors that would drive the primary market to be oligopolistic could also affect the price in the whole market. Therefore, to evaluate whether the "concentration" of the primary market has an effect on the price, we would need to "separate" the effect of the market structure from other "exogenous factors". Recently, Chen et al (2013) calibrate a structural model of US automobile market, which is clearly oligopolistic in the primary market, and find that the net effect of opening the secondary market would suppress the profit of new car manufacturers as much as 35 percent. It is then natural to ask whether the same is true for housing, which is also a durable consumption goods and arguably being at least as important as automobile, and has an important secondary market as automobile.[1] Unfortunately, the implications of an oligopolistic primary market may not be easily tested with the U.S. housing data. As reflected by the quotations, Glaeser and Gyourko (2008), Glaeser et al (2005), among others, it is not easy to find a city in which a few developers dominate the primary market. On the other hand, Somerville (1999) suggests that homebuilders in United States should be treated as monopolistically competitive suppliers of differentiated products, where the builder size and concentration vary across different MSA. Thus, it may be controversial to identify a housing market in U.S. whose primary market is oligopolistic in the first place.

[1] Among others, Stein (1995) argues that secondary market transactions typically dominate the primary ones in the housing market.

This paper attempts to address the importance of an oligopolistic housing market by studying an Asian market. First, it is well-known for its oligopolistic structure in the primary market. For instance, the information of Hong Kong Real Estate Agencies General Association[2] reveals that, in 2013, there are 36 real estate developers in Hong Kong, where 26 of them are listed in the main board of the stock market [Table 1]. If we define the developer's market share as the percentage of total gross floor area completed, the "four main developers" – Sun Hung Kai Properties Limited (SHK), Cheung Kong Holdings Limited (CHK), Henderson Land Development Company Limited (HEN) and New World Development (NWD) – could take more than a half of the total market share [Figure 1a]. In addition, the listed developers could share around 60 to 90 percent of the market [Figure 1b]. Thus, the housing market of Hong Kong provides us a natural platform to study the effect of an oligopoly structure of primary market.

[Figure 1a, 1b and Table 1 are about here]

Other features of the Hong Kong economy may provide further justifications for the study. For instance, there is neither capital control nor capital gains tax in the Hong Kong housing market. During our sampling period, the nominal exchange rate between the U.S. dollar and Hong Kong dollar has remains fixed, and foreign investors receive equal treatment as domestic ones. All these features facilitate the possibility of arbitrage by domestic and foreign investors. In addition, Hong Kong does not practice fiscal federalism. Public goods provision (such as public schools, police, etc.) is financed by the overall budget of the Hong Kong government rather than local property tax. Most residents in Hong Kong are broadly-defined Chinese. All these factors mitigate certain incentives behind segregation and hence simplify the analysis.[3]

Traditionally, the existence of an oligopolistic primary housing market in Hong Kong is attributed to the land scarcity of Hong Kong. According to the CIA World Factbook, for each square kilometers of land in Hong Kong, it hosts 6,480 people, which is the second densest country in the world [Figure 2]. On top of that, only 7% of land is used for residential purposes, hence actually the living environment is even more crowded [Figure 3]. To host such an amount

[2] For details of the list of real estate developers, please refer to the following link (in Chinese only): http://hkreaga.org/Partners.php#jump1

[3] Among others, see Hanushek and Yilmaz (2007) show how fiscal federalism would change the locational choices of economic agents and hence the equilibrium rent gradient.

of population, an obvious solution is to build high-rise buildings[4]. Unlike detached houses in United States, which may take several months to complete, it is normal to spend more than three years to complete a residential project in Hong Kong. Starting from land auction[5], to site investigation and foundation, and finally superstructure and completion[6], it requires huge amount of human resources and capital. That may create an implicit barrier for other firms to enter. Table 1 shows that the market capitalization of the four main developers ranges from HK$75 billion to HK$367 billion.

[Figures 2 and 3 are about here]

While the population density clearly contributes to the market structure of the primary market, there may be other economic factors for this phenomenon as well. Therefore, to identify the potentially independent effect from the market structure of the primary market to the housing price, we need to proceed in several steps. First, we need to measure the "competitiveness" of the primary market. Fortunately, there are many related studies in the Industrial Organization literature. For simplicity and compatibility with the literature, we adopt the Herfindahl Index as a measure of "industrial concentration".[7] Recently, Beck et al (2012) also use the Herfindahl Index to measure the degree of concentration in the real estate brokerage industry across different cities in the U.S.

Another merit of the Herfindahl Index is that it is easy to calculate. In fact, we can compute the Herfindahl Index for each period and this enables us to examine the *dynamic interactions* among the Herfindahl Index, other indicators of the housing market (such as the housing price index), macroeconomic variables of Hong Kong, and other variables that are exogenous to Hong Kong. This is the second step of our investigation. Needless to say, there are some econometric issues on which variables to select, and how those variables enter into the "final regression model" with the Herfindahl Index. We will provide more details in a later section.

[4] In United States, condominium developers compete with multifamily counterparts for a piece of land [Cypher and Hayunga (2010)]. However, it usually occurs in Hong Kong that the developers compete a piece of land through an auction, and then build condominiums on it.

[5] Ching and Fu (2003) show that the Hong Kong land market is imperfectly contestable.

[6] In the multi-stage construction process, Spiegel (2001) shows that developers acquire land when expected housing returns lie above the rate of interest, and develop when housing returns lie below.

[7] Clearly, it is beyond the scope of this paper to review the literature. Among others, see Djolov (2013) and the reference therein.

The construction of market share then allows us to further compute the Herfindahl Index, which is widely used in the literature of industry organization. It captures the amount of competition within a sector or market. In general, an increase of index suggests an increase of market power and a lower market competition level. In our paper, it is defined as the sum of the squares of the market shares of 26 real developers in Hong Kong and ranges between 0 and 1. Our paper will show that the shocks of macroeconomic variables have impact on Herfindahl Index.

The rest of the paper is organized as follows. It first provides a general picture of the major real estate developers in Hong Kong. Next, by using principal component analysis, we show that there is a feedback relationship between developers' real stock prices and real housing price. Then, through constructing the Herfindahl Index, we apply vector error correction model and perform variance decompositions and impulse response analysis. Implications will be made at the end of the paper.

2. More Background Information about Hong Kong and the Major Developers

The four main developers[8] in Hong Kong are Cheung Kong Holdings (CKH), Sun Hung Kai Properties (SHK), Henderson Land Development (HEN) and New World Development (NWD). These companies have sustainable business activities for a long time, and their market capitalizations rank within the top 10 developers [Table 1]. Since 2003, even though the economy experienced peaks and troughs[9], their profit rates are stayed between 5% and 10% per year [Figure 4]. At the same time, the developers could take an advantage to arrange cheaper loans with their relationship banks [Euroweek (2013)], but they (except NWD) are taking at a low risk position, where their leverage ratios are less 40% in recent years [Figure 5].

Concerning the revenue decomposition, Figure 6 shows that the revenues for CKH, SHK and HEN are mainly came from the business located in Hong Kong, while the revenue of NWD comes from both Hong Kong and Mainland China[10]. On the other hand, according to Figure 7, these developers have significant businesses related to real estate, including property sales, property rental and hotel operation. Hence, it is natural for us to conjecture that the

[8] Our paper studies other 6 developers as well. Readers who are interested can refer to Appendix 1.

[9] Among others, see Leung and Tang (2012) for the performance of Hong Kong real estate markets under Asian Financial Crisis and Global Financial Crisis.

[10] The data for earlier years is not available, because less than 10% of the revenue generated outside Hong Kong is not required to be shown in the annual reports.

performance of housing market would have a significant effect on the developers' stock prices. In addition, we are interested to determine whether the developers influence the local housing market through its market power, so that their stock prices can be maximized[11]. This feedback effect between stock prices and housing prices will then be investigated in the next section.

[Figures 4, 5 and 6 are about here]

3. Granger causality

Before any statistical analysis, the prices are first turned into real terms by deflating them with the consumer price index (A). Next, since the correlations between real developers' stock prices are significant and highly correlated [Table 2], Leung et al (2006) suggest constructing principal components. Table 4 shows that, the first principal component, which is mainly composed of the developers' stock prices with a positive weight [Table 3], explains most of the variation, and hence it is chosen in the coming analysis.

