Supply of Subsidized Sale Flats and Private Housing Prices in Hong Kong

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Abstract

This paper investigates the association between the supply of subsidized sale flats by the Hong Kong Housing Authority and private residential property prices in Hong Kong, and their cause-and-effect relationships. The objective is to determine whether a sudden cessation of production and sale of the Home Ownership Scheme (HOS) and Private Sector Participation Scheme (PSPS) flats between September 2001 and end of June 2002, and indefinitely from 2003 onwards would encourage public tenants to buy in the private sector and subsequently increase private housing prices. The analysis is based on the supply of HOS/PSPS flats since its introduction in February 1978 until the last batch of flats sold in July 2002. The impact of supply restriction on private housing prices was examined. Using quarterly data for 1978-2003, the results show that housing prices move independently of the supply of these subsidized sale flats and that such supply does not "Granger cause" housing prices. The study has also found evidence that the cessation has not restored the market or resulted in any increase in housing prices. Finally, the private housing market is not affected by the implementation of the moratorium nor do the production and sale of subsidized sale flats pose a direct threat to the private housing sector in Hong Kong.

Key words: Subsidized sale flats, private housing prices, Hong Kong

Background and Research Problem

As a consequence of high population density and limited land availability, Hong Kong's property prices had been sky-high. Just a few years ago, for the price of a house/apartment in New York City, London or Singapore, one could only pay for the down payment of a similar property in Hong Kong. The housing market was largely fuelled by speculative activities. The high property prices have caused housing problems among large number of low-income families.

In response, the government had developed an elaborate public housing

programme for eligible families. In 1997 public rental housing provided accommodation for 670,000 families, or 35% of Hong Kong's population. However, despite the enormous efforts, private housing remained expensive and the waiting list for public housing continued to grow. Recognising the problem, the Government has explicitly and repeatedly stated that the housing problem is an issue of the highest priority on its agenda and that it would make efforts to improve the situation.

In July 1997, in an attempt to suppress the ever-inflating property prices and to promote home ownership (with a goal of raising home ownership rate from 50% to 70% in ten years), the then newly established Government of the Hong Kong Special Administrative Region (HKSAR) announced the aggressive plan of building 85,000 housing units, of which 50,000 would be public housing units, per year. Prior to that year, supply of housing units, both public and private combined, was not more than 50,000 a year.

"Unforeseen" consequences soon followed. Private property prices dropped by 40% within one year of the announcement of the 85,000-unit policy. To appreciate the impact, one should note that the private property market plays a very important role in Hong Kong's economy. At the consumer level, private properties represented the single largest investments for large number of individuals, especially mid-income families. At the corporate level, real estate developers were among the largest companies in the city employing more than 300,000 people in 1997.

Needless to say, the property market slump caused much difficulty in the economy. According to the Hong Kong Monetary Authority, there were about 106,000 residential mortgage loans in negative equity with a total value of HK$165 billion at end June 2003 (HKMA, 14 August 2003), compared to 65,000 loans with HK$127 billion in 2001(HKMA, 2001). This represented 22% of all residential mortgage loan cases and 31% of total mortgage loan value in that year. Some even argued that the figure was a conservative estimate. Profits of real estate developers and their stock prices have dropped significantly, leading to large-scale salary cuts and layoffs. Economy-wide investment and consumption went down. Developers lost interests in Government land disposals, which led to persistent reductions in Government revenues. In 2000 the Government received HK$15.8 billion through land disposal. But in 2001 it received only HK$3 billion, according to the Financial Secretary (Monetary Authority, 2001).

Not surprisingly, the 85,000-unit policy has drawn much criticism. In a

newspaper article, Dr. Chung Kim Ming described the policy as "one of the two major mistakes the HKSAR Government has made" (Hong Kong Economic Journal, 1999). Sun Hung Kai Properties Limited Vice Chairman and Managing Director Kwok Ping Kong attacked the policy as "inflexible" and would cause "substantial fluctuations in the property market" (Sing Tao Daily, 1998). In June 1998, the Hong Kong Real Estate Agencies Association Limited submitted a letter to the Government, which contained six suggestions on housing policy, one of which was to revise the 85,000-unit plan. In September 1999, a coalition of ten real estate developers requested the Government to lower the target of building 85,000 per year. The collapsed housing market has created so many negative-equity families that in November 2001 they formed a coalition to fight for their own interests.

In fact, the 85,000-unit policy was just one of the more visible components of the overall public housing programme in recent years. Other initiatives included the selling of Housing Authority rental flats to sitting tenants and the subsequent cessation of production and sale of HOS/PSPS flats, both of which have likewise drawn considerable attention from many different sectors. Given the colossal amount of resources devoted to the public housing programme, the attention it has received, and the economic significance of the private property sector, public housing policy and its impacts on related sectors warrant an in-depth and critical investigation. The study would examine the general direction of public housing policy with a special focus on the impact of the supply of subsidized sale flats on private property prices.

Following this introduction, section 2 briefly describes the characteristics of subsidized sale flats, including their trends and patterns. Section 3 is the literature review. Section 4 contains the study methodology and data source. Section 5 presents the results and findings and section 6 concludes the study.

HOS/PSPS Subsidized Sale Flats

Very roughly, there are two million housing units in Hong Kong. Half of these were built by the private sector. One third were built by Government for rent, and one-sixth for subsidized sale. The HOS/PSPS flats are subsidized public housing. The HOS was introduced in February 1978. Up to the last batch (Phase 24A) of HOS flats sold in July 2002, the total number of HOS/PSPS flats completed so far amounted to 310,000.

HOS was designed to assist public housing tenants and lower-income

people in the private sector to buy their own home at subsidized, i.e., non-market values. The buying, selling and mortgage of these flats are subject to certain restrictions. For example, change of ownership and re-mortgage of a HOS/PSPS flat is prohibited within the 5-year alienation restriction period (before 4 February 1999, the re-sale restriction period was ten years) or if the premium has not been paid after the aforesaid period. Within two years from the first assignment, HOS flat owner must assign the flat back to the HA at original purchase price. Between three to five years from the date of first assignment, owner may opt to assign the flat back to the HA. The buyback price is assessed by the HA by deducting the original discount from the assessed market value. Owners may opt to sell in the HOS secondary market, without paying the premium. After five years, owner may either sell it to eligible persons in the HOS secondary market or pay the premium to the HA and then sell, rent and transfer ownership in the open market. In all respects, they are private property after the expiry of the alienation period, as freely tradable, as privately built housing.

HOS was initially successful. In 1989 about one quarter of sitting tenants in an estate due for redevelopment opted to buy HOS flats. As the older public housing estates were redeveloped, by 1998 the percentage had fallen to under 10 percent. HOS was becoming less attractive to public rental tenants. The reason is that the monthly expenditures for the purchase of a HOS flat runs at about five times monthly rentals for modern public rental flats. The dramatic increase in expenditure is simplify too great for most public tenants.

According to HA's HOS/PSPS application records, the over-subscription rate of HOS/PSPS has dropped from the peak of 30.5 times in 1994-95 to as low as 1.83 times in a Phase 22B development in February 2001. In the midst of the falling housing market in Hong Kong, a decision was made by the HA to freeze HOS/PSPS sales. On 3 September 2001, the Government called for a moratorium of HOS/PSPS sales between 24 September 2001 and end of June 2002, and the capping of annual sales at 9,000 units until end March 2006, subject always to the avoidance of any direct competition with the private property market. Subsequently, the HA also accepted the Government's recommendation on cessation of production and sale of HOS/PSPS flats indefinitely from 2003 onwards. HA members agreed that such measures had to be in place to avoid an overlap between HOS/PSPS and the private property market. In his Statement on Housing, Tsang (2001), the Chief Secretary for

Administration, the Government of the HKSAR called for the need for certainty after the moratorium. He argued that the lowest income group would benefit from an accelerated access to quality public rental housing. And would-be property owners will no longer face additional downward price pressure from an over-supply of new HOS/PSPS flats.

General Trends and Patterns

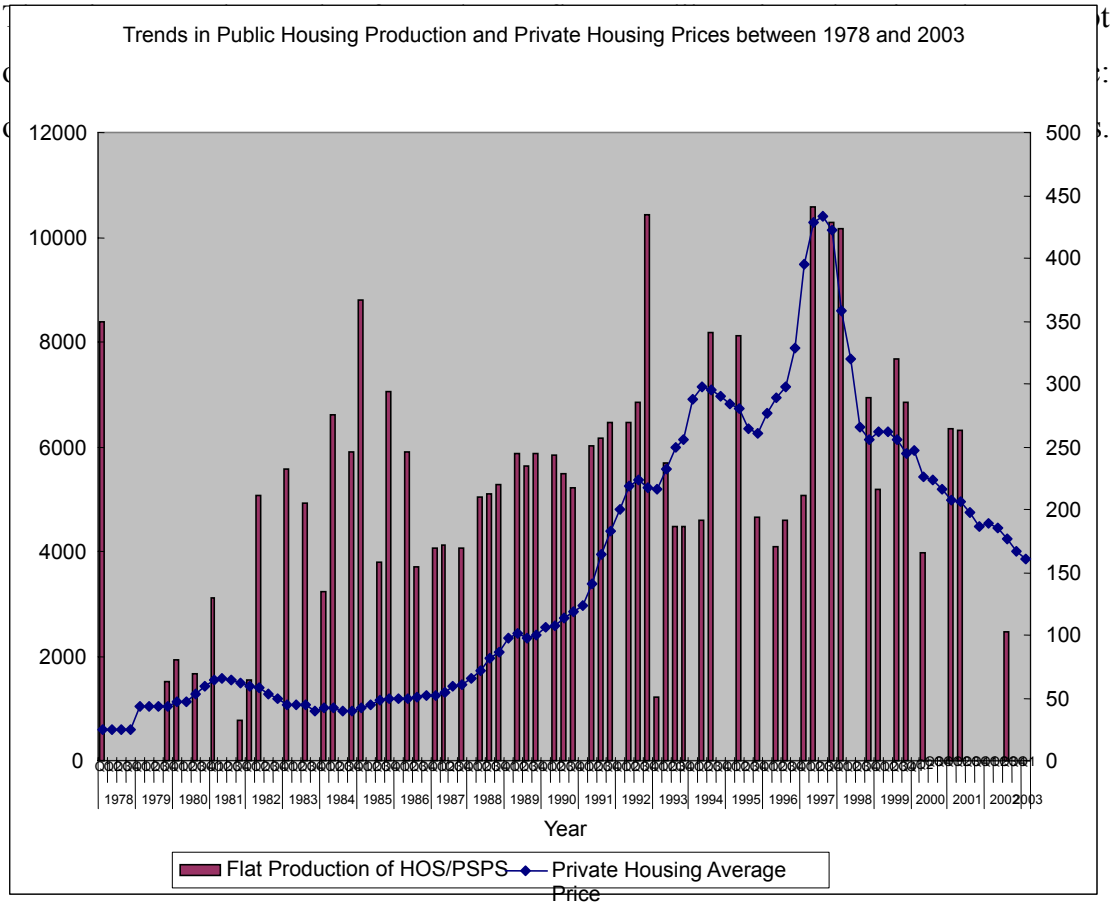

Figure 1 Public Housing Production and Private Housing Prices from 1978 to 2003

Figure 1 displays different trends of the production of HOS/PSPS flats and the average price of private housing (inflation rate unadjusted) from 1978 to 2003. The two trends do not seem to follow a particular pattern. The flat production trend fluctuated greatly between 1978 and 1997, peaked at 26,000 in 1997, with a lowest volume of about 2,500 in 2002. Since 1997 flat production has been falling at about 14,000 each year. Yet the percentage of HOS/PSPS flats produced and sold to the

total residential flats completed rose from 5.5 % in 1987 to 15.3 % in 2002 (refer to Table 1 below). In fact, the production of HA rental flats has been fallen gradually since 1987, leading to a higher HOS/PSPS production, while the production of private housing has remained fairly static (around 53 % of the total stock) over the past 15 years (Table 1).

