PATTERNS OF SUB-MARKET LEAD AND LAG IN HONG KONG HOUSING PRICES

RAYMOND Y. C. TSE
The Hong Kong Polytechnic University, Hong Kong

and

DOMINIQUE FISCHER
Curtin University of Technology, Australia

ABSTRACT

This study analyses estate-type housing prices in Hong Kong by investigating the lead-lag relationships between prices of small/medium and large estate-type residential units in urban areas and the New Territories. The results of this study suggest that house prices of small/medium units tend to lead prices of large units in urban areas, and house prices of large units in urban areas tend to lead prices of small/medium units in New Territories. There is evidence of a feedback effect between prices of small/medium and large units in urban areas, and between prices of large units in the urban and the New Territories.

Keywords: House prices, unit root test, causality, Hong Kong.

INTRODUCTION

Different specific sub-markets have populations that demand differing specific attributes, with small-scale landlords tending to be more willing than large-scale landlords to trade-off lower rents for higher occupancy rates and to induce tenants to stay longer. The large-unit market that faces larger adjustment costs for occupancy variations tends to have a greater reluctance to adjust occupancy levels to changing economic climates. Heterogeneity of the housing market also increases the dispersion in rents, making the housing market "thin". For instance, the large-unit market is always "thinner" than the small/medium one. It takes longer to fill vacant units, because there are fewer searchers per vacancy in the large-unit market (Tse and MacGregor, 1999).

This study argues that if housing markets are interdependent, disturbances in one sub-market will be transmitted to other markets. However, there have been few empirical studies of the lead-lag relationships between house prices in sub-markets. It is important to examine how the house prices between sub-markets interact, that leads to the equilibrium condition in the construction industry. Housing market segmentation is caused by a number of factors relating to the disequilibrium in the demand and supply of housing. Thus local housing markets will typically be characterised by functional disequilibrium and segmentation (Goodman, 1981; Adair *et al.*, 1996; Case and Mayer, 1996; Goodman and Thibodeau, 1998). The issue of concern in this study was whether the housing markets are segmented or interdependent.

Housing prices for all classes of private domestic flats in Hong Kong rose an average of 50 percent between 1992–94. The average price indices show a rise of 28 percent in 1993, with much of the increase chalked up in the second and third quarters. In certain popular districts and developments, much higher increases were noted (Property Review, 1994). For instance, prices in respect of the more popular estate-type developments increased by more than 60 percent. Whereas price increases in respect of small/medium-size flats moderated somewhat in 1993, steeper increases were seen in the large-size units. Following widespread public concern at the rapid rise in large-size residential property prices in 1993 and early 1994, it was argued that the "ripple effect" of price increases in large-size units had spread to small/medium-size flats. (South China Morning Post, 10 January 1997).

It might be expected that house price movements in urban areas in Hong Kong would be similar to those in the New Territories, and that the price of small/medium units relative to that of large units would be the same in both areas. During 1992–93 and 1996–97, Hong Kong residential house prices, especially the estate type housing units, increased rapidly. Some commentators argued that house prices of large units tend to lead house prices of small/medium units (*SCMP*, 10 January 1997). In view of the concern over spiralling prices, particularly in the large-size flats market, in 1995, the Hong Kong Government formed an inter-departmental group to collate information on and monitor the operation of the private residential property market.

This paper presents the results of a study to investigate the lead-lag relationships between prices of small/medium and large estate-type housing units in urban areas and the New Territories in Hong Kong. This paper concludes that the evidence does not support some of the popular assumptions about sub-market leads and lags.

REVIEW OF HONG KONG HOUSING MARKET

Hong Kong is situated on the south-eastern coast of Mainland China adjoining the Shenzhen Special Economic Zone. It has a total land area of 1,084 square kilometres covering Hong Kong Island, Kowloon Peninsula and the New Territories, which includes many islands, the largest of which is Lantau. About 80% of the land in Hong Kong is hilly and development costs are expensive. The remainder of the territory is mainly composed of uneven woodland and scrubland that is unsuitable for development. The built-up area constitutes around 5% (55 sq km) of all land for residential use. As a result, Hong Kong has always relied on reclamation as a source of land supply.