[Tables 2, 3 and 4 are about here]

Since correlation does not imply any causation, it is necessary to consider Granger causality[12] analysis. It studies how much of the current dependent variable (y) is explained by its lagged values and to determine whether adding lagged values of x can improve the explanation. Typically, the mathematical form is:

$$y_t = \alpha_0 + \sum_{i=1}^{l} \alpha_i y_{t-i} + \sum_{i=1}^{l} \beta_i x_{t-i} + u_t$$

where l is the lag length. The null hypothesis (H_0: $\beta_1 = \beta_2 = \cdots = \beta_l$) is that x does not granger cause y. In our analysis, since the data is monthly, we choose the lag length(s) to be 1, 2, 3, 4, 8

[11] For the behavior and price strategy of developer, refer to Henderson and Thisse (1999), Lai and Wang (1999), Tse, Hui and Chan (2001), Gillen and Fisher (2002), Lai, Wang, Zhou (2004) and Mukhija (2004).
[12] See Leung et al (2006) and Leung and Tang (forthcoming for details).

and 12. Obviously, from Table 5, the results suggest a feedback relationship between real housing price and principal component of stock prices[13]. In order words, we find strong evidence that the developers' stock price (included in principal component) granger causes the real housing price, and real housing price granger causes developers' stock price. Intuitively, the developers have significant businesses related to housing, and hence the movements on housing market would have significant impact on stock prices. In addition, it suggests that the developers have market powers on real estate businesses, and hence changes of their stock prices could exert effect on real housing prices.

[Table 5 is about here]

4. Herfindahl Index

As we explained previously, there are several merits of the the Herfindahl Index, which are transparent once we define the index explicitly. Thus, it may be instructive to begin with some notations. Formally, the Herfindahl Index is given by the following simple formula, $H = \sum_{i=1}^{n} (s_i)^2$, where s_i is the market share of firm i, $i = 1,...,n$, and n is the total number of firms in the industry. By definition, the market share of each firm is in between zero and unity, $0 \le s_i \le 1$, and they sum up to unity $\sum_{i=1}^{n} s_i = 1$. As $0 \le s_i \le 1$, $0 \le (s_i)^2 \le s_i \le 1$. It follows that the Herfindahl Index naturally falls between zero and unity. In fact, in the case of a monopoly, the market shares of other firms are zero and the Herfindahl Index becomes unity. If all firms in the industry have the same size, $s_i = s_1 = 1/n$ for all i, the Herfindahl Index becomes the reciprocal of n, $H = 1/n$.

In the case of Hong Kong, market share information is not provided in the official statistics. We therefore focus on the 26 listed developers, which are bounded by the law to provide annual reports to public.

[13] Similar results are obtained for the other six developers. Details will be available upon request.

Since the information on market share is available to the 4 main developers only, we assume that the remaining of market is equally shared among 22 developers. As Figure 8 shows, before 2003, the index is staying below 25%, which indicates the primary housing market is competitive. However, since 2004, the index occasionally reaches 30% or above. In some extreme cases, the index rises up to 70%. These facts suggest the primary housing market is changing from a competitive one to a concentrated one.

After constructing Herfindahl Index, the next step is to use vector error correction model (VECM) to study the inter-relationships between macroeconomic variables and Herfindahl Index. For a set of eight I(1) variables under consideration [Table 6], the VECM model can be written as:

$$\Delta y_t = \Pi y_{t-k} + \tau_1 \Delta y_{t-1} + \tau_2 \Delta y_{t-2} + \cdots + \tau_{k-1} \Delta y_{t-(k-1)} + u_t$$

where $\Pi = (\sum_{i=1}^{k} \beta_i) - I_8 \; and \; \tau_i = (\sum_{j=1}^{i} \beta_j) - I_8$. Π is a long-run coefficient matrix, and the test for cointegration between the macroeconomic variables is calculated by looking at the rank of the matrix via its eigenvalues, where the rank is equal to the number of its characteristic roots that are different from zero [Brooks (2008)].

[Table 6 is about here]

By using the Johansen Cointegration Test, it is found that all specifications suggest that there are at least two cointegration equations. In addition, the AIC criterion suggests using a lag length of three[14]. In Table 7, it shows that results of the error correction model. Notice that in the equation of differenced Herfindahl Index, the two cointegrating equations are all 1% significant. However, for the differenced macroeconomic variables, they are all insignificant to explain differenced Herfindahl Index, suggesting the lack of short-run relationship.

[14] Details will be available upon request.

On the other hand, it is worth interpreting the equation of differenced TM. First, there exists a long-run relationship because the co-integrating equations are significant. Second, the coefficient of a lag of the differenced TM is negative and significant. When the share of primary transaction increases currently, the stock of new houses reduces. Hence, there will be fewer new houses for sale next period and TM will drop. Finally, the lagged differenced Herfindahl Index is found to be positive and significant. This is an interesting result in a sense that when the Herfindahl Index increased in the last period, it indicates the primary housing market is more concentrated. The increased market power of developers would encourage them to supply more new housing in the current period, which in turn motivates the transactions in primary market and results to a positive change in TM.

[Table 7 is about here]

Next, we are interested to determine how much of the *s*-step-ahead forecast error variance of Herfindahl Index is explained by innovations to each macroeconomic variables, for *s* = 1, 2, 3, 4, 8, 12. In using variance decompositions, the ordering of the variables is important. Hence, our paper applies two different orders, where they are exactly opposite to another. For order I, it is clear that by the 3-year forecasting horizon, the shocks of Herfindahl Index accounts for more than 60% of its own variation. However, when order II is used, the shocks of Herfindahl Index only accounts for 35% for its own variation. On the other hand, the shocks from TM and RBL are getting important in explaining the variation of Herfindahl Index. Their innovations account for 20% and 19% respectively for the Herfindahl Index variation. In fact, from an investor point of view, these two macroeconomic variables denote the relative attractiveness of primary housing market, and hence their innovations can bring a change in developers' strategies and directly affect the variation of Herfindahl Index.

[Table 8 is about here]

At last, we study the impulse responses for Herfindahl Index with separate one standard deviation shocks to TM and RBL. From Figure 9A, it is clear that the innovations in TM always have a negative impact on the Herfindahl Index, and the effect does not die down after 12 quarters. The positive shock of the attractiveness of primary housing market would motivate the sale of new houses among existing developers, and hence the Herfindahl Index drops. The

shocks of RBL can bring two effects. To the reputable developers, the ease of bank loans allows them to build and supply more new housing, which leads to a rise of Herfindahl Index. On the other side, the potential buyers can obtain more housing loans and participate actively in the primary housing market. It results to a higher attractiveness of the primary market and hence lowers the Herfindahl Index. As a whole, the effect of the former dominates, and figure 9B shows that it generates a positive impact on the Herfindahl Index for the first 8 quarters.

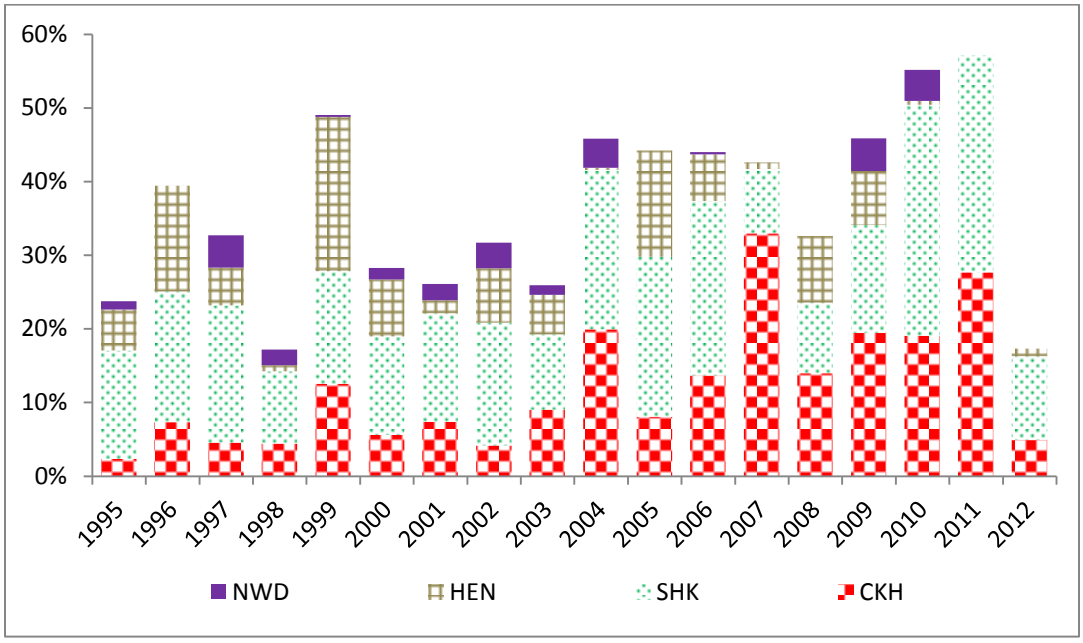
[Figure 9 is about here]

Conclusion

This paper takes a preliminary step in studying the oligopolistic structure of primary housing market. Based on the gross floor area built the developers, we construct a relatively objective measure of market share. It is found that the four main developers could take more than half of market share in some periods. Then, we follow conventional method to produce Herfindahl Index. Typically, we find that the primary market is highly competitive in earlier years. However, since 2004, the index sometimes takes a value of 0.25 or above. In some extreme cases, the index may be taken up to 0.7. All these facts suggest the primary housing market is turning from a competitive one to a concentrated one. Next, we formulate vector error correction models to study the relationships between Herfindahl Index and macroeconomic variables. For example, we find that in the differenced Herfindahl index equation, the long-run relationship is significant but the short-run relationship is not. The analysis then comes to variance decomposition. The variation in Herfindahl Index is mainly explained by its own shock, and the shocks from TM and RBL. Finally, through the impulse response analysis, the paper finds that the innovations of TM will bring a negative response to Herfindahl Index, while the innovations of RBL will bring a positive impact to Herfindahl Index.

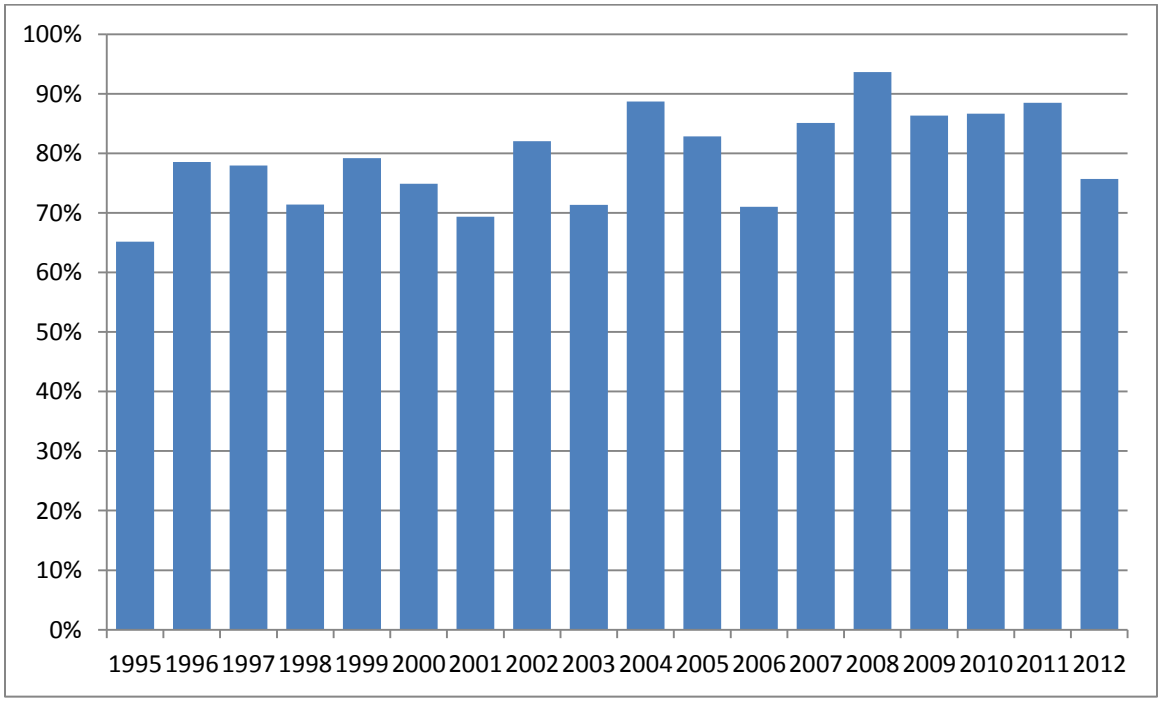
Given the existence of oligopolistic structure in Hong Kong primary housing market, it has important implications regarding the behavior of developers. For examples, will the developers compromise the schedule of new home sales? Will the developers exercise their market power and jointly push the selling prices up? Will the developers collude in the land auction process? Clearly, it requires a richer dataset, and should leave for further research.

Figure 1a Market Share of the Four Major Real Estate Developers in Hong Kong



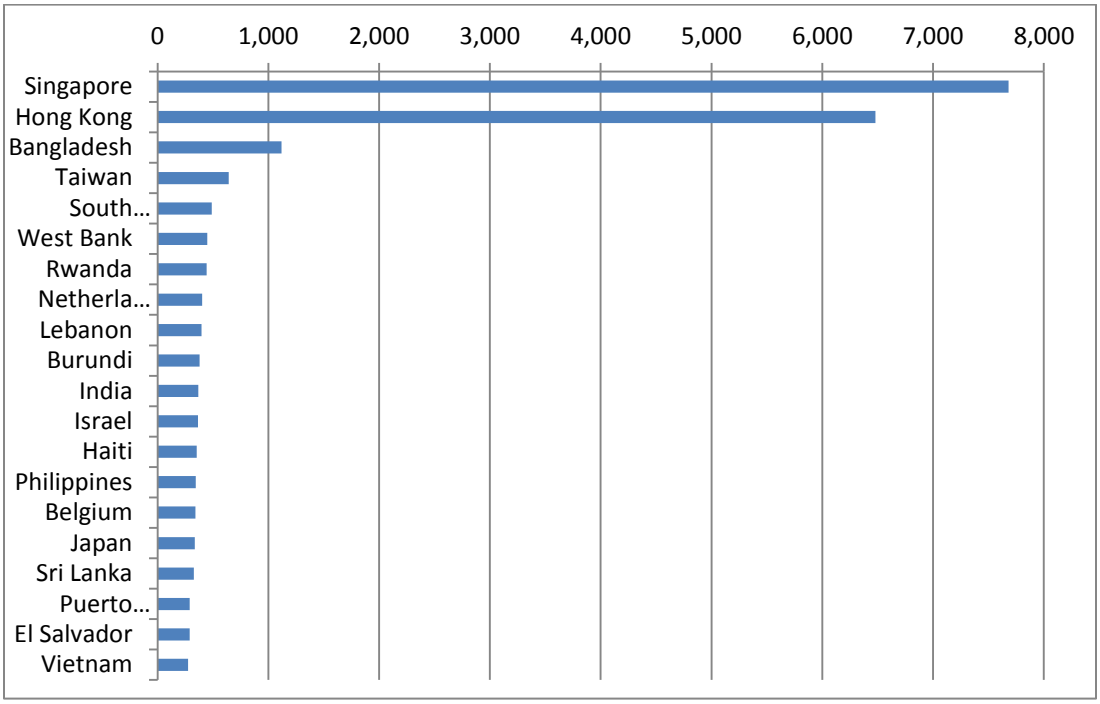
Sources: Hong Kong Exchanges and Clearing Limited, Buildings Department

Figure 1b Market Share of the All Listed Real Estate Developers in Hong Kong



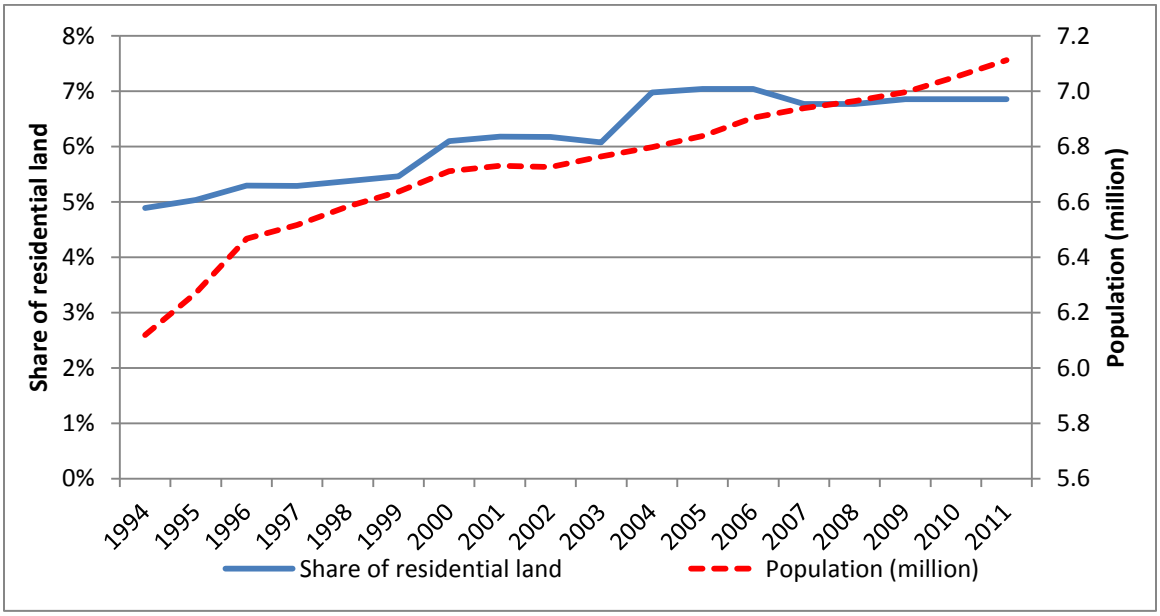
Sources: Hong Kong Exchanges and Clearing Limited, Buildings Department

Figure 2 Densities of the Countries (People per Square Kilometers of Land)



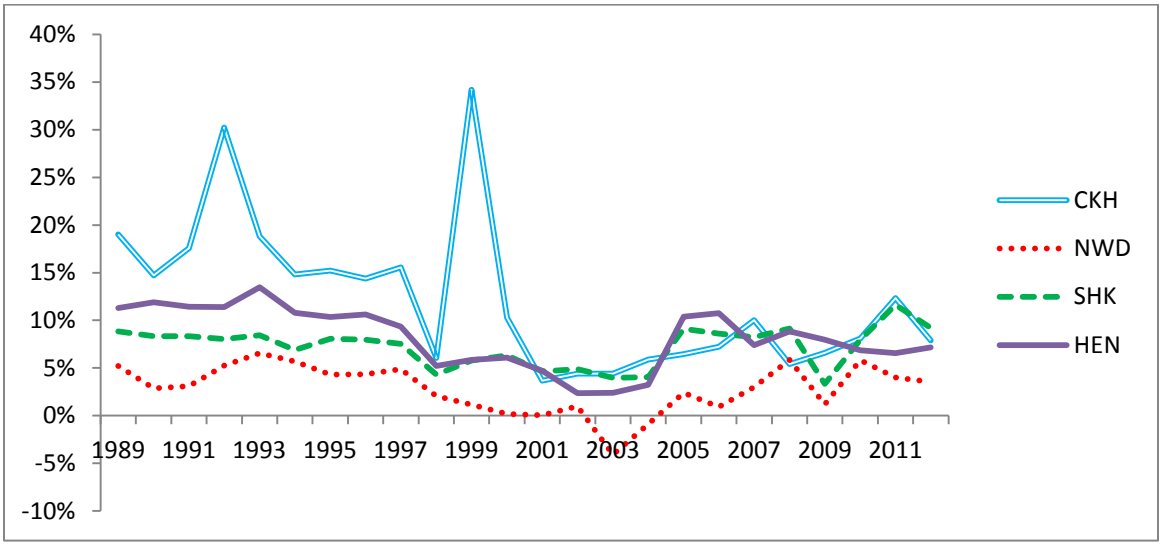
Source: CIA World Factbook (2012)

Figure 3 Share of Land Used for Residential Purpose and Population



Source: Census and Statistics Department

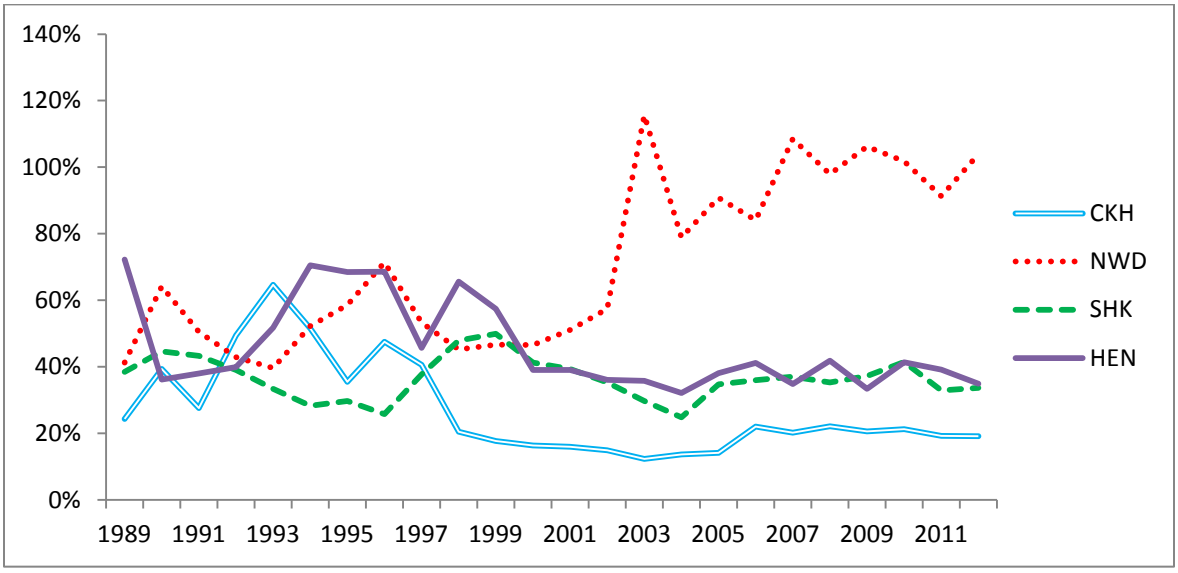
Figure 4 Profit Rate of Developers



Note: The accounting period for CKH and HEN ends at 31 December; while the accounting period for SHK and NWD ends at 30 June.

Source: Annual Reports of Developers

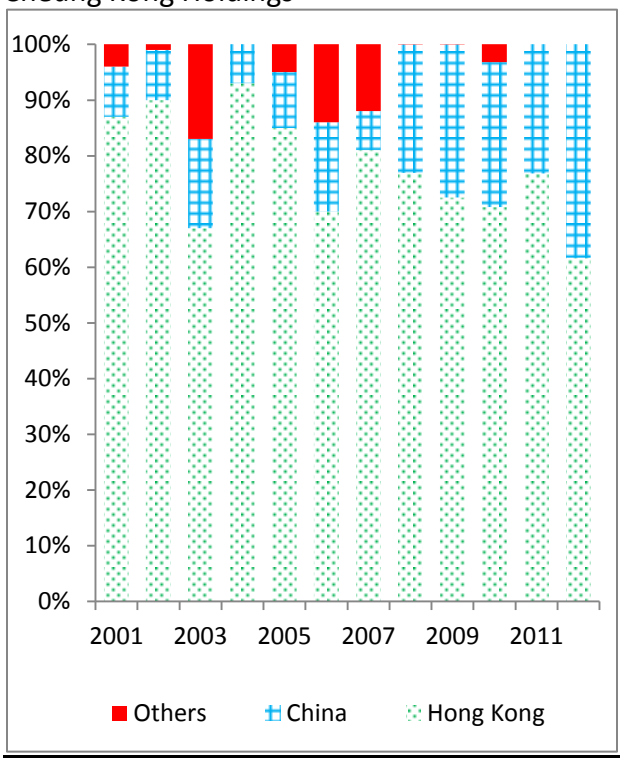
Figure 5 Leverage ratio of Developers



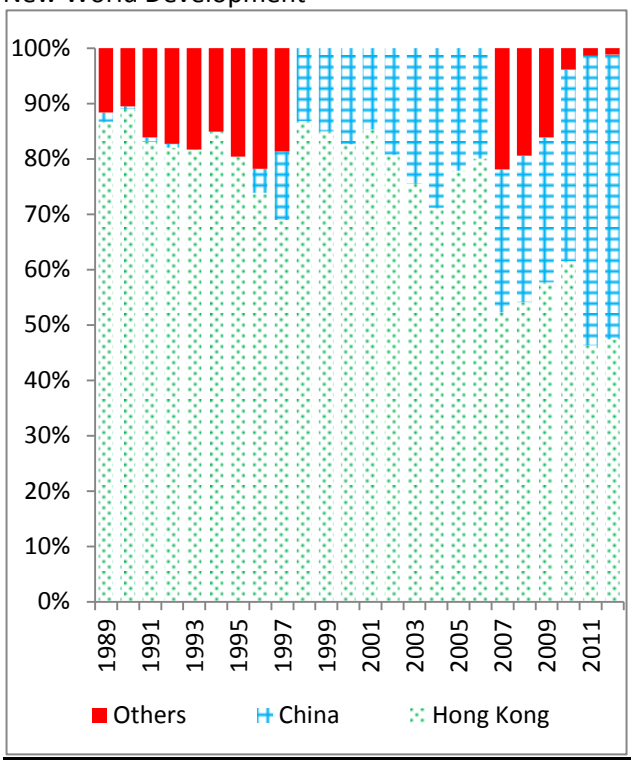
Source: Annual Reports of Developers

Figure 6 Geographical Revenue Decomposition

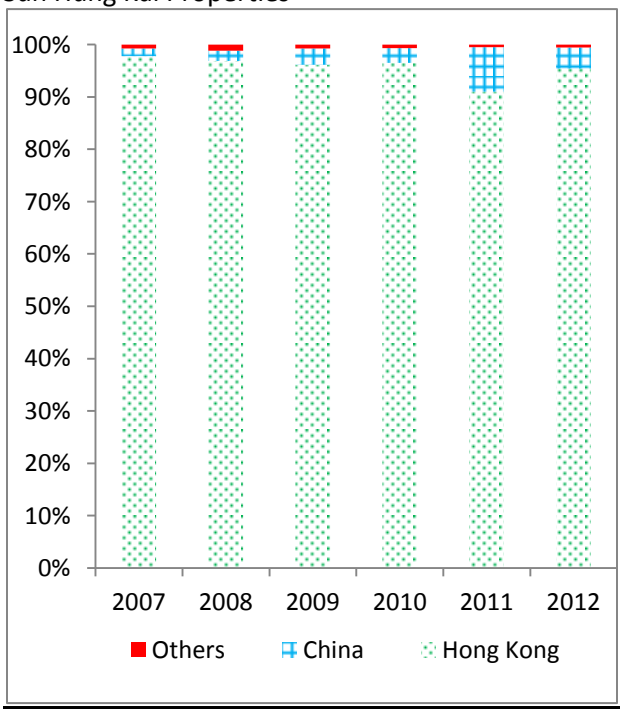
Cheung Kong Holdings



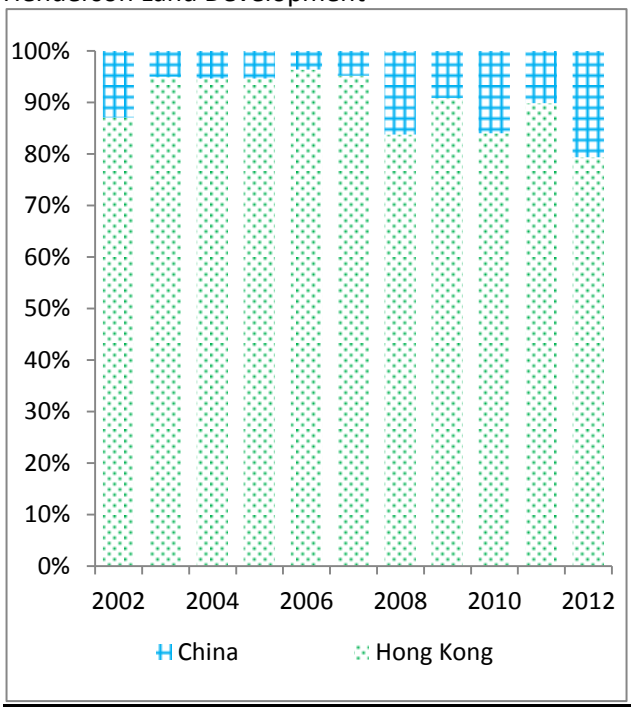
New World Development



Sun Hung Kai Properties



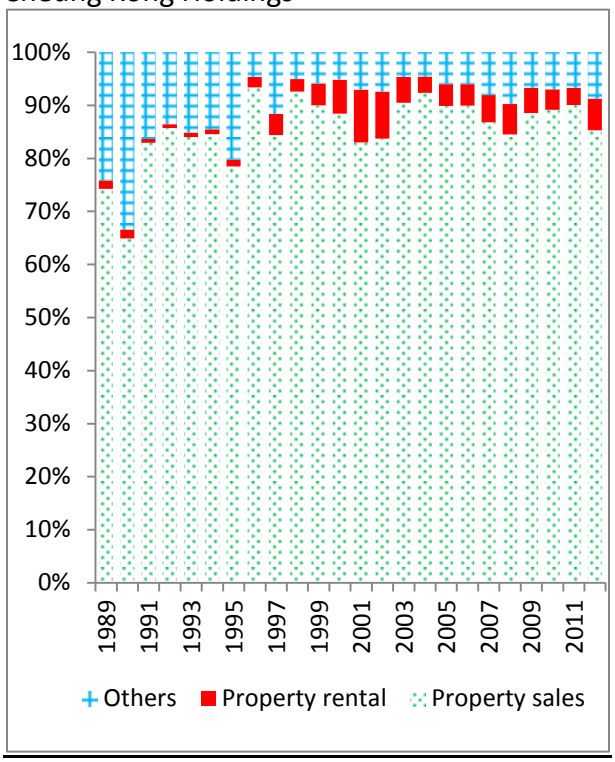
Henderson Land Development



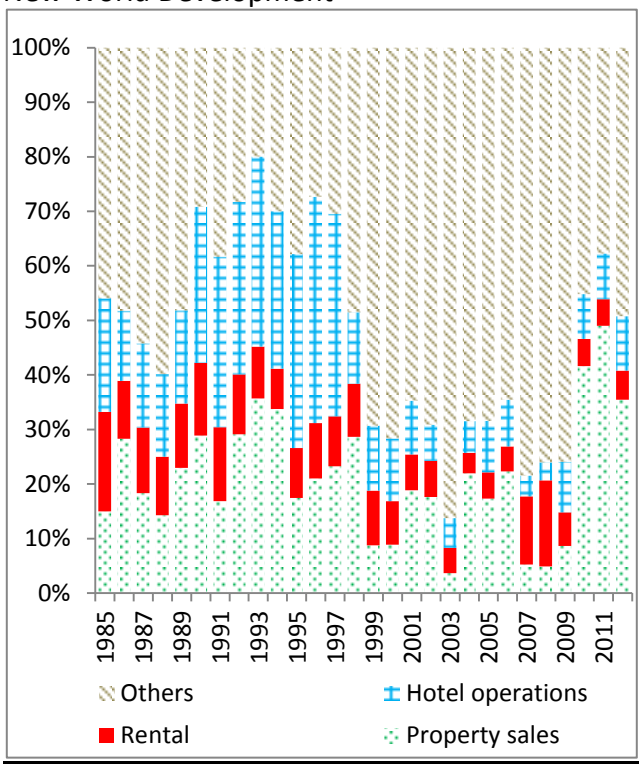
Source: Annual Reports of Developers

Figure 7 Functional Turnover Decomposition

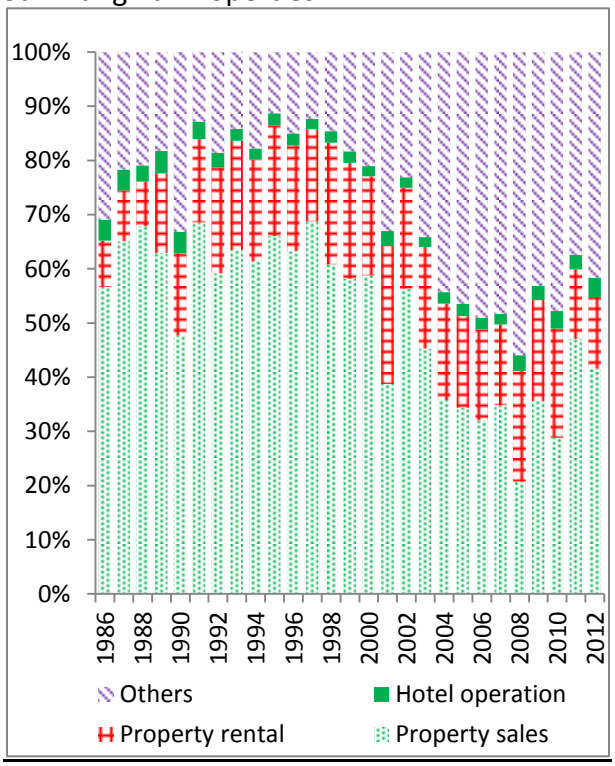
Cheung Kong Holdings



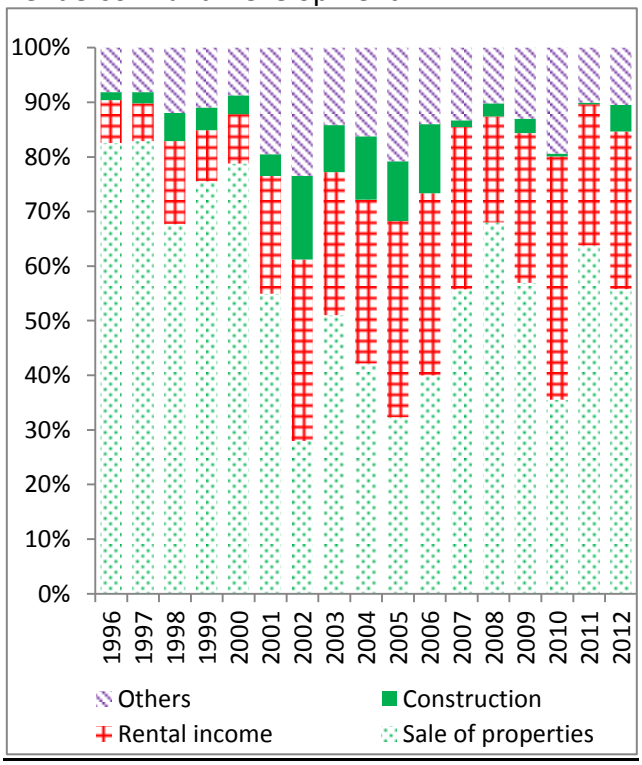
New World Development



Sun Hung Kai Properties

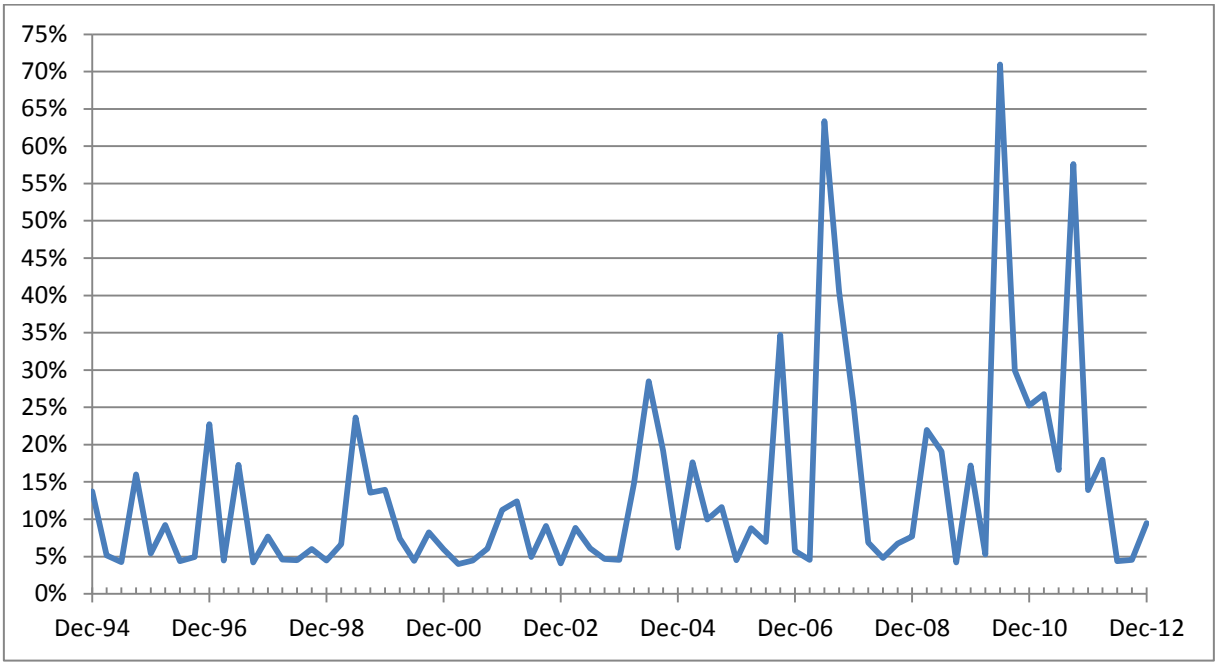


Henderson Land Development



Source: Annual Reports of Developers

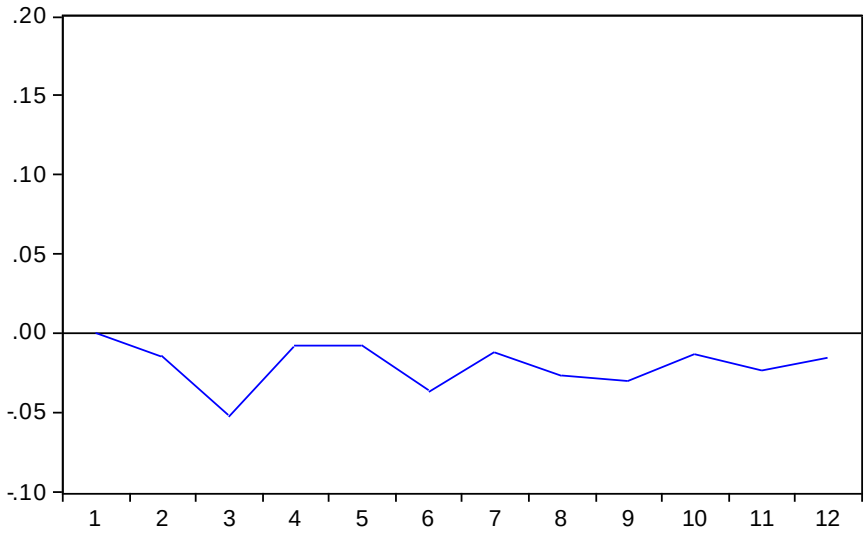
Figure 8 Herfindahl Index



Source: Authors' Calculations

Figure 9 Impulse Response of Herfindahl Index

A. Innovations in TM



B. Innovations in RBL

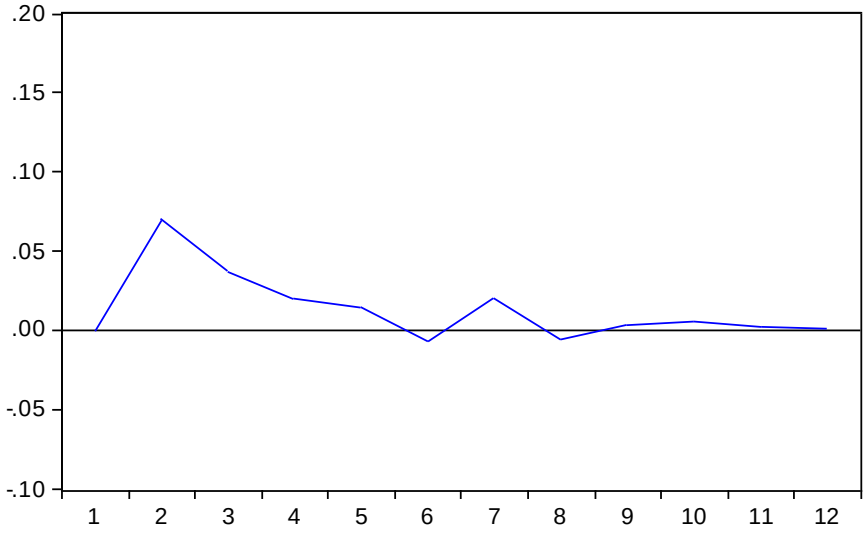


Table 1 Listed Property Developers

Property Developers	Abbreviations	Stock Code	Market Capitalization [15](HKD)
Sun Hung Kai Properties Limited *	SHK	0016	367,629,050,221
Hutchison Whampoa Property ^	HUT	0013	347,251,550,031
Cheung Kong (Holdings) Limited *	CH	0001	245,050,186,960
Wharf Holdings Limited ^	WH	0004	212,686,858,355
China Overseas Land and Investment Ltd.	COL	0688	186,744,279,530
Henderson Land Development Company Limited *	HEN	0012	127,503,688,224
Hang Lung Properties Limited ^	HL	0101	122,925,410,885
Swire Pacific A	SW	0019	84,988,542,225
New World Development *	NWD	0017	75,612,975,128
Sino Land ^	SINO	0083	68,518,936,800
China Resources	CR	0291	61,265,206,560
Kerry Properties Limited	KP	0683	44,348,403,422
Hysan Development Company Limited ^	HYS	0014	35,790,915,397
Chinese Estates Holdings Limited	CEH	0127	25,562,095,659
New World China Land Limited	NWCL	0917	24,950,598,742
Hopewell Holdings Limited ^	HOPE	0054	23,366,038,311
Shun Tak Holdings Limited	STH	0242	12,407,086,177
K. Wah International	KW	0173	10,344,401,121
Emperor International	EMP	0163	8,690,256,575
Lai Sun Development	LSD	0488	4,694,717,029
Tai Cheung Holdings Limited	TCH	0088	3,865,745,721
SEA Holdings	SEA	0251	3,171,706,547
Y. T. Realty	YTR	0075	1,958,915,667
Chuang's Consortium International Ltd.	CCI	0367	1,781,383,563
Asia Standard International	ASI	0129	1,781,068,108
Tai Sang Land Development	TSLD	0089	1,035,610,834

Note: The developers marked with * and ^ are referred as "Top 4 developers" and "Other 6 developers" respectively.

Source: Bloomberg

[15] The values are obtained from Hong Kong Exchanges and Clearing Limited, as at 6 June 2013.

Table 2 Correlations among developers' stock

(1983Q1 – 2013Q1)

	CH	HEN	NWD	SHK
CH	1			
HEN	0.761***	1		
NWD	0.622***	0.841***	1	
SHK	0.870***	0.916***	0.768***	1

Key: CKH = Cheung Kong (Holdings) Limited; HEN = Henderson Land Development Company Limited; SHK = Sun Hung Kai Properties Limited; NWD = New World Development

Note: The cyclical components are used. *** denotes 1% significance.

Table 3 Explanatory Power of Principal Components

	Proportion explained
PC1	**84.90%**
PC2	10.09%
PC3	3.63%
PC4	1.39%

Table 4 Principal Components

	PC 1	PC 2	PC 3	PC 4
CH	**0.479**	-0.672	0.491	0.280
HEN	**0.519**	0.188	-0.587	0.592
NWD	**0.475**	0.689	0.538	-0.102
SHK	**0.525**	-0.197	-0.354	-0.749

Table 5 Granger Causality between PC1 and Real Housing Price (F-statistics)

	PC1 does not granger cause Real Housing Price	Real Housing Price does not granger cause PC1
Lag = 1	25.96 ***	9.287 ***
Lag = 2	5.972 ***	5.864 ***
Lag = 3	3.639 **	5.527 ***
Lag = 4	2.718 **	4.174 ***
Lag = 8	4.748 ***	3.033 ***
Lag = 12	3.859 ***	1.782 *

Table 6 Unit Root Test for Key Macroeconomic Variables

Sampling period: 1994Q4 – 2012Q4

	Abbreviation	Level (constant and trend)	1st Difference (constant)
Herfindahl index	HI	-7.323 ***	-7.663 ***
Real housing price index	RHP	-0.317	-5.106 ***
Share of primary market transaction number to the total	TM	-2.200	-12.248 ***
Real GDP	RGDP	-1.774	-5.269 ***
Real interest rate	RI	-2.298	-7.912 ***
Real stock price	RSP	-3.218 *	-7.261 ***
New private housing supply	HS	-7.006 ***	-9.966 ***
Annual growth in real bank loans	RBL	-4.448 ***	-5.901 ***

The optimum lag is determined by AIC criteria at a maximum lag of 8 quarters.

*** significant at 1% level; ** significant at 5% level; * significant at 10% level

Note: data for the share of primary market transaction number (or value) is only available since 1995Q3.

Table 7 Vector Error Correction Model

Vector Error Correction Model:

	D(HI)	D(RHP)	D(TM)	D(RGDP)	D(RI)	D(RSP)	D(HS)	D(RBL)
Cointegrating Equation 1	-1.224 ***	-0.102	-0.518 ***	-179.514	-0.015	55.945	8246.696	0.025
Cointegrating Equation 2	0.232 ***	-0.014	0.112 ***	46.703	-0.015 **	-9.474	-2006.957	-0.049 ***
D(HI)(-1)	0.352	0.121	0.445 ***	319.108	0.034	30.288	-6166.779	0.036
D(HI)(-2)	0.408	0.075	0.236	182.294	-0.015	32.289	-1187.426	-0.005
D(HI)(-3)	0.291	0.012	0.110	74.153	-0.016	17.339	1516.769	0.016
D(RHP)(-1)	-0.347	0.538 ***	-0.267	96.575	-0.085 ***	70.871	5613.341	-0.044
D(RHP)(-2)	-0.573	-0.245	-0.224	206.751	0.018	9.549	3080.100	-0.008
D(RHP)(-3)	-0.663	-0.219	-0.242	-323.737	-0.041	-33.100	9042.063	-0.236 ***
D(TM)(-1)	0.126	0.026	-0.497 ***	-302.131	-0.014	-13.831	-280.851	-0.106
D(TM)(-2)	-0.302	-0.214	-0.060	-404.583	-0.019	-78.829	6724.184	-0.082
D(TM)(-3)	-0.021	-0.057	0.045	-29.373	0.027	-48.273	3541.028	0.108
D(RGDP)(-1)	$-1.48*10^{-4}$	$-1.17*10^{-4}$	$-4.11*10^{-6}$	-0.723 ***	$6.20*10^{-6}$	-0.036	-3.997	$7.80*10^{-5}$ **
D(RGDP)(-2)	$-8.68*10^{-6}$	$9.52*10^{-5}$	$-3.10*10^{-5}$	-0.906 ***	$-8.33*10^{-7}$	0.013	-3.799 **	$7.93*10^{-6}$
D(RGDP)(-3)	$-7.61*10^{-5}$	$-1.90*10^{-5}$	$-7.62*10^{-5}$	-0.740 ***	$8.49*10^{-6}$	-0.021	-5.049	$7.10*10^{-5}$ **
D(RI)(-1)	-1.706	-1.479	-0.853	-450.089	0.594 ***	332.957	24095.840	0.683
D(RI)(-2)	-2.928	1.125	-1.328	-953.559	-0.107	470.300	39891.350	-0.608
D(RI)(-3)	1.291	-1.142	0.273	-460.144	0.036	266.108	76936.820 **	0.029
D(RSP)(-1)	$-8.20*10^{-4}$	0.002 **	$-4.70*10^{-4}$	2.338 **	$5.39*10^{-5}$	-0.078	-66.516 ***	$2.71*10^{-4}$
D(RSP)(-2)	0.001	$-8.20*10^{-5}$	$6.09*10^{-5}$	0.731	$-8.90*10^{-5}$	-0.114	-6.989	$5.71*10^{-6}$
D(RSP)(-3)	$6.80*10^{-4}$	$-3.22*10^{-4}$	$1.70*10^{-4}$	2.139 **	$-1.14*10^{-4}$	0.109	7.211	$2.80*10^{-4}$
D(HS)(-1)	$-4.34*10^{-6}$	$8.50*10^{-9}$	$7.63*10^{-7}$	-0.021 ***	$-2.06*10^{-6}$ ***	-0.001	-0.713 ***	$-5.445*10^{-6}$ ***
D(HS)(-2)	$-3.33*10^{-6}$	$-6.88*10^{-6}$	$-1.99*10^{-6}$	-0.010	$-8.39*10^{-7}$	-0.002	-0.673 ***	$-1.72*10^{-6}$
D(HS)(-3)	$-2.68*10^{-6}$	$-2.07*10^{-6}$	$3.10*10^{-7}$	-0.013	$-2.66*10^{-7}$	$-1.55*10^{-4}$	-0.428 ***	$-4.45*10^{-6}$ **
D(RBL)(-1)	1.317	0.382	-0.311	-186.245	-0.016	38.540	18387.460	0.348 ***
D(RBL)(-2)	0.226	0.021	-0.001	738.784	0.213 ***	-117.097	14193.920	0.571 ***
D(RBL)(-3)	-1.136	0.354	0.015	385.584	0.193 ***	22.525	-576.488	0.235
Constant	0.020	0.009	0.011	66.622 ***	0.001	1.476	74.342	-0.001
Adjusted R^2	0.410	0.354	0.105	0.852	0.496	0.325	0.470	0.543

*** significant at 1% level; ** significant at 5% level

Cointegrating equations:

	Cointegrating Equation 1	Cointegrating Equation 2
HI(-1)	1.000000	0.000000
RHP(-1)	0.000000	1.000000
TM(-1)	0.324013	0.375248
RGDP(-1)	$-2.95*10^{-5}$	-0.000433
RI(-1)	5.853507***	33.70241***
RSP(-1)	-0.001577	-0.007872
HS(-1)	$-8.91*10^{-6}$	$-8.01*10^{-6}$
RBL(-1)	1.447314***	12.49407***
Constant	-0.158781	-0.362721

*** significant at 1% level; ** significant at 5% level

Table 8 Variance Decompositions for the Herfindahl Index

Months ahead	Explained by innovation in															
	HI		RHP		TM		RGDP		RI		RSP		HS		RBL	
	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	100.0	74.7	0.0	6.4	0.0	7.8	0.0	1.2	0.0	5.3	0.0	1.0	0.0	0.3	0.0	3.4
2	83.8	58.4	1.2	5.4	1.0	7.1	0.0	3.0	0.0	6.4	0.9	3.5	0.0	0.3	13.0	16.0
3	71.2	44.3	0.9	7.9	4.7	11.8	2.2	2.8	2.8	9.3	5.1	2.6	0.8	0.3	12.4	20.9
4	68.6	41.0	1.7	9.1	4.3	10.8	2.0	3.5	2.9	10.6	7.3	2.6	1.3	0.8	11.9	21.6
8	65.5	37.4	2.0	8.2	5.1	16.0	3.3	3.4	2.3	9.8	9.8	2.9	2.0	1.4	10.1	21.0
12	62.4	35.0	4.3	7.4	6.4	20.0	3.1	3.5	2.3	10.4	10.3	2.9	2.2	1.9	8.9	19.2

Order I: HI, RHP, TM, RGDP, RI, RSP, HS, RBL

Order II: RBL, HS, RSP, RI, RGDP, TM, RHP, HI

Reference

Adams, D., C. Leishman and C. Watkins (2012). Housebuilder Networks and Residential Land Markets. Urban Studies, 49(4), 705-720.

Ambrose, B. W. and J. Peek (2008). Credit Availability and the Structure of the Homebuilding Industry. Real Estate Economics, 36(4), 659-692.

Arnott, R. and D. McMillen (2007). A Companion to Urban Economics, New York: Wiley-Blackwell.

Beck, J., F. Scott and A. Yelowitz (2012). Concentration and Market Structure in Local Real Estate Markets. Real Estate Economics, 40(3), 422-460.

Brooks, C. (2008). Introductory Econometrics for Finance. 2nd ed., Cambridge University Press.

Chen, J., S. Esteban and M. Shum (2013), When Do Secondary Markets Harm Firms? American Economic Review, 103(7), 2911-2934.

Ching, S. and Y. Fu (2003). Contestability of the Urban Land Market: An Event Study of Hong Kong Land Auctions. Regional Science and Urban Economics, 33(6), 695-720.

Coase, Ronald (1972). Durability and Monopoly. Journal of Law and Economics, 15(1), 143–49.

Cypher, M. L., and D. K. Hayunga (2010). Market Competition for High-Density Residential Land. International Journal of Strategic Property Management, 14(1), 19-34.

Djolov, G. (2013). The Herfindahl-Hirschman Index as a Decision Guide to Business Concentration: A Statistical Exploration. Journal of Economic & Social Measurement, 38(3), 201-227.

Euroweek (2013), HK Property Companies Tap Banks for Clubs. Issue 1325, 81-82.

Gillen, M. and P. Fisher (2002). Residential Developer Behaviour in Land Price Determination. Journal of Property Research, 19(1), 39-59.

Glaeser, E. and J. Gyourko (2008). Rethinking Federal Housing Policy: How to Make Housing Plentiful and Affordable. Washington, D.C.: American Enterprise Institute.

Glaeser, E., J. Gyourko and R. Saks (2005). Why is Manhattan so Expensive? Regulation and the Rise in Housing Prices. Journal of Law and Economics, 48(2), 331-369.

Hanushek, E., Yilmaz, K., (2007). The complementarity of Tiebout and Alonso, Journal of Housing Economics, 16(2), 243-261.

Henderson, J. V. and J. Thisse (1999). On the Pricing Strategy of a Land Developer. Journal of Urban Economics, 45(1), 1-16.

Lai, N. and K. Wang (1999). Land-Supply Restrictions, Developer Strategies and Housing Policies: The Case in Hong Kong. International Real Estate Review, 2(1), 143-159.

Lai, N., K. Wang and Y. Zhou (2004). Sale before Completion of Development: Pricing and Strategy. Real Estate Economics, 32(2), 329-357.

Leung, C. K. Y., Y. C. F. Leong and K. S. K. Wong (2006). Housing Price Dispersion: An Empirical Investigation. Journal of Real Estate Finance and Economics, 32, 357-385.

Leung, C. K. Y. and E. C. H. Tang (2012). Comparing Two Financial Crisis: The Case of Hong Kong Housing Markets, in Global Housing Markets: Crises, Policies and Institutions, eds. by A. Bardhan, R. Edelstein and C. Kroll, New York: John Wiley & Sons.

Leung, C. K. Y. and E. C. H. Tang (forthcoming). Speculating China Economic Growth Through Hong Kong? Evidence from the Stock Market IPO and Real Estate Markets, International Real Estate Review.

Marshall, R. C. and L. M. Marx (2012). The Economics of Collusion., Cambridge: MIT Press.

McDonald, J. and D. McMillen (2007). Urban Economics and Real Estate: Theory and Policy, 2nd ed., New York: John Wiley & Sons.

Mukhija, V. (2004). The Contradictions in Enabling Private Developers of Affordable Housing: A Cautionary Case from Ahmedabad, India. Urban Studies, 41(11), 2231-2244.

O'Sullivan, A., (2007). Urban Economics, 6th ed., New York: McGraw Hill.

Somerville, C. T. (1999). The Industrial Organization of housing Supply: Market Activity, Land Supply and the Size of Homebuilder Firms. Real Estate Economics, 27(4), 669-694.

Spiegel, M. (2001). Housing Return and construction Cycles. Real Estate Economics, 29(4), 521-551.

Stein, J. (1995). Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects, Quarterly Journal of Economics, 110, 379-406.

Tse, R. Y. C., E. C. M. Hui, and C. H. K. Chan (2001). On the Competitive Land Market: Evidence from Hong Kong. Review of Urban & Regional Development Studies, 13(1), 46-61.

Waldman, D. and E. J. Jensen (2012). Industrial Organization: Theory and Practice, 4th ed., New York: Prentice Hall.

Appendix

The appendix will be provided upon request.