Table 1 - Stock of Permanent Residential Flats in Hong Kong

As at March	1987		1992		1997		2002	
	'000	%	'000	%	'000	%	'000	%
Public housing	659	46.1	827	47.4	923	47.1	1049	46.2
- Housing Authority HOS/PSPS flats	**79**	**5.5**	**145**	**8.3**	**218**	**11.1**	**348**	**15.3**
- Housing Society subsidized sale flats	-	-	3	0.2	6	0.3	17	0.7
- Housing Authority rental flats	550	38.5	646	37.0	665	33.9	640	28.3
- Housing Authority interim housing flats	-	-	-	-	1	0.1	12	0.5
- Housing Society rental flats	30	2.1	33	1.9	33	1.7	32	1.4
Private housing	770	53.9	918	52.6	1039	52.9	1220	53.8
Total	1429	100	1745	100	1962	100	2269	100

Source: Hong Kong Housing Authority

Despite the decrease in HOS/PSPS supply, private housing prices have also been falling in the past few years. It is clear from Table 1 above that the price of private housing does not respond directly to changes (precisely, increased from 11.1% in 1997 to 15.3% in 2002) in flat production, rather, it follows a completely different trend: a generally increasing price trend from 1978 to 1998, and a decreasing one from that year onwards (Figure 1). By 2003 private residential property prices have been fallen by over 60% since the 1997 peak. However, average prices of HOS/PSPS flats have risen substantially relative to those of the private residential units in the past decade. For example, as shown in Table 2 below, in 1992 the average price of HOS/PSPS is 43.2 % of that of private housing in Hong Kong Island, while in 2001 it raised to 72.7% in the same region. In the New Territories the average HOS/PSPS price also raised from 48.5% to 78.8% in the same corresponding years. As a result of an increasing price in subsidized sale flats relative to private housing, it would therefore seem that HOS flats are becoming less attractive to public sitting tenants and potential homebuyers in the private sector.

Table 2 - Price of Permanent Residential Flats

HOS/PSPS flats (average price per sq. m. of saleable floor area)	1987 HK$/sq.m.	1992 HK$/sq.m.	1997 HK$/sq.m.	2001 HK$/sq.m.
Hong Kong Island	8,000	17,460	26,910	26,900
% to price of private flat in same region	73.3	43.2	34.2	72.7
Kowloon	-	-	40,640	25,900
% to price of private flat in same region	-	-	73.1	93.2
New Kowloon	-	21,330	-	-
% to price of private flat in same region	-	67.8	-	-
New Territories	6,230	15,860	22,040	21,900
% to price of private flat in same region	68.5	48.5	36.9	78.8

Private flats (average price per sq. m. of saleable floor area)	1987 HK$/sq.m.	1992 HK$/sq.m.	1997 HK$/sq.m.	2001 HK$/sq.m.
Hong Kong Island	10,910	40,380	78,640	37,008
Kowloon	9,430	32,320	55,560	27,799
New Kowloon	10,180	31,440	65,280	-
New Territories	9,100	32,680	59,770	27,802

Source: Hong Kong Housing Authority

Also, the data in Figure 1 show an abrupt increase of private housing prices from 1997 to 1998, yet this is very short-lived. The figure drops back to the 1997 level, at about HK$58,000 per square meter, in the following year. At the same time, HOS/PSPS flat production has declined over the 3-year period since 1997. It is contrary to the traditional phenomenon of falling supply leading to a higher housing price. This may have suggested that there are other underlying reasons that have sky rocketed the private housing price before 1997 and then sharply decreased it thereafter, the volatility of which is unique in the year of Hong Kong's handover.

Furthermore, as subsidized housing is, if not perfect, close substitutes for private housing, especially for those who could not afford to move out of public housing. Thus, when the supply of public housing is high, such as in 1992, the demand for private housing should decrease, resulting in a fall in private housing prices. Similarly, a fall in HOS/PSPS supply in recent years is not met by an increase in private housing prices. This phenomenon does not exist in our data; the price of

private housing appears to move independently with the production and sale of HOS/PSPS flats of the same year. Thus, we may ask the following questions: Is it true that there is no correlation between the production of public subsidized housing and the price of private housing? Or, are there other factors that have a dominating effect on private housing price outweighing the effect of substitution from an increase in subsidized housing production? We speculate that factors such as: Buyers' expectations, quantity supplied by private developers and other demand conditions may also have an effect on private housing prices.

To investigate further into the relationship between the supply of HOS/PSPS flats and the price of private housing, we construct a "ratio" of the volume of subsidized sale flats produced to the total number of housing units (both private and subsidized sale flats combined) produced in the same year. We hypothesize that such proportion of subsidized sale flats supplied to the total stock of public and private sale flats supplied in that year has a role to play in determining the price level of private housing. Figure 2 below shows the trends of "ratio" and private housing prices from 1978 to 2003.

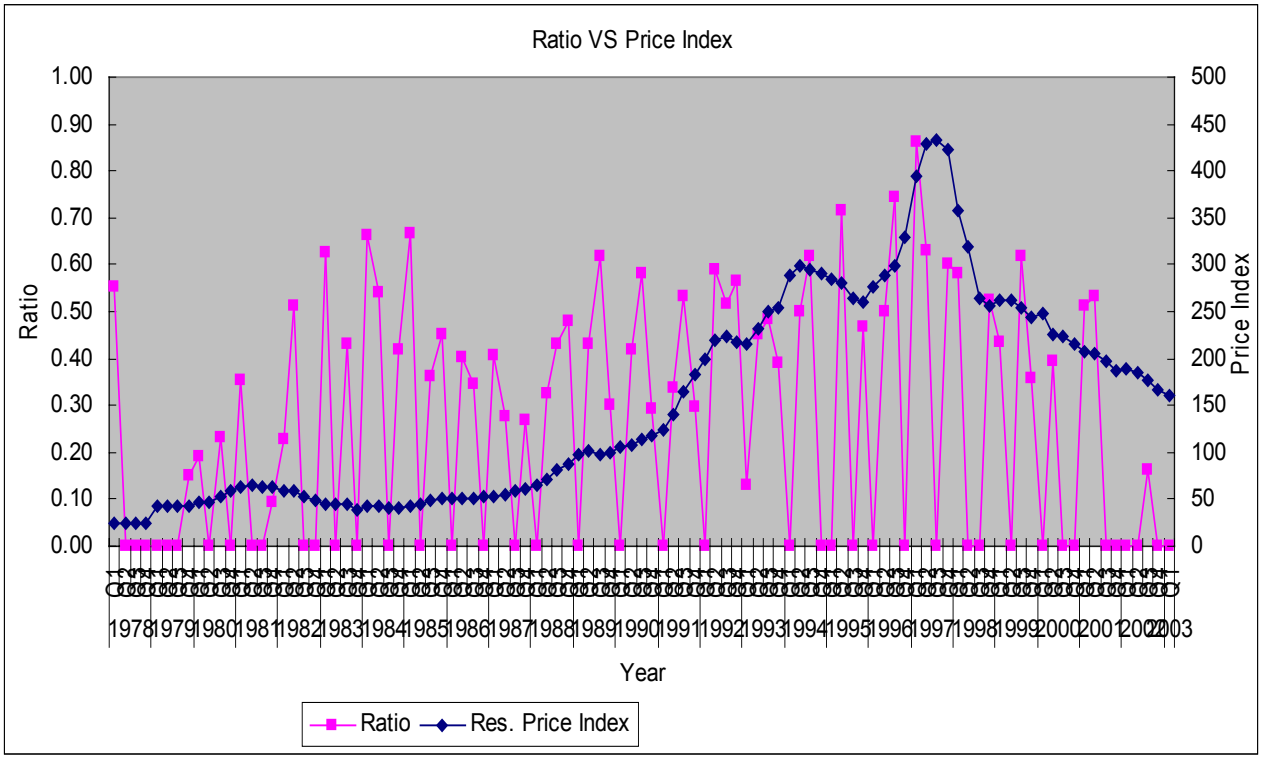

Figure 2 Trends of "Ratio" and Private Housing Prices from 1978 to 2003

Compared to Figure 1, the "ratio" of HOS/PSPS flats produced to the total

(HOS/PSPS and private) housing units produced seems to show a somewhat stronger correlation, relative to the number of HOS/PSPS produced only. For instance, private housing price peaked in 1994 and 1997. In the same year, the "ratio" shows a trough, indicating that the proportion of HOS/PSPS flats to the total supplied is lower than the previous and the coming year. The overall correlation for the period 1978-2003 is not evident, as shown in Figure 2. Note there are some quarters with no supply at all. There might be some other underlying relationship between the two, subject to further investigation by means of a Pearson Correlation Test and a Granger Causality Test on the data with time lag terms of 1 and 2.

Literature Review

The Government of HKSAR owns all the land in Hong Kong. Land supply in Hong Kong is very limited, as 80% of the 1,092 square kilometers of land is mountainous. In 1997 around 60% of the population lived in only around 80 square kilometers of land that is extremely densely developed (Renaud *et. al*., 1997). Using data for the 1973-1997 period, Neng and Ko's (1999) empirical results show that an increase in land supply by the Hong Kong Government may not be a solution to the perceived shortage of housing supply in Hong Kong. They further concluded that developers' housing supply is independent of the amount of land provided by the Hong Kong Government. They also found that developers would examine economic conditions in making their housing supply decisions.

Turning to the public housing supply, in terms of percentage, the public housing sector in Hong Kong is the second largest in the capital world, after Singapore (Peng and Wheaton, 1994). Since the end of 1980s, the public sector has supplied about half of the total housing stock in Hong Kong. Peng and Wheaton (1994) used a multi-equation aggregate housing model to investigate the impact of a sudden scarcity of land in Hong Kong. They concluded that supply restrictions had caused higher housing prices but not lower housing output. The higher prices resulted directly from capitalization of expected higher rents, and they encouraged capital land substitution in housing production.

Commenting on the reduction of the re-sale restriction period for HOS/PSPS flats from ten to five years that would increase the number of HOS flats from 87,000 flats of the 230,000 (at 1998 level), Miller (1998), the ex-Director of

Housing Department, HKSAR, PRC, rejected the suggestion that the restriction might have a negative impact on the existing private market because there were two totally different market segments. But the significant concerns came from purchasers of HOS flats and the vast majority, who simply could not afford to purchase private property. For those who can afford to buy, the restriction was clearly not their concern. However, it may raise the issue of threat of substitutes in the private sector. For this, Shen and Dong (2002) used Porter's Five-forces Model to analyze the profitability level of the post-crisis housing sector in Hong Kong. They pointed out that the HKSAR Government had planned to sell a large number of public rental housing units at heavily subsidized prices to existing tenants. But this availability of public units in the private market as a substitute does not pose a direct and serious menace to the entire private housing sector. This is because of their poor locations, low quality and relatively small size, compared to their counter-parts in the private sector.

The empirical study of Tse, Ho and Ganesan (1999) found that the transaction volume of private residential flats is "Granger causing" the house price in Hong Kong from 1976 to 1995. Wheaton (1990) presented a model where housing prices were determined by the expected time it took a dissatisfied owner to find a suitable property to move into. Further, building on a stochastic life-cycle model, Ortalo-Magne and Rady (1999) found evidence that housing prices depended on the current income of young households. They also suggested that income of young households affected housing prices independently of aggregate income. Close to this paper, Reichert (1990) found evidence that local factors, such as population shifts, employment, and income trend had a unique impact on housing prices.

Tse *et al*. (1998) examined the linkage between housing prices and the macro-economy in general. Clayton (1996) explored how current housing prices were affected by expected future price change. Phang and Wong (1998) examined how Government policies were related to private housing prices in Singapore. In the more specific area of relationship between public and private housing, Hui *et al*. (1999) examined how public and private housing rent interacted and related to each other, using Hong Kong as a case study. Along the same line, Walker and Marsh (1998) examined England's new policy of linking public sector rents with that of the private sector. Finally, He and Webb (2000) supported that residential and commercial real estate market had similar responses to some important economic and political news.

The optimizing behavior of a representative investor ensures that the equilibrium price of a housing unit depends solely on the user cost of capital, rent and some form of supply cost. In an effort to explain the rise in home prices during the late 1970s, Harris (1989) suggested that homebuyers focused on real user costs when making their housing decision. The buying behavior was assumed to be forward-looking. In reality, there are some departures from rational expectations. In such a world, on the supply side, small fluctuations in it, such as the current suspension of HOS sales, may generate large fluctuation in price through their impact on the equilibrium vacancy rate. The sudden shortage of HOS/PSPS supply provides a unique situation for studying the impact of public supply fluctuation on private housing prices. It is this issue the current study attempts to examine. In short, previous research on how public subsidized sale flats affects private housing prices is however lacking. The current research, the first of its kind, intends to fill that gap of knowledge.

Methodology and Data

This section presents: (a) the objectives of the study; (b) the working hypotheses; (c) the study methodology; and (d) sources of data.

Study Objectives

Primary objectives of the study are to:

(a) determine on statistical ground whether a relationship between public housing supply and private housing prices exist; and

(b) quantify the responsiveness of private housing prices to change in public housing supply. Technically, the relationship can be termed the "cross-sectional price elasticity of supply.

As this will be the first attempt to study the interactions between public supply of subsidized sale flats and private property prices, the models will be kept simple so as to establish an analytical framework for further research. The significance of this study is to:

(a) provide policy makers with a tool to evaluate the costs and benefits of public housing programme in a more accurate and comprehensive manner by clarifying the "ripple effects"; and

(b) provide policy makers with a tool to adjust public housing supply in a more precise and predictable manner to attain policy objectives, such as price,

ownership, and affordability goals using the statistical relationship discovered regarding public housing supply and private property prices.

The study objectives focus on the intellectual level. In light of the impacts of the public housing programme on the economy, we offer policy makers an analytical tool to evaluate the costs and benefits and evaluate the impact of the programme. A by-product of the study will be the investigation as to whether the 85,000-unit policy is solely responsible for the property market slump in 1997-98.

Study Hypotheses

It is hypothesized that:

(a) there is a direct association between the supply of subsidized HOS/PSPS sale flats by the HA and the residential property prices in Hong Kong in times of inflation and in times of deflation; and

(b) there is cause-and-effect relationship between these two variables in the corresponding inflationary and deflationary periods. Research Methodology

To explore the relationship between subsidized housing supply and private housing prices in Hong Kong, a few procedures were deployed to evaluate the effect of the former on the latter.

In measuring the linear association between these two variables, the Pearson production moment correlation (r) was selected as an appropriate inferential statistic for associational hypothesis. The parametric statistic was therefore computed for three periods 1978Q1-2003Q1, 1978Q1-1997Q4 and 1998Q1-2003Q1.

The twenty-five-year period from 1978 to 2003 was selected for analysis, as the earliest application period for the first batch of HOS flats for sale was in February 1978 and the last batch (Phase 24A) in July 2003. For the last two periods, the cut-off point is 1997. Before that there was the inflationary period and thereafter the deflationary. This enables us to analyze the effects of different economic conditions on housing prices.

A Granger causality test was used to test whether public housing supply affects private property prices, and if there exist feedback effects between the two sectors (see Granger, 1969; Ashley *et al*.,1980, Ball and Wood, 1996). Public housing is defined as the all public sale flats that receive full or partial financial subsidies from the Government. The main categories of public sale housing include Housing Authority's Home Ownership Scheme (HOS) flats and Private Sector Participation

Scheme (PSPS) flats. The test equations are as follows:

$$HP_t \quad \sum_{i=1}^{n} {}_{0i} HS_{t\ i} \quad \sum_{i=1}^{n} {}_{0i} HP_{t\ i} \quad u_t \qquad (1)$$

$$HS_t \quad \sum_{i=1}^{n} {}_{1i} HP_{t\ i} \quad \sum_{i=1}^{n} {}_{1i} HS_{t\ i} \quad v_t \qquad (2)$$

where:

HS = supply of public subsidized sale flats

HP = private housing price

The null hypothesis is that no causal relationships exist whatsoever. If some *α's* are found to be non-zero we can reject the null and conclude that casual relationships exist between the two sectors.

Having established the relationship between public housing supply and private housing prices, a by-product of the proposed study will be to examine the validity of the criticism that the 85,000-unit policy is solely responsible for the collapse of the private real estate market. The proposed change in public housing supply will be plugged into the model. The model will show how much private housing prices will be affected as a result. The predicted price change will be compared with the actual price change to check whether the two coincide. If not, the results would imply that other factors might have also contributed to the property market slump.

The usual properties of the least squares estimator in a regression using time-series data depend on the assumption that the series data are stationary. That is its mean and variance are constant over time, and the covariance between two values from the series depends only on the length of time separating the two variables, and not on the actual times at which the variables are observed. It is, therefore, necessary to check the time-series data for stationarity to avoid spurious results in the later analysis. The Augmented Dickey Fuller (ADF) Test was performed to test for the existence of unit roots. Granger causality tests were performed on the data with the time spans of 1 and 2. A variable containing a unit root is non-stationary over time, following a random walk process. It may reach stationarity by differencing t times,

and then the variable is referred as an I(t).

Regression analysis also depends on another important assumption: the absence of autocorrelation. Therefore, the residuals of the observations should be uncorrelated. To avoid violation of this assumption, the Durbin-Watson Test of the auto-correlation was performed. If the Durbin-Watson statistic lies outside the critical values between 1.59 and 2.41, we reject the null hypothesis of no autocorrelation, thus our analysis would be problematic.

Data Sources

The volume of HOS/PSPS flats completed on a quarterly basis was obtained from the sale program of the Hong Kong Housing Authority, the developer of these subsidized flats. The volume of permanent residential flats completed in the quarter was based on various issues of the *Hong Kong Monthly Digest of Statistics* complied by the Census and Statistics Department, The Government of Hong Kong Special Administrative Region (HKSAR), People's Republic of China (PRC).

Transaction-based quarterly data on housing prices in the private sector were the levels of housing prices expressed in indices for five types of private domestic premises by size during the quarter, using 1989 as the base year. They were derived from property indices ("Overall Class") in the *Hong Kong Property Review* (various issues) constructed by the Rating and Valuation Department, the Government of the HKSAR, PRC. The data, which are used for stamp duty purposes, are most systematic and reliable source available for Hong Kong real estate markets.

The descriptive statistics of the variables are presented in Table 3 below. Abbreviations HOS, PRIVATE, TOTAL, RATIO, PINDEX, RINDEX stand for production of HOS/PSPS flats, production of permanent private residential units, total flat production, ratio of HOS/PSPS production to total production, residential property price index and residential rental index, respectively, on a quarterly basis.

Table 3 - Summary Statistics for HOS and Private Flats and Price Indices

Year	HOS	PRIVATE	TOTAL	RATIO	PRICE INDEX	RENT INDEX
1978-2003						
Sum	315292	689330	1004622	26.10	15417	10655
Mean	3121.70	6825.05	9946.75	0.26	152.64	105.50

Min	0	811	1437	0	25	28
Max	10592	15173	21625	0.86	433	200
Mode	0	6783	6783	0	25	64
Std. Dev.	3191.71	2922.47	4307.90	0.25	110.30	48.51
Count	101	101	101	101	101	101
1978-1997						
Sum	259426	549236	808662	21.98	10607	7723
Mean	3242.83	6865.45	10108.28	0.27	132.59	96.54
Min	0	811	2053	0	25	28
Max	10592	15173	21625	0.86	433	200
Mode	0	6783	6783	0	25	64
Std. Dev.	3134.08	2940.74	4180.34	0.26	113.22	50.18
Count	80	80	80	80	80	80
1998-2003						
Sum	55866	140094	195960	4.12	4810	2932
Mean	2660.29	6671.14	9331.43	0.20	229.05	139.62
Min	0	1437	1437	0	161	110
Max	10156	12751	19070	0.62	358	180
Mode	0	#N/A	#N/A	0	262	141
Std. Dev.	3442.94	2917.76	4822.96	0.25	49.60	16.52
Count	21	21	21	21	21	21

Results and Findings

Table 4 - Distribution of Residential Flats by Region as at 2002

Region	Private Flats		Subsidized Flats		Difference	
	No	%	No	%	No	%
	(a)		(b)		(a) – (b)	[(a)-(b)]/(a)
Hong Kong Island	88748	21.7	34177	13.3	54571	61.5
Kowloon	67917	16.6	58612	22.9	9305	13.7
Tsuen Wan/Kwai Tsing	35126	8.6	11863	4.6	23263	66.2
Sha Tin	30496	7.5	35854	14.0	-5358	-17.6
Tuen Mun	39820	9.8	26252	10.3	13568	34.1
Tai Po	18731	4.6	10038	3.9	8693	46.4
Faning/Sheung Shui	19838	4.9	15078	5.9	4760	24.0
Rest of NT	107588	26.4	64173	25.1	43415	40.4
Total	408264	100.0	256047	100.0	152217	37.3

Table 4 shows the overall distribution of the total production of HOS/PSPS and private flats by geographical region as at 2002. Most of the HOS/PSPS flats (64%) were located in the New Territories, while 23% were located in Kowloon and 13% on Hong Kong Island. As for residential flat distribution, while the production in the New Territories remains relatively the same (61%), most private flats were completed on Hong Kong Island (22%) and relatively less in Kowloon (17%). As housing is completely immobile goods, HOS/PSPS flats and private housing engage in direct competition in supply if they are located close to each other. To avoid competition with the private market, the Government therefore decided to suspend the production and sale of HOS/PSPS flats. Also, the demand for housing by consumers is highly affected by the location of housing as well. Thus, the average price of private housing is highly affected by the distribution pattern of the locations. This impact can be visualized from the distribution patterns of subsidized sale flats and private residential units in Table 4 and their price trends in Table 2.

There is apparently little association between private housing prices and the overall HOS/PSPS production. However, when it comes to different regions in Table 4,

clearly, there is an "over" supply of HOS flats (see "difference" column) in Kowloon relative to Hong Kong Island. The difference in supply is 13.7% in Kowloon and 61.5% in Hong Kong Island. As shown in Table 2, there were higher public housing prices (93.2% of Price of private flats) in Kowloon than that (72.7%) on Hong Kong Island in 2001. There was also a wider gap of difference in 1997 (compare 73.1% in Kowloon with 34.2% on Hong Kong Island in 1997, as shown in Table 2). Even in the sudden cessation of HOS/PSPS sales between 2001 and 2002, and from 2003 onwards, its supply is not, in general, negatively related to private housing price, as it should have been so under the pure theory. Empirical tests that follow later will confirm this observation.

Empirical Results

Results of Unit Root Tests

Unit Root Tests are essential to test stationarity of time-series data. Spurious results in the analysis might be obtained if the time series variables involved are non-

stationary stochastic processes. Table 5 below displays the results of the ADF Unit Root Tests. The Tests reject the null hypothesis of a unit root for HOS and PRIVATE in all three periods under study, except for PRIVATE in 1998Q1-2003Q1, in levels, suggesting that unit root does not exist. The HOS and PRIVATE data series are therefore stationary at the 1% significance level. PINDEX and RINDEX are integrated of order one, I(1). The first-differenced series of PINDEX and RINDEX achieve stationarity at the 1% significance level in the 1978Q1-2003Q1 and 1978Q1-1997Q4 periods. In other words, the unit root results thus provide support for the random walk hypothesis for PINDEX and RINDEX, the series of which, in level, seems to show no definite trend. But the first-difference series of them become stationarity. The Durbin-Watson statistics of the HOS time-series data fall within the range of critical values, suggesting that autocorrelation does not exist.

Table 5 - Results of Unit Root (ADF) Test

Variable and Period	At the level (No Trend)			First Differenced (Trend)		
	N	ADF	DW	N	ADF	DW
HOS						
1978Q1 - 2003Q1	101	-6.153658*	2.256497	101	-17.00052*	2.586466
1978Q1 - 1997Q4	80	-5.281132*	2.258627	80	-16.65483*	2.635808
1998Q1 - 2003Q1	21	-3.686096*	1.732240	21	-5.801307*	2.527361
PRIVATE						
1978Q1 - 2003Q1	101	-3.008029*	2.937937	101	-19.87034*	2.289895
1978Q1 - 1997Q4	80	-2.669002*	3.036256	80	-19.37101*	2.320138
1998Q1 - 2003Q1	21	-1.382643	2.304148	21	-6.309715*	2.065658
PINDEX						
1978Q1 - 2003Q1	101	0.057196	0.724990	101	-4.695045*	1.922631
1978Q1 - 1997Q4	80	4.813277	1.497374	80	-4.515383*	1.632764
1998Q1 - 2003Q1	21	-3.939064*	1.262778	21	-3.205873	1.997037
RINDEX						
1978Q1 - 2003Q1	101	0.747999	0.958907	101	-5.844787*	2.075427
1978Q1 - 1997Q4	80	4.813277	1.497374	80	-6.694081*	1.982878
1998Q1 - 2003Q1	21	-4.040218*	0.766880	21	-2.178940	1.792402

Notes:

*, ** and *** indicate significance at the 1, 5 and 10% levels respectively with the computed t-statistic being less than ADF critical value.

We can reject the null hypothesis, i.e., unit root does not exist.

Correlation Tests

Table 6 below shows the Pearson pair-wise correlation matrix of each with all the other HOS, PRIVATE, RATIO, TOTAL, PINDEX and RINDEX variables. As shown, overall, the association between HOS and PINDEX is weak. The Pearson correlation coefficient for 1978Q1-2003Q1 is 0.23, and for 1978Q1-1997Q4 is 0.27. By contrast, the association between HOS and PINDEX for 1998Q1-2003Q1 is moderate, at 0.45. The correlation between HOS and RINDEX is 0.44 over the same period. The correlation is positive, suggesting the production increases / decreases with price indices only in the post-1997 period.

Table 6 – Pair-wise Correlation Matrix

1978Q1 - 2003Q1 (N=101)

	HOS	PINDEX	PRIVATE	RATIO	RINDEX	TOTAL
HOS	1.000000					
PINDEX	0.230795	1.000000				
PRIVATE	-0.009102	-0.176390	1.000000			
RATIO	0.910403	0.217413	-0.246453	1.000000		
RINDEX	0.236623	0.967646	-0.129451	0.224076	1.000000	
TOTAL	0.734721	0.051333	0.671654	0.507321	0.087494	1.000000

1978Q1 - 1997Q4 (N=80)

	HOS	PINDEX	PRIVATE	RATIO	RINDEX	TOTAL
HOS	1.000000					
PINDEX	0.267958	1.000000				
PRIVATE	-0.053990	-0.182562	1.000000			
RATIO	0.895825	0.282423	-0.327474	1.000000		
RINDEX	0.288137	0.964642	-0.121860	0.298205	1.000000	
TOTAL	0.711740	0.072467	0.662992	0.441250	0.130298	1.000000

1998Q1 - 2003Q1 (N=21)

	HOS	PINDEX	PRIVATE	RATIO	RINDEX	TOTAL
HOS	1.000000					
PINDEX	0.453322	1.000000				
PRIVATE	0.144030	-0.197710	1.000000			
RATIO	0.971515	0.373296	0.057251	1.000000		
RINDEX	0.440089	0.952377	-0.285352	0.381596	1.000000	

TOTAL	0.801000	0.204002	0.707791	0.728166	0.141535	1.000000

Granger-causality Tests

Table 7 below shows the results of the Granger-causality test at lag = 1. In both 1978Q1-2003Q1 and 1978Q1-1997Q4 periods, the null hypothesis of no granger causality between HOS and the Price Index (PI) cannot be rejected at the 0.01 and 0.05 level of confidence at lag = 1. In other words, HOS does not "Granger cause" PI. However, PI does "Granger cause" HOS at the 0.01 level in the said two periods, so does the Rent Index (RI) "Granger cause" HOS. In the post-1997 period (1998Q1-2003Q1), HOS and PI do not "Granger cause" each other. The Test results for lag = 2 in table 8 are similar, except in 1998Q1-2003Q1 the Granger causality for HOS and PI is significant at the 0.05 level.

Table 7 - Granger Causality Results (Lag = 1)

Period	Direction of Causality	F - Statistic	p - Value
1978Q1 - 2003Q1	PI ---> HOS	7.33662*	0.00799
(N = 101)	HOS ---> PI	0.28048	0.59760
	RI ---> HOS	7.89267*	0.006
	HOS ---> RI	0.27319	0.60239
	PI ---> PRIVATE	3.70653	0.05713
	PRIVATE ---> PI	0.31856	0.57377
	RI ---> PRIVATE	1.83167	0.17908
	PRIVATE ---> RI	1.40478	0.23882
	PI ---> TOTAL	0.40565	0.52569
	TOTAL ---> PI	1.74-05	0.99670
	RI ---> TOTAL	1.13766	0.28880
	TOTAL ---> RI	0.17713	0.67478
1978Q1 - 1997Q4	PI ---> HOS	9.41361*	0.00298
(N = 80)	HOS ---> PI	0.55246	0.45960
	RI ---> HOS	11.6477*	0.00103
	HOS ---> RI	1.05253	0.30818
	PI ---> PRIVATE	3.30428	0.07304
	PRIVATE ---> PI	0.42037	0.51871
	RI ---> PRIVATE	1.26595	0.26407
	PRIVATE ---> RI	1.42957	0.23555
	PI ---> TOTAL	0.63779	0.42700
	TOTAL ---> PI	0.00640	0.93646
	RI ---> TOTAL	2.16443	0.14537
	TOTAL ---> RI	0.01274	0.91042
1998Q1 - 2003Q1	PI ---> HOS	0.44616	0.51313
(N = 21)	HOS ---> PI	4.23826	0.05518
	RI ---> HOS	0.37821	0.54670
	HOS ---> RI	2.59241	0.12579
	PI ---> PRIVATE	1.91079	0.18477
	PRIVATE ---> PI	1.24628	0.27980
	RI ---> PRIVATE	3.97401	0.06251
	PRIVATE ---> RI	1.91743	0.35158
	PI ---> TOTAL	0.18913	0.66911
	TOTAL ---> PI	4.33045	0.05287
	RI ---> TOTAL	0.54707	0.46961
	TOTAL ---> RI	2.65254	0.12177

Notes:

The null hypothesis of no causality is rejected if F statistic exceeds the critical value,
or p-value is less than 0.01.
* and ** indicate, respectively, the "Granger-causality" is significant at the 0.01 and 0.05 level.

Table 8 - Granger Causality Results (Lag = 2)

Period	Direction of Causality	F - Statistic	p - Value
1978Q1 - 2003Q1	PI ---> HOS	6.20849*	0.00293
(N = 101)	HOS ---> PI	0.35131	0.70468
	RI ---> HOS	6.21547*	0.00292
	HOS ---> RI	0.83892	0.43539
	PI ---> PRIVATE	1.37811	0.25710
	PRIVATE ---> PI	0.44246	0.64379
	RI ---> PRIVATE	0.98574	0.37699
	PRIVATE ---> RI	1.38417	0.25559
	PI ---> TOTAL	1.85801	0.16166
	TOTAL ---> PI	0.0795	0.92364
	RI ---> TOTAL	2.50701	0.08695
	TOTAL ---> RI	0.35359	0.70309
1978Q1 - 1997Q4	PI ---> HOS	5.70872*	0.00497
(N = 80)	HOS ---> PI	0.67071	0.51447
	RI ---> HOS	5.79983*	0.00460
	HOS ---> RI	7.76997	0.46675
	PI ---> PRIVATE	1.24886	0.29289
	PRIVATE ---> PI	0.25375	0.77656
	RI ---> PRIVATE	0.49253	0.61309
	PRIVATE ---> RI	1.00239	0.37280
	PI ---> TOTAL	1.19848	0.30752
	TOTAL ---> PI	0.06471	0.93740
	RI ---> TOTAL	1.35142	0.26527
	TOTAL ---> RI	0.05505	0.94648
1998Q1 - 2003Q1	PI ---> HOS	4.86711**	0.02485
(N = 21)	HOS ---> PI	4.28599**	0.03531
	RI ---> HOS	3.30150	0.06689
	HOS ---> RI	1.56157	0.24424
	PI ---> PRIVATE	0.77530	0.47936
	PRIVATE ---> PI	2.57525	0.11159
	RI ---> PRIVATE	1.14552	0.34614
	PRIVATE ---> RI	0.84240	0.45138
	PI ---> TOTAL	2.14654	0.15378

TOTAL ---> PI	9.10921*	0.00293
RI ---> TOTAL	0.67482	0.52506
TOTAL ---> RI	2.37565	0.12932

Notes:

The null hypothesis of no causality is rejected if F statistic exceeds the critical value,

or p-value is less than 0.01.

* and ** indicate, respectively, the "Granger-causality" is significant at the 0.01 and 0.05 level.

Conclusions

The objective of the study is to investigate the relationships between the production of subsidized sale flats and private residential property prices and the impact of the former on the latter, particularly when there is a sudden freeze of HOS/PSPS flat production. This study has determined the presence of the supply-price relationship and quantified the relationship. It has also examined possible substitution and complementary effects of the public and private housing sectors.

The empirical results show that the association of these two variables is week in general except that there is a direct relationship between HOS/PSPS production and private housing prices in the post-1997 period. This suggests that the drop in such production had been met with falling housing prices after the financial crisis in 1997 and that there was no overlapping of supply of flats in private and public sectors. Overall, HOS/SPS flat production, in the long term, does not seem to determine private housing prices, nor does it “Granger cause” or lead to higher or lower prices.

In recent years, buying a HOS/PSPS flat, as it seems, have become less attractive to sitting tenants in public housing and private sector applicants. It can be viewed as no direct substitute or threat to the post-crisis private housing sector in Hong Kong. Nor would the sudden shortage of HOS/PSPS flats generate housing price volatility in the short run. The implementation of a moratorium on all sales of HOS/PSPS flats is not meant to rejuvenate the current sluggish market but arguably leads to a more efficiency in the allocation of public money.

The findings here may potentially provide policy makers with a tool which contributes to evaluation of a public housing programme in a more accurate and comprehensive manner clarifying the “ripple effects” between sectors. As such, policy makers may adjust public housing supply including the subsidized sale flats in a more

precise and predictable manner to attain their policy objectives, such as price, ownership, and affordability goals--- i.e. using the statistical relationship discovered regarding public housing supply and private property prices. This study is the first attempt to study the interactions between public supply of subsidized sale flats and private property prices. The models and the results here will provide a foundation upon which to establish a refined analytical framework for further research.

--- The end --

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