In pursuance of a free market economy, the Government's policy on housing development is to provide sufficient land, supporting infrastructure and a financial environment that induces private sector investment in property development. The distinguishing feature of Hong Kong's land tenure system is that all land is held leasehold from the government, while freehold titles are rarely granted. Terms of the existing leases can be extended to 2047. Holders of renewed leases or new leases will have to pay an annual rent of 3% of the rateable value of the properties. The government's basic policy in the land sales is to sell leases to the highest bidder at public auctions. Thus the government acts like a private land supplier, and attempts to maximise revenue from land sales (Tse, 1998). The supply of private housing comes mainly from new land, with a relatively small amount from redevelopment.

Because population densities in Hong Kong are among the greatest in the world, the government can best produce new housing by building taller blocks and reclaiming land from the sea. Development strategies have been used such as the Hong Kong government's New Towns initiative that moved people out of the central city cores, such as New Territories, so as to reduce population densities. At the other end of this spectrum is urban renewal that involves re-planning and rebuilding the old urban areas to maximize potential use of land resources. However, land use planning in Hong Kong has largely been effective in containing residential land uses and preventing urban sprawl. Major residential development has been confined to the clearly defined building envelopes of New Towns, rural townships and village settlements. A recent trend has been the spread of suburban type housing in certain areas zoned as Rural Development Areas, where comprehensive residential development schemes are permitted.

Table 1: Population density by District Board district in 1986 and 1996

District	Area (sq. km)	Population (1986)	Population (1996)	Population Density (1986)	Population Density (1996)
Urban Areas					
a. Hong Kong Island	**80.3**	**1 175 860**	**1 312 637**	**14 643**	**16 347**
Southern	39.1	237 888	287 670	6 084	7 357
Central and Western	12.4	251 846	259 224	20 310	20 905
Wan Chai	9.8	195 944	171 656	19 994	17 516
Eastern	19.0	490 182	594 087	25 799	31 268
b. Kowloon	**47.1**	**2 301 691**	**1 987 996**	**48 868**	**42 208**
Yau Tsim Mong	7.2	345 282	260 573	47 956	36 191
Sham Shui Po	9.5	424 669	365 927	44 702	38 519
Kowloon City	9.8	423 976	378 205	43 263	38 592
Wong Tin Sin	9.3	429 499	396 220	46 183	42 604
Kwun Tong	11.3	678 265	587 071	60 023	51 953
New Territories	**957.4**	**1 881 166**	**2 906 733**	**1 965**	**3 036**
Sai Kung	126.8	45 276	197 876	357	1 561
Sha Tin	69.4	356 881	582 993	5 142	8 400
North	140.0	144 879	231 907	1 035	1 656
Tai Po	147.0	139 153	284 640	947	1 936
Yuen Long	144.3	209 391	341 030	1 451	2 363
Tuen Mun	82.0	284 529	463 703	3 470	5 655
Tsuen Wan	60.0	240 842	270 801	4 014	4 513
Kwai Tsing	19.9	413 308	470 726	20 769	23 655
Islands	168.0	46 907	63 057	279	375
Hong Kong*	**1084.8**	**5 358 717**	**6 207 366**	**4 940**	**5 722**

*Note: All land areas, excluding marine area.
Population density is number of persons/ land area in sq. km.

As shown in Table 1, while thinning out the existing urban areas by redistributing population to New Territories has significantly increased the population in the New Territories from 1.88 million in 1986 to 2.91 million in 1996, the population density in urban areas is still much higher than the New Territories. Although the population density in the New Territories increased significantly from 1,965 per sq km in 1986 to 3,036 per sq km in 1996, Kowloon has seen little improvement in population density—a decrease from 48,868 per sq km in 1986 to 42,208 per sq km in 1996. A combination of high population density, the local concentration of economic activities, and limited road space discourages extensive use of private cars in Hong Kong; this leads to a high dependence on public transport. The Mass Transit Railway (MTR) is the main network, connecting work places within the urban areas. However, the daily need to move tens of thousands of workers from the residential areas in the New Territories to their places of work (most of which is in urban city) has burdened city transit systems, and contributes to surging motor vehicle traffic.

METHODOLOGY

Data Sources

In this study, the data were based on monthly house price indices of the selected popular developments. Since house prices in Hong Kong often change rapidly, monthly data is prepared for the present study. All of the data come from Property Review (various issues). This study employs data from 1992:1 to 1998:12.

The indices are based on an analysis of prices paid for completed flats, as recorded in Sale and Purchase agreements. In Hong Kong, popular developments generally involve the so-called estate-type residential developments. The developments selected for analysis are listed in the Appendix. The component index for each property group in the sample developments is calculated by reference to the factor of price divided by rateable value of the subject properties. The composite index for a property group is compiled by calculating a weighted average of the component indices. The weights are based on the number of transactions effected during the base period. These estate-type properties usually have relatively higher transaction rates. The data are divided into two groups:

(1) Small/medium units.
Flats with a saleable area < 100 sq m.

(2) Large units.
Flats with a saleable area ≥ 100 sq m.

In addition, we introduce the following variables:
SMU = small/medium units in urban areas;
SMN = small/medium units in New Territories;
LU = large units in urban areas;
LNT = large units in the New Territories;
SMA = overall small/medium units;
LA = overall large units.

Unit Root Tests

Table 2 reports the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) test statistics on the logarithm of the variables, omitting minus signs for simplicity. The null hypothesis of unit root for all variables in level form is rejected at all conventional levels of significance, showing that monthly house price data series are non-stationary in log-level terms. The unit-root tests for the six data series are performed using 0–4 lagged (log) first-difference of the dependent variable. Estimations both with and without the trend term are reported (Table 2). The AD/ADF tests reject the hypothesis of a unit root at all conventional levels of significance, suggesting that the variables are log first-difference stationary, and integrated with order one. The DF/ADF approach preserves the validity of the test by ensuring the residuals are white-noise.

Alternatively, Phillips-Perron (PP) uses a non-parametric procedure to correct the standard statistics to take into account the presence of any general forms of serial correlation, as well as conditional heteroscedasticity (Perron and Phillips, 1987). The PP tests were carried out in first differences of the data, indicating that the data series are (log) first-difference stationary. Thus, we have shown that house prices based on monthly data are $I(1)$.

The nature of non-stationarity in a data series can be evaluated by determining the degree of persistence in the data. The variance ratio test can be applied to provide a measure of persistence (Cochrane, 1988). The variance ratio test is to detect if the short-term fluctuations dominate the stochastic trend components, while the ADF approach is formulated to examine only the existence of stochastic trend components.

Estimations show that the variance ratio of the variables in log-level terms for lags of k = 6 is within the range of 1.56–2.30, and for lags of k = 12 is within the range of 1.29–2.22 (Table 3). This suggests that most of the data series contain a large permanent or random-walk component in level terms. However, we cannot reject the null hypothesis of random walks for LNT with lags of k = 6 and 12, and for SMN with lags of k = 12.

Table 2: Results of unit-root tests

	SMU	SMN	SMA	LU	LNT	LA
log-Level	1.464	1.214	1.336	1.400	1.662	1.398
log-First Difference						
No Trend						
No Constant						
0-lag	4.126	4.022	3.876	5.180	5.465	4.782
1-lag	3.934	3.340	3.605	3.346	4.389	3.390
2-lags	3.364	3.218	3.312	2.981	3.023	2.914
3-lags	3.396	3.502	3.398	2.830	2.535	2.794
4-lags	3.151	2.881	2.989	2.802	2.804	2.721
No Trend						
+ Constant						
0-lag	4.202	4.079	3.933	5.545	5.669	5.066
1-lag	4.040	3.357	3.666	3.522	4.594	3.550
2-lags	3.431	3.230	3.358	3.126	3.099	3.021
3-lags	3.518	3.568	3.496	3.001	2.564	2.925
4-lags	3.304	2.923	3.085	3.055	2.938	2.916
Trend						
No Constant						
0-lag	4.128	4.010	3.862	5.371	5.573	4.922
1-lag	3.963	3.293	3.597	3.395	4.509	3.434
2-lags	3.383	3.182	3.309	3.017	3.050	2.928
3-lags	3.462	3.521	3.443	2.887	2.526	2.829
4-lags	3.242	2.863	3.027	2.915	2.896	2.800
Trend						
+ Constant						
0-lag	4.191	4.046	3.915	5.518	5.624	5.037
1-lag	4.011	3.306	3.629	3.492	4.545	3.515
2-lags	3.416	3.176	3.319	3.089	3.059	2.981
3-lags	3.483	3.503	3.449	2.955	2.525	2.877
4-lags	3.262	2.833	3.026	2.994	2.892	2.852
PP test	6.218	5.942	6.700	3.414	2.218	4.526

Table 3: Variance ratio tests

***log*-level**	SMU	SMN	SMA	LU	LNT	LA
V_k, k = 6	2.061	2.302	2.251	1.922	1.561	2.089
V_k, k = 12	2.202	1.616	1.934	2.215	1.295	2.221
Z(6)	3.642	4.469	4.294	3.165	*1.926	3.738
Z(12)	2.720	*1.394	2.114	2.750	*0.668	2.763
Sample mean of $log(X_{t+1})$ - $log(X_t)$	0.0106	0.0086	0.0097	0.0149	0.0137	0.0145
t-statistics for mean = 0	2.406	2.106	2.343	3.016	2.155	2.993
Std. dev. of mean	0.0044	0.0041	0.0041	0.0049	0.0063	0.0049

Note: * indicates the hypothesis of a random walk is rejected at the 0.05 level.

CAUSALITY TEST RESULTS

The appropriate test for Granger causality between cointegrated variables has to include an error-correction term. Cointegration means that the two variables move together in the long run. Testing for cointegration is a way of testing the long-term relatedness between time series that have individually a unit root. Cointegration is concerned with the long-run equilibrium, whereas Granger causality refers to short-run forecastibility.

Table 4: Results of cointegration tests

Cointegrating vector	*No Trend*	*Trend*
logSMU = -0.62 + 1.149logSMN	2.07	2.20
logLU = -0.44 + 1.114logLNT	3.45*	3.77*
logSMU = 1.35 + 0.701logLU	2.65	2.92
logSMN = 1.50 + 0.669logLNT	3.32*	3.30
logSMU = 0.96 + 0.798logLNT	3.84**	4.76**
logSMN = 1.91 + 0.570logLU	2.23	2.24
logSMA = 1.47 + 0.674logLA	2.61	2.65

Note: * and ** indicate significant at the 0.05 and 0.01 levels. ADF tests are based on 1-4 lags.

Table 4 reports the results for the cointegration tests. Tests for cointegration now reject the null hypothesis that the series are not cointegrated for LU vs LNT, SMN vs LNT and SMU vs LNT. To test whether prices of small/medium housing units stimulate that of large units or prices of housing units in urban areas lead that in the New Territories, or if there exist feedback effects between different sub-markets, the Granger causality test is used in the present study, fitted with monthly data from 1992:1 to 1998:12. The causality test is performed with an error-correction term.

Table 5 presents the results of the Granger-causality tests for the logarithmic first-difference of the variables. From the F-statistics, the causal effects running from SMN $\rightarrow$ SMU; SMN $\rightarrow$ LU; LNT $\rightarrow$ SMU; LNT $\rightarrow$ SMN and SMA $\rightarrow$ LA in our sample are strongly rejected in all lags. Furthermore, there is weak causal effects in the following cases: LNT $\rightarrow$ LU; LU $\rightarrow$ LNT; SMN $\rightarrow$ LNT and LA $\rightarrow$ SMA. One way of testing the overall causal effects between 2 variables with different lags, is to compute the Significance Index SI, such that:

$$SI = \sum_{i=l}^{l} s_i / 2\,l \quad (1)$$

where:
s_i = 2 if the causal effect is significant at the 0.01 level;
s_i = 1 if the causal effect is significant at the 0.05 level;
s_i = 0 if the causal effect is rejected at the 0.05 level, and
l refers to the number of lags used for testing.

Note that SI = 0 when causal effects at all lags are rejected at the 0.05 level, and SI = 1 when causal effects at all lags are significant at the 0.01 level. Thus, $0 \leq SI \leq 1$.

Equation (1) also implies that SI = 0.5 when causal effects at all lags are significant at the 0.05 level. Following this background, the overall causal effect is classified as "strong" when SI ≥ 0.5 and "weak" when SI < 0.5. In the present study, l = 6. By using Equation (1), we obtain: SI for LNT → LU is 0.17; for LU → LNT is 0.25; for SMN → LNT is 0.17; and for LA → SMA is 0.25.

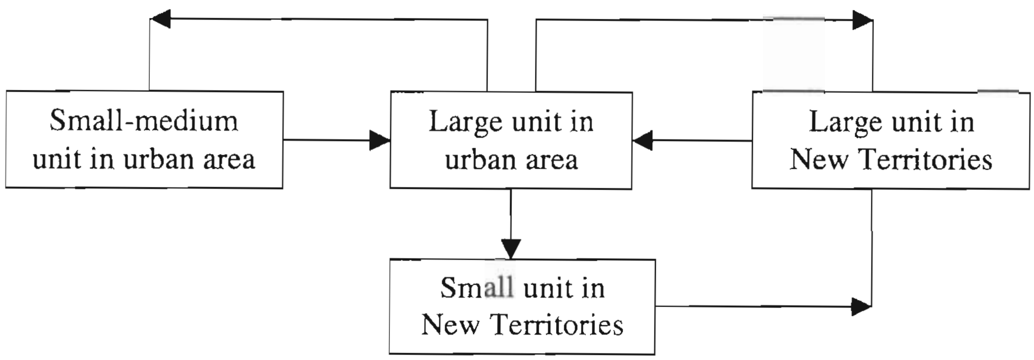
Three special cases should be given attention: (i) the Granger tests for SMU → LNT seem to suggest that the causal effect tends to diminish after 5 months (i.e., 5 lags), (ii) the results for LU → LNT indicate that there is no causal effect after 4 months, and (iii) the causal effect of LU → SMU emerges after 1 month. On the other hand, although the null hypothesis of causality for SMN → LNT is strongly rejected at 2-lags, the results are not stable when different lags were used. The corresponding SI is 0.17.

Table 5: Granger-causality test f-statistics for the logarithmic first difference of variables

Lags	1	2	3	4	5	6	SI
SMU leads LU	**11.85	*3.97	*2.50	*2.44	**2.70	**2.32	0.75
LU leads SMU	0.0002	**3.41	*3.01	**3.22	**3.83	**3.57	0.75
SMU leads SMN	**17.93	**10.51	**6.90	**5.40	**5.14	**4.11	1.0
SMN leads SMU	0.916	1.64	1.26	1.19	1.25	0.953	0
SMU leads LNT#	*3.84	*3.37	*2.71	*2.86	2.15	1.43	0.33
LNT leads SMU#	0.78	1.00	0.71	1.93	1.56	1.68	0
SMN leads LNT#	3.08	**4.86	2.55	2.22	1.06	1.37	0.17
LNT leads SMN#	0.84	0.74	1.04	1.82	1.56	1.92	0
LU leads SMN	**6.35	*3.89	*2.68	*3.60	*3.18	*2.77	0.58
SMN leads LU	1.27	0.404	0.913	1.40	1.11	1.07	0
LU leads LNT#	*6.34	*4.17	*2.85	1.44	1.04	0.78	0.25
LNT leads LU#	**7.86	2.59	1.67	1.44	1.03	0.98	0.17
SMA leads LA	12.88	0.722	0.652	1.04	1.16	1.31	0
LA leads SMA	2.84	1.24	0.980	*3.48	*3.05	*2.83	0.25

Note: * and ** indicate significant at the 5% and 1% levels respectively. The null hypothesis of no causality is rejected if the F-statistics exceed the critical values. # indicates an error correction model has been used.

Figure 1: Causal relationships between SMU, SMN, LU and LNT



Immediate Only in the second month

Based on these results, the overall causal effect is such that SMU → LU → LNT with a further feedback effect running from LU → SMU, and LU → SMN → LNT with a further feedback effect running from LNT → LU. This relationship is depicted in Figure 1. This implies that price increases will start from small/medium units in urban areas, which then trigger prices of large units in urban areas, which subsequently influence prices of large units in the New Territories and prices of small/medium units in the New Territories. The feedback effect from LU to SMU, and from LNT to LU will emerge after 1 month. When the data series in urban areas and the New Territories was merged together, the causal effect running from LA → SMA is significant after 3 lags. While the true causal effect may be masked by using aggregate data, this could imply that the combined causal effect is relatively stronger from prices of large units to small/medium units. However, the mass market of small/medium units in urban areas will always be the lead. A summary of the causal effects is given in Table 6.

Table 6: Summary of causal effects

	SMU → LU	LU → LNT	LU → SMN	SMN → LNT
Timing of effect	Immediate	Immediate	Immediate	2nd month
Strength of effect	Strong	Strong	Strong	Weak
Duration of effect	Past 1–6 months	Past 1–4 months	Past 1–6 months	Only in 2nd month
Feedback effect	Strong	No	No	No

Note: Strength of effect is based on the Significance Index SI.

CONCLUSION

Using monthly data for the period 1992:1–1998:12, we tested the lead-lag relationship between prices of estate-type residential units in the urban areas and New Territories in Hong Kong. We have shown that prices of large units in the urban and New

Territories; prices of small/medium and large units in the New Territories; and prices of small/medium units in urban areas and prices of large units in the New Territories are cointegrated. We also showed that: (i) house prices of small/medium units tend to lead prices of large units in urban areas, which in turn lead prices of large units in the New Territories; (ii) house prices of large units in urban areas tend to lead prices of small/medium units in the New Territories which in turn lead prices of large units in the New Territories; and (iii) there is evidence of a feedback effect between prices of small/medium and large units in the urban areas, and between prices of large units in the urban and New Territories.

REFERENCES

Adair, A., J. Berry and McGreal, W. 1996, 'Hedonic Modelling, Housing Submarkets and Residential Valuation', *Journal of Property Research*, 13, pp. 67–83.

Ashley, R., Granger, C. and Schmalensee, R. 1980, 'Advertising and Aggregate Consumption: An Analysis of Causality', *Econometrica*, 48, pp. 1149–1167.

Case, K. and C. Mayer 1996, 'Housing Price Dynamics Within a Metropolitan Area', *Regional Science and Urban Economics*, 26, pp. 387–407.

Cochrane, J. 1988, 'How Big is the Random Walk in GNP?' *Journal of Political Economy*, 96, pp. 893–920.

Dickey, D. and Fuller, W. 1979, 'Distribution of Estimates for Autoregressive Time Series With Unit Root', *Journal of the American Statistical Association*, 74, pp. 427–431.

Engle, R. and Granger, C. 1987, 'Co-integration and Error Correction Representation, Estimation and Testing', *Econometrica*, 55, pp. 251–276.

Engle, R. and Granger, C. 1991, *Long-Run Economic Relationships*, OUP, UK.

Goodman, A. 1981, 'Housing Submarkets Within Urban Areas: Definitions and Evidence', *Journal of Regional Science*, 21, pp. 175–185.

Goodman, A. and Thibodeau, T. 1998, 'Housing Market Segmentation', *Journal of Housing Economics*, 7, pp. 121–143.

Granger, C. 1969, 'Investigating Causal Relations by Econometric Methods and Cross-Spectral Methods', *Econometrica*, 34, pp. 541–551.

Granger, C. 1981, 'Some Properties of Time Series Data and Their Use in Econometric Model Specification', *Journal of Econometrics*, 16, pp. 121–130.

Granger, C. and Newbold, P. 1974, 'Spurious Regressions in Econometrics', *Journal of Econometrics*, 2, pp. 111–120.

Harvey, A. 1989, *Forecasting, Structural Time Series Models and the Kalman Filter*, Cambridge University Press, Cambridge.

Lo, A. and Mackinlay, A. 1989, 'The Size and Power of the Variance Ratio Test in Finite Samples: A Monte Carlo Investigation', *Journal of Econometrics*, 40, pp. 203–238.

Perron, P. and Phillips, P. 1987, 'Does GNP Have A Unit Root?' *Economics Letters*, 23, pp. 139–145.

Tse, R. 1998, 'Land Supply, House Price and Revenue from Land Sales', *Urban Studies*, 35, pp. 1377–1392.

Tse, R. and MacGregor, B. 1999, 'Housing Vacancy and Rental Adjustment—evidence from Hong Kong', *Urban Studies,* 36, pp.1769–1782.

APPENDIX

Popular developments selected for analysis:

Baguio Villa, Beverly Hill, Braemar Hill Mansions, Cavendish Heights, Chi Fu Fa Yuen, City Garden, Dynasty Court, Greenville Gardens, Heng Fa Chuen, Hillsborough Court, Hong Kong Parkview, Kornhill, Pacific Palisades, Pacific View, Parkway Court, Redhill Peninsula, Pacific View, Parkway Court, Redhill Peninsula, Robinson Place, South Horizons, Taikoo Shing, The Grand Panorama, Villa Lotto, Villa Rocha, Beacon Heights, Beverly Villa, Laguna City, Mei Foo Sun Chuen, Parc Oasis, Sceneway Garden, Telford Gardens, Village Gardens, Whampoa Garden, Riviera Gardens, Wonderland Villas, Belvedere Garden, Luk Yeung Sun Chuen, Sea Crest Villa, Marina Garden, Sun Tuen Mun Centre, City One, Royal Ascot, Sunshine City, Hong Lok Yuen, Serenity Park, Uptown Plaza, Fairview Park, Kingswood Villas, Avon Park, Fanling Centre, Sheung Shui Centre and Discovery Bay.

In general, each estate-type development has over 1,000 flats with private gardens, swimming pools or club house. For example, Kingswood Villas is the largest estate-type development, which has about 15,000 flats.