

RELATIONSHIP BETWEEN THE LAND-USE PLANNING SYSTEM, LAND SUPPLY AND HOUSING PRICES IN HONG KONG

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Abstract

Hong Kong has been faced with property market ups and downs for many reasons over the past ten years or so. It once experienced shortages of housing supply, leading to prolonged escalating prices. This was followed by a downturn of housing prices since the end of 1997 and in the wake of the financial turmoil in Asia. Hong Kong people have been very concerned with the housing market situation, particularly housing prices, and consider that the problem needs to be addressed to prevent its recurrence in the future. To address the problems arising from “market failure”, the Hong Kong government uses its land-use planning system to impose constraints on land supply and development. Such system includes: Town Planning and Buildings legislation and government land lease conditions. On the other hand, it controls land supply through various means, such as by altering the volume of land auction and tender, lease modifications and land exchange. All this fundamentally has a strong bearing on housing prices.

This research investigates the relationship between the land-use planning system, land supply and housing prices in Hong Kong; how the “land-use planning system and constraints” influence land supply in general and the residential property market in particular and whether it is justifiable to amend, relax, or revamp some or all of constraints and the “how” in the context of Hong Kong in order to address this dilemma. Lessons from this study should also be applicable to other places in the world, for example Singapore and Mainland China.

1. Introduction

Hong Kong faces a shortage of housing supply, due primarily to limited developable or re-developable land relative to the keen demand for different types of land uses by its sizable population. Hong Kong has an area of 1098 km², of which 184 km² are developable lands (Census and Statistics Department, 2000). Residential land accounts for only 32% of the developable land in Hong Kong. With a total population of 6,720,200³ (the number of households in Hong Kong is about 2,050,800), there is a persistent demand of land supply for housing. This has led to the high population density, reaching an average population density of 6,310⁴ persons per square kilometer, compared with other cosmopolitan cities such as London (4483 persons per square kilometer), Singapore (6088 persons per square kilometer) and Tokyo (5384 persons per square kilometer). On the other hand, the housing shortage results in prolonged

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³ The total population in 1999 was 6,720,200 (as quoted from the Hong Kong Annual Digest of Statistics, 2000)

⁴ The population density in 2000 was 6,310 persons per square kilometer (as quoted from the Census and Statistics Department's webpage)

escalating prices, partly fueled by speculation. Loh (1998) criticized that the Government controls land supply and its policies “have not prevented a housing shortage and have led to extremely high land and property prices”. (South China Morning Post, 8 Feb. 1998).

As land is so scarce in Hong Kong, the appropriate use of land to meet different land use demand becomes an important issue. The government uses its land use planning system to regulate or impose constraints on land supply and development – to address the problems arising from “market failure”. The planning system in Hong Kong has been subjected to most criticisms. For instance, developers have complained that “land approval procedures were slow, bureaucratic and inherently anti-development” (S.C.M.P, 6th June 1997). Lai (1997) pointed out that the reasons put forward by the Town Planning Board in rejecting planning applications are often so vague and general there is no assured method by which an applicant can revise the original submission in order to get through the approval process in a new application or review. This agrees with Staley(1994) that the planning application process increased uncertainty in the development process, since public administrators had discretion over determining the types, pace and pattern of development on district level.

The government itself is dissatisfied with the fluctuating property market in the past with property values either rising too rapidly or falling drastically, which leads to many undesirable social problems (Ho, 2001). Given the *de facto* long-term constraints on land supply, the Government recognises the need to increase supply to provide affordable housing for households. The Housing Branch (1997) has also acknowledged that the “small the gap between the supply and demand for private housing, the lower the pressure on domestic property prices”. The paramount question for the Government is to resolve the dilemma between (1) the policy of providing adequate and affordable housing against the shortage of housing supply and (2) the land use regulations for control on residential development.

This Paper starts with the preliminary introduction of the planning system and a review on the previous literature on the relationship between the land-use planning system, land supply and housing prices in Hong Kong. An analytical model will then be formulated. This will be followed by the discussion of the findings of the empirical study on the impacts of the land use regulation on land supply, housing supply and housing price in Hong Kong. Based on the findings, recommendations for policy change on the land supply/regulation for housing will be drawn.

2. The Planning System in Hong Kong

In order to understand the impact of planning system on housing and land markets, it is inevitable for us to get a basic understanding of the planning system in Hong Kong. The two principal bodies responsible for town planning in Hong Kong are the Committee on Planning and Land Development (CPLD) and the Town Planning Board (TPB). The CPLD determines the long-term development strategies and major proposals for land development, evaluates major planning studies, development plans and programmes,

formulates land use planning standards and policies for land development and considers departmental town plans. The TPB is a statutory body appointed by the Chief Executive under the Town Planning Ordinance to prepare statutory plans and consider applications for planning permission under these plans. The Planning Department takes policy directives from the CLPD, the Planning and Lands Bureau and the Housing Bureau and services the TPB and is responsible for formulating, monitoring and reviewing urban and rural planning policies and associated programmes for the physical development of Hong Kong. It deals with all matters relating to land use planning at the territorial, sub-regional and district levels (Information Services Department, 1999).

Statutory plans are prepared by the Town Planning Board (TPB) under the Town Planning Ordinance (Chapter 131). Attached to each statutory plan is a Schedule of Notes showing the uses which are always permitted (Column 1 uses) in a particular zone and other uses for which the TPB's permission must be sought (Column 2 uses). The statutory plans control both the use and density of development. Section 16 of the Town Planning Ordinance enables the TPB to grant permission for uses under Column 2 of the Notes. The TPB shall consider applications within two months and may approve the application with or without conditions or refuse to grant permission applied for. In view of the mechanisms of planning application and zoning, we observe that the Planning Department has the power to control the density of development, the use of the site and the approval rate of development.

3. Literature Review

Land use planning is regarded as a mechanism for the government to exercise its control on the urban development process. There are theories which advocate that land use regulations (such as zoning and growth controls) may affect property market by constraining supply and increasing demand. Gerald (1992) states that the planning system restricts land supply in four main ways: (1) restricting the total quantity of housing land made available; (2) restricting the location of land that is made available; (3) restricting the way that the available land is developed; and (4) changing the timing of development. A limited number of empirical researches have attempted to test this relationship in order to capture the real impact of government regulation on housing supply. Mayo and Sheppard (1996) undertook a comparative study on the impact of regulatory control on housing supply in Malaysia, Thailand and Korea. These countries adopt different degree of development control. Korea has relatively strict development control while Thailand has little effective regulation of development. Malaysia offers an intermediate case. Empirical findings confirm that countries with more restrictive planning systems have reduced supply elasticities. The paper suggests that the "stochastic development control" (this refers to a situation which exists when governments regulate and limit the nature, timing, or extent of housing development in a way which cannot be forecast or known with certainty) introduced by the planning bureaucracies may alter the structure of housing supply.

Subsequent to Mayo and Sheppard's study, Mayer and Somerville (1999) established a structural model describing the relationship between land use regulation and residential

market supply. They considered two types of land use regulations, namely, those that impose explicit financial costs on builders (development or impact fees) and those that delay or lengthen the development process. The model shows that in the absence of input prices for land, housing starts are properly specified as a function of changes in the level of house prices, and not as a direct function of the level itself. Based on the quarterly data on a panel of 44 US metro areas, the authors found that land use regulations have a significant effect on both the steady state level of new construction and the responsiveness of local supply to price shocks.

In order to identify the key variables of land and housing price determination for the purpose of formulating the analytical model, it is necessary to draw upon the overseas literature due to limited local studies. There are a considerable amount of studies done in 1970s and 1980s. A regression study on New Jersey communities by Sagalyn and Sternlieb (1973) concluded that zoning increases housing costs. Seidel (1978) argued that the increase in housing prices is caused by the widespread adoption of local ordinances restricting the rate and form of development. Buttler (1981) investigated the impact of land use zoning on housing rent, land rent, the design parameters of a building and population density in a residential city. A theoretical land use model was used. The study shows how both land use zoning and housing attributes determine housing rent, and rent and design parameters in equilibrium. Other studies include Urban Land Institute and Gruen Associates (1977), Frieden (1979), Case and Gale (1981), Elliott (1981), Dowall and Landis (1982), Dowall (1984) and Stanford Environmental Law Society (1989). In particular, Dowall and Landis, and Elliott employed regression analysis in their studies, and all concluded that growth controls raised housing prices.

Based on the previous researches, a number of refined studies have been undertaken in 1990s. Bramley (1993) studied the impact of land use planning and tax subsidies on the housing supply and price in Britain. He performed a cross sectional analysis at the inter-urban level to express the degree of variation in the supply elasticity and in the impact of policy measures on local housing markets. A model was developed to represent the effects of planning policies on the supply elasticity. Evans (1996) subsequently raised questions concerning Bramley's method of using cross sectional data for time series analysis. One of the main flaws, in which Evans raises, is that the data collected for Bramley's analysis was in the year when England's housing prices was at its peak, thus creating a moderately biased environment. In response to the comments, Bramley (1998) further examined the indicators of planning constraint and its impact on housing land supply. A range of quantitative and qualitative measures of planning restraint developed in the context of cross-sectional modeling of housing supply in England were examined. These indicators were assessed, first, in a priori terms, second, in terms of their interrelationships, and, third, in terms of their performance in statistical explanation of variations in a number of outcomes relating to the supply of land with planning permission for housing, new housebuilding, the share of urban land, density and house prices. It is found that certain quantitative measures are crucial in modeling land supply and housing development outcomes. The structure-plan housing provision 'numbers' and the amount of land zoned in local plans are important for the flow of land into the system, whereas the stock of land with permission is the key driver of new building in

conjunction with demand and/or prices. Moreover, four main dimensions of planning policy and constraint were identified by means of factor analysis, namely, 'the dimension of land area which is or is not subject to formal constraints of existing built-up area, greenbelt or AONB'; 'informal constraints'; 'reduced provision'; and 'environmental capacity and/or subjective restraint'.

Hannah *et al* (1993) also analysed the effects of land use controls over land supply on housing in Korea. Through a case study of five Seoul development projects, it is found that a substantial part of the rise in housing prices has resulted from the government's tendency to underallocate land for residential use. Monk & Whitehead (1996) also undertook a similar study on the impact of land use planning controls on the supply, price and type of dwellings provided. The study reveals that planning raises the land and housing prices by affecting land supply in different locations, densities, type and mix of houses built in different localities, and speculative behaviour and volatility.

To a large extent, most of the overseas literature suggests a relationship between land use regulation and housing supply/price. Land use planning affects the property market by restraining the location and the density of supply, thus increasing price. Empirically, land use regulation has an effect on housing supply elasticity, though the degree of impact will vary in different contexts. Land availability tends to be an important variable in affecting the property market.

However, in Hong Kong, there has never been any research adopting econometric model to study the effects of land use planning system on the housing market. Only Tang and Choy (2000) tried to use a logistic regression analysis on office development applications in urban Kowloon of Hong Kong. Most researchers tend to adopt quantitative approach in analyzing the relationship between land supply, housing demand and housing supply, disregarding the planning issues (Peng and Wheaton, 1994; Tse, 1998; Tse *et al.*, 1999; Hui and Lui, in press 2002). For example, Tse (1998) conducted a study to examine the impact of land supply on housing prices in Hong Kong. The Granger causality test was used in the study, fitted with annual data from 1976 to 1995, to test whether land supply affects housing prices. The results show that there is no causality between land supply and housing prices in Hong Kong. A later study by Tse (1999) focused on the determinants of house prices and investment demand for residential property. Specifically, it examined the role of population growth, transaction volume, inflation and interest rate in determining house prices. A reduced-form equilibrium model to explain change in house prices in Hong Kong was developed. For qualitative study, there are numerous studies discussing various aspects of the planning system (Bristow, 1984; Planning Department, 1995; Lai, 1996, 1997, 2000; Tang and Leung, 1998; Yeung, 1998). All this concerns the debates of the planning policy and the statutory planning enforcement mechanism.

In view of the above, housing prices are affected by economic, demographic and other supply and demand factors. Overseas literature considers that planning also has a significant impact on housing market by affecting locations, densities and uses of land

supply. Below is a summary of the critical planning factors that have been mentioned in previous paragraphs:

- The adoption of local ordinances restricting the rate and form of development
- The housing provision numbers noted on the structure plan
- The amount of land zoned
- The stock of land with planning permission
- The government's tendency to underallocate land for residential use

These can act as guidelines for the establishment of the planning indicators which will be mentioned in our model specification (see section 5E).

Although the housing problem in Hong Kong has attracted considerable scholarly attention, there appears to be limited research on the effects of the land use planning system on the land and housing markets except a few overseas studies (Bramley, 1998; Gerald, 1992; Monk & Whitehead, 1996). What are the impacts of land use planning on the housing market in Hong Kong? How can adequate and affordable housing be achieved through planning control? In order to fill this gap of knowledge, this study attempts to investigate the relationship between the land use planning system, land supply and housing prices in Hong Kong; how the "land-use planning system and constraints" influence land supply in general and the residential property market in particular. Based on the findings of the empirical study, it is hoped to draw some insights for policy direction in the land use planning and the residential market in Hong Kong

4. The Model

Section 3 has discussed all the determinants that affect housing prices, including planning and economics factors. These determinants apply to Hong Kong and also the region. This section aims to establish a model for analyzing the relationship between housing price and these factors.

In order to study the effect of planning system on the housing demand and housing supply, we attempt to integrate planning indicators into the econometric analysis of the housing market. Political changes may have a bearing on the housing market; and the return of Hong Kong's sovereignty to China might have affected housing prices. However, that was not the case. Housing prices remained steadily upwards in 1997 until the impact of the Asian financial turmoil. This has caused subsequent effects. First, there was an acute downturn of economic performance of the territory. That led to a dramatic decline in prices and transaction volume. All these changes can be proxied by the economic performance.

We adopt time series regression to identify the relationship between housing price, land supply and land use planning. The literature review section has suggested that the performance of the housing market is determined by the interaction of both demand and supply factors. Equation (1) and Equation (2) are first established to structurally present

the housing demand and housing supply situations in Hong Kong. They draw out the overall picture of the housing market. In view of the previous studies, the availability of data in Hong Kong and the situation of Hong Kong, we have selected and incorporated some of the relevant demand and supply factors into the model. The demand factors we have chosen include income, employment, demographic and economic factors. For the supply factors, they include the amount of land supply and the planning constraints. The detailed description of the data will be given in the following section. The core assumptions of the regression model are as follows:

- (a)The model is of medium flow equilibrium with lags. Under market equilibrium, quantity demanded equals quantity supplied.
- (b)There may be time-lag effects of some explanatory variables so that the market functions in a sequential way.
- (c)Planning policies are in part responsive to market demand and in part autonomous.

Given these assumptions, we may therefore write out expressions for the supply of and demand for housing units of the Hong Kong housing market in the following manner. The quantity demand function is

$$Q_D = a_1 HP + a_2 I + a_3 GDP + a_4 POP + a_5 UE + a_6 ASP \dots \dots \dots (1)$$

and the quantity supply function is

$$Q_s = b_1 LS_{t-3} + b_2 UFA + b_3 GB_{t-3} + b_4 AR_{t-3} + b_5 RZ_{t-3} + b_6 GA_{t-3} + b_7 HP \dots \dots (2)$$

- Where
- HP = average housing price
 - I = average household Income
 - GDP = gross domestic product
 - POP = population
 - UE = unemployment rate
 - ASP = agreement for Sales and Purchase
 - LS = land supply includes auctions, tenders, private treaty grants, letter A/B
 - UFA = residential usable floor area completed
 - GB = area of greenbelt and open space zoning
 - AR = approval rates of planning applications
 - RZ = area of residential zoning
 - GA = approved total gross floor area of planning applications
 - t-3 = 3 years time lag

The above are the structural equations for the supply of and demand for housing respectively. As there is no available information about quantity demanded, we are unable to separately identify the equations (1) and (2), but we can estimate the reduced form. As the quantity demanded (Q_D) equals the quantity supplied (Q_s) under market equilibrium, i.e.

$$Q_D = Q_s \dots \dots \dots (3)$$

We can get the reduced form by re-arranging the equations, then

$$HP = g + a_2 I + a_3 GDP + a_4 POP + a_5 UE + a_6 ASP + b_1 LS_{t-3} + b_2 UFA + b_3 GB_{t-3} + b_4 AR_{t-3} + b_5 RZ_{t-3} + b_6 GA_{t-3} \dots \dots \dots (4)$$

After re-arranging and reparametrising the equations, the factors which affect housing price significantly can be identified under model testing.

5. Data

Following model specification, this section discusses the data sources; and explains each variable and its hypothesized impact. Relevant data are extracted from various issues of Hong Kong Property Review, issued by the Rating and Valuation (R&V) Department, and the Monthly Statistics, issued by the Census and Statistics (C&S) Department. The planning data are collected and modified from the Planning Department. The sample quarterly data cover from 1988 Q1 to 2000 Q4 and consist of 52 observations.

Dependent Variable

Housing Price (HP). Quarterly average housing prices are derived from the transaction records published in Hong Kong Property Review by the R&V Department. The data adopted are the average housing prices of five classes in four districts. The five classes range from Classes A to E with saleable area not exceeding 39.9 m², 40 m² to 69.9 m², 70 m² to 99.9 m², 100 m² to 159.9 m².and area of at least 160 m² respectively. The three districts include Kowloon, New Kowloon and New Territories. As the quarterly average housing price includes all classes across the whole territory for each quarter, it is a proxy of the aggregate housing price level.

Independent Variables

A. Indicators of Economic Factors

Average Household Income (I). It is the quarterly median household income obtained from the Quarterly Report on General Household Survey issued by the Census and Statistics Department. Ganeson and Ho (1994) suggest that the ability to pay for home ownership is supported by current household income, estimated future household incomes and current and future assets of the households. An increase in income level leads to higher affordability to pay for home ownership if the housing price keeps constant.

Gross Domestic Product (GDP). It is always an indicator of the performance of the local economy. An increase in GDP would mean an improvement in wealth and income levels among local people. The increase in household incomes would normally raise housing demand and housing prices. The data are from Hong Kong Monthly Digest of Statistics.

B. Indicators of Demographic Factors

Population (POP). Population growth puts direct pressure on housing demand, particularly when the growth stems from the affordable group with home buying needs. A high level of population growth tends to cause higher future housing prices when the supply of housing units cannot meet the demand. However, there are no official quarterly population statistics available in Hong Kong. Therefore, the half-yearly population statistics cited from Hong Kong Annual Digest of Statistics are transformed to quarterly data and the missing data are estimated by taking the average of two nearby values.

Unemployment Rate (UE). The unemployment rate figures are obtained from the Hong Kong Annual Digest of Statistics. The data include all age and sex groups. The higher the unemployment rate, the lesser the people have the affordability to purchase housing units, which leads to decreases in demand. As Green and Henderscott (1999) explain, the region is more likely experiencing recession when people lose their jobs. It is this recession which can drive down the price of the house.

C. Indicator of Market Factors

The Agreement for Sale and Purchase(ASP). This is the Agreement for Sales and Purchase of property that are registered with the Land Registry. Since the transactions may involve short-term resale of property for anticipation of capital gains, which is generally labeled as speculations. The transaction volume may reflect the speculative demand for property. Tse, Ho and Ganesan (1999) apply the Granger causality tests on the annual residential property prices from 1975 to 1995. Their findings suggest that the transaction volume is “Granger causing” to the housing prices in Hong Kong. Speculative demand is expected to contribute to price increases to some extent. Since there is no official quarterly data on transaction volume, and then the quarterly transaction volume is calculated by summing up of all the monthly transactions within that quarter from Hong Kong Annual Digest of Statistics (see Hui and Lui, in press 2002).

D. Indicators of Land and Housing Supply

Usable Floor Area (UFA). This is the usable floor area of newly completed residential buildings in Hong Kong. The figures include buildings of the Hong Kong Housing Society, Private Sector Participation Scheme of the Hong Kong Housing Authority and private buildings. The data are collected from the Annual Digest of Statistics issued by the Census and Statistics Department. This figure represents the new housing supply.

The increase in the provision of usable floor area will decrease the housing price, *ceteris paribus*.

Land Supply(LS). This is the overall disposal of government land by means of public auction, public tender, private treaty grants, letter A/B in both Urban Areas and the New Territories. Land uses include pure residential use and composite residential and commercial use. The data are collected from the Annual Digest of Statistics. After buying a site, developer needs to produce certain amount of residential floor area within a few years in accordance with the lease conditions. The developers at least take several years to turn the site into housing units. It is expected that an increase in housing production in future will decrease future housing price. As the land supplied by the government is readily developable, it requires 6 months to 12 months further for the building plan approval and 2 years to 3 years for the construction period, it is therefore assumed that the average development period after obtaining the land is 3 years. Therefore, 3 years time lag of land supply is being tested.

E. Indicators of Planning Constraints

In Hong Kong, there is a lack of readily available and easily interpretable measures of planning constraints. Having examined the planning policy and the massive and scattered information, the extent of the policy constraints are considered to be reflected by the approved residential gross floor area of planning applications, the area of residential and restricted zones and the approval rates of planning applications respectively.

Approved Residential Gross Floor Area of Planning Applications(GA). This is the total residential gross floor area of all the planning applications which have been approved by the Planning Department. The data can only be obtained on the computer in the office of the Planning Department. The residential gross floor area of the planning applications has to be checked case by case. This indicator implies the concept of development density control. The more the residential gross floor area has been approved, the more the relaxation is on the development density. The higher the development density will finally lead to an increase in housing supply and a decrease in housing price.

Residential Zones(RZ) and Greenbelt/Open Space Zones(GB). There are no readily available data provided by government departments. For the area of residential zones, it is the total area of all zones which involve residential use. These zones include Residential (Group A), Residential Group (B), Residential Group (C), Residential Group (D), Residential Group (E), Commercial/Residential (C/R), Village (V) and Comprehensive Development Area (CDA). The area of greenbelt and open space zones reflect the planning constraints. The area figures were taken off from Outline Zoning Plans of all districts in Hong Kong. Mayor and Somerville (1999) have built a model describing the relationship between land use regulation and new residential construction. They conclude that land use regulations such as zoning and growth control have

significant effects on both the steady state level of new construction and the responsiveness of local supply to price shocks. The increase in the area of residential zoning will relax the constraints on housing supply, which leads to a decrease in housing price. However, as no residential developments are allowed in greenbelt and open space zoning, the increase in greenbelt and open space zonings will further constrain the housing supply, which causes the decrease in housing price.

Approval Rate of Planning Applications (AR). This is the percentage of the number of approved planning applications involving residential use against the total number of planning applications involved residential use. The data can only be obtained from the computers provided in the office of the Planning Department. The approval rate of planning applications is one of the indicators of planning constraints. The higher the approval rate of planning applications, the more the housing units will be produced. This will in turn decrease the housing price in future, ceteris paribus.

All three planning indicators are assumed to have three years time lag effect on the housing market. It is assumed that no lease modification is required after zoning or planning approval. After zoning or obtaining planning approval, it still needs 2 -3 years for development. Thus , these 3 factors with 3 years time lag effect are being tested.

The descriptive statistics for the data are put forth in **Table 1**.

Table 1 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
I Average Household Income (HK\$)	52	8797	26884	18433	5480
GDP Gross Domestic Product (fixed price at 1980) (HK\$Mn)	52	55041	103106	78285	12274
POP Population	52	5621450	6974800	6171397	440562
UE Unemployment rate (seasonally adjusted %)	52	1.30	6.20	2.8577	1.4748
ASP No. of agreements for sales and purchase of building units	52	11743	62843	29022.96	12222.78
LS Land supply includes auctions, tenders, private treaty grants, letter A/B with 3 years time lag (m2)	52	1025	475817	102463	120819
GA Approved total residential gross floor area of planning applications with 3 years time lag (m2)	52	52054	3237502	836819	863634
GB area of greenbelt and open space zoning with 3 years time lag (hectares)	52	7946	15597	12252	2614
RZ area of residential zoning with 3 years time lag (m2)	52	3393	16140	7842	4936
AR approval rate of planning applications with 3 years time lag (%)	52	.21	.80	.5000	.1289
UFA residential usable floor area completed ('000m2)	52	18	249	100.19	45.28
Valid N (listwise)	52				

6. Expected Results

The above expectations of the impact of various factors on the housing price are shown in **Table 2**. The economic condition of Hong Kong is reflected by the average household income and the gross domestic value. It is expected that a better economic condition will generate a greater demand for housing and the housing price will eventually rise. For the demographic factor, it is represented by the population and unemployment rate. The increase in population will bring more demand for housing units, however the increase in unemployment rate will decrease the purchasing power of people and the housing price will drop eventually due to falling demand. The Agreement for Sales and Purchase is an indicator of market atmosphere. The hot market sentiment will steer up housing price.

For the supply side factors, the land supply through auctions, tenders, private treaty grants and letter A/B, and the newly built residential usable floor area reflect the housing production. It is expected that the increase in the supply of housing units relative to demand, will lead to the decrease in housing price. The area of zonings, approval rates and the approved residential gross floor area of planning applications measure the constraints of planning system. The looser the constraints, such as higher approval rates, more area of residential zonings, lesser area of greenbelt and open space zonings and more approved residential gross floor area of the planning applications, the more the housing production will be. This will eventually lead to lower housing price in future. .

Table 2 Expected Results

Independent Variables	Expected Relationship with Housing Price
I average household Income	+
GDP gross domestic product	+
POP population	+
UE unemployment rate	-
ASP Agreement for Sales and Purchase	+
LS land supply includes auctions, tenders, private treaty grants, letter A/B	-
UFA residential usable floor area completed	-
GB area of greenbelt zoning and open space zoning	+
AR approval rates of planning applications	-
RZ area of residential zoning	-
GA approved total residential gross floor area of planning applications	-

7. Empirical Results

The final equation obtained after “Enter” procedure with the highest explanatory power becomes:

$$HP = 0.826 I - 0.272 GDP + 5.328E-02 POP - 10039.549 UE + 0.243 ASP - 1.375E-03 LS_{t-3} - 49.649 UFA + 2.429GB_{t-3} - 19225.047 AR_{t-3} - 0.201RZ_{t-3} - 4.471E-03 GA_{t-3} - 269273.604 \dots \dots \dots (5)$$

Table 3 reports estimation results for regression of housing price on various demand, supply and planning variable. The coefficient g is a mixture of the parameters from the equation (1) and (2). The adjusted R^2 is quite high, indicating that the model we have chosen fits the actual data quite well. Most explanatory variables are statistically significant at 5% significance level except I, GDP, LS_{t-3} and RZ_{t-3} . We can also see that the estimated coefficients of all explanatory variables except GDP are coherent with the hypothesized signs. This may due to the presence of minor multicollinearity among the variables.

Explanatory variables	Coefficient	t	Sig	Correct Sign
I	0.826	1.451	0.155	Yes
GDP	-0.272	-1.330	0.191	No
POP	5.328E-02	3.278	0.002 *	Yes
UE	-10039.549	-6.024	0.000*	Yes
ASP	0.243	3.13	0.003 *	Yes
LS_{t-3}	-1.375E-03	-2.361	0.873	Yes
UFA	-49.649	-2.361	0.023 *	Yes
GB_{t-3}	2.429	1.898	0.065**	Yes
AR_{t-3}	-19225.047	-2.156	0.037 *	Yes
RZ_{t-3}	-0.201	-0.312	0.757	Yes
GA_{t-3}	-4.471E-03	-2.138	0.039 *	Yes
g	-269273.604	-3.571	0.001 *	

Adjusted $R^2 = 0.922$

F Value : 55.817

Degree of Freedom: 40

Note: *significant at 5% significance level

** significant at 10% significance level

Table 3: Statistical Results of Equation 4

Figures 1, 2 and 3 further illustrate that several normality tests of residual are satisfied. First, the histogram of residuals is approximately close to the picture of the normal distribution. Second, the normal probability plot of standardized residual is obtained. Third, scattered residual plots are obtained as there is no relationship between the predicted and residual value.

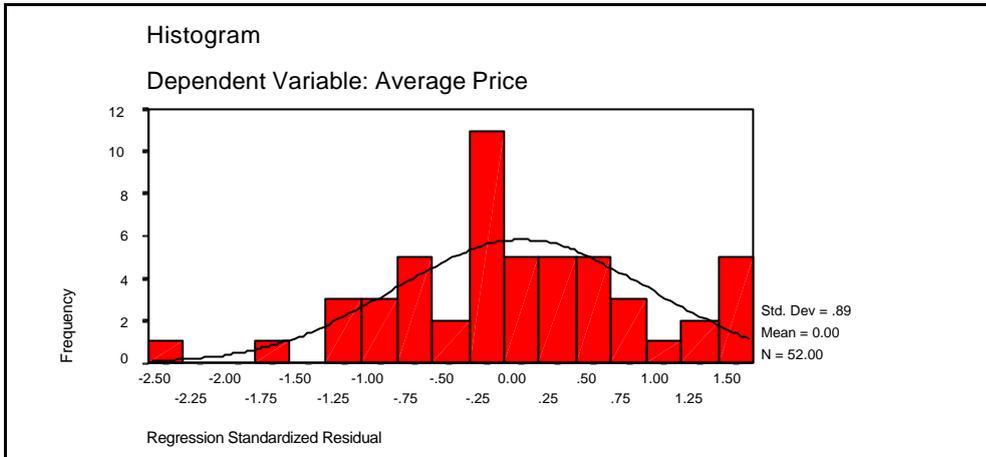


Figure 1

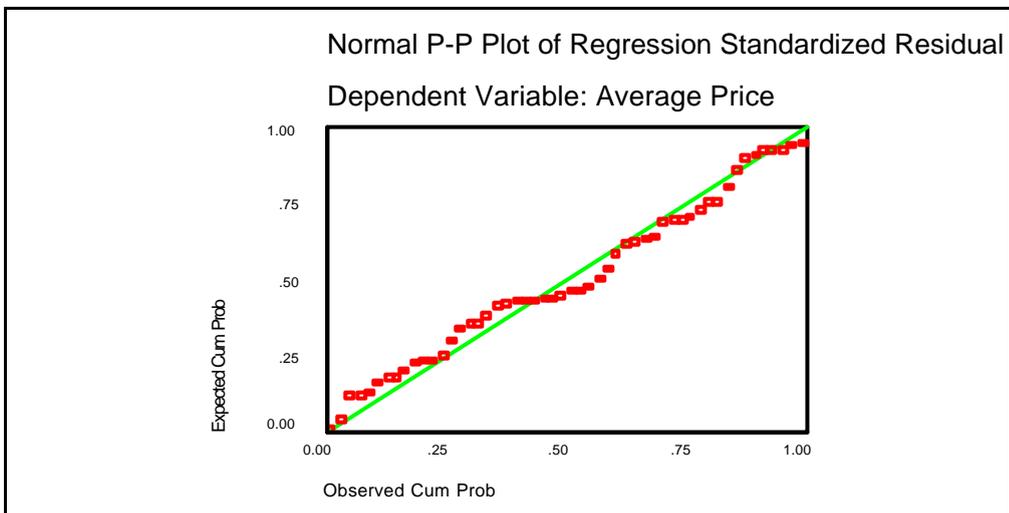


Figure 2

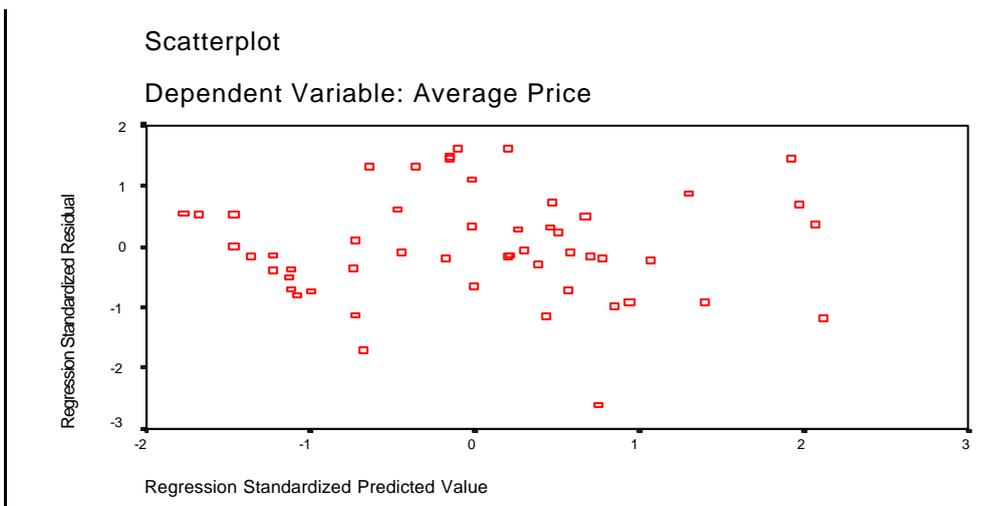


Figure 3

Following the “Enter” procedure, “Stepwise regression” is also adopted. It avoids working with more variables than are necessary while improving the equation at every stage. It first starts by selecting an equation with the best independent variable and then attempts to build up with subsequent additions of variable (Draper and Smith, 1998). Variables are scrutinised for removal or entry at each step. The default criteria for the probability of F-to-enter equals or is smaller than 0.05, whereas the criteria for the probability of F-to-remove equals or is smaller than 0.1. The stepwise regression has established 8 models with 3 variables being excluded eventually. The adjusted R² is 0.924. The variables which are identified as significant are, namely, average household income, population, unemployment rate, agreement for sale and purchase, residential usable floor area completed, area of greenbelt and open space zonings, approval rates of planning application and total approved residential gross floor area of planning applications. The final equation arrived at after running the stepwise regression is:

$$HP = 0.957 I + 4.248E-02 POP - 8902.076 UE + 0.248 ASP - 54.266 UFA + 1.983GB_{t-3} \dots \dots \dots (6) \\ -17465.426 AR_{t-3} - 4.045E-03GA_{t-3} - 225884.6$$

All of the above explanatory variables are statistically significant at the 5% level. Three variables that are excluded from the model setting are *GDP*, *LS*_{t-3} and *RZ*_{t-3}. When comparing the results of “Stepwise” regression to that of the “Enter” regression, the major difference is that the average household income has become a significant variable. This may due to the application of different regression procedures and the existence of multicollinearity.

Both regression models suggested that planning constraints have significant impact on housing price in Hong Kong. The results confirm with Bramley (1992) that house prices are determined by economic, demographic, supply and other variables. He suggested that general planning policies for land release (especially Structural Plans) had quite a substantial effect on housing output, although it was far from being a one-for-one relationship. He further asserted that the effect of local land release targets and policies on local house prices in general is very weak indeed due to the openness of local markets in Britain. However, this research proves that the planning system, which restricts the location, density and amount of land supply, has a statistically significant effect on housing price. This agrees with Peng and Wheaton (1994) that supply restrictions in Hong Kong have caused higher housing prices, though they mainly focus on the impact of restricted land sales supply on the housing market.

In our study, the approval rate of planning applications adopted in the regression model reflects the magnitude of these delays and creates fluctuations in the costs of development and the timing of production. As Hong Kong’s high-rise housing involves considerable development and construction time, the approval rate has 3 years time lag significant effect on the housing price. The significance of approval rate of the planning applications in our result also supports the view of Mayor and Sheppard (1996) that the stochastic development control alters the structure of housing supply in a way which may change the equilibrium price of housing by an amount far in excess of what would be expected from the costs imposed by the expected duration of planning delay.

Other than approval rate, the planning system may also influence the housing market by controlling the density and use of the future development. The explanatory variable of the total approved residential gross floor area of planning applications shows that it is statistically significant with 3 years time lag effect. We also find that the significant negative effect of greenbelt and open space zonings on housing prices in our model reconciles the idea of Hannah *et al.* (1999) that a substantial part of the rise in house prices has resulted from the government had tendency to under-allocate land to urban residential use. In view of the above, the housing price is influenced by the development constraints and other demand and supply factors. Our result is also in line with what Cheshire and Sheppard (1989) studied. They estimated the effects of the planning system on housing prices by analyzing the housing markets in Darlington and Reading in 1984. It was found that the low price of houses in Darlington did not only reflect looser constraints on development, but also a falling demand relative to supply of houses.

8. Conclusions

This study mainly focuses on how planning impinges on the supply of land for housing and affects the housing price as a result. The regression results demonstrate that the planning system has significant impact on the housing market in Hong Kong. We used both “enter” and “step-wise” regression analysis. The latter analysis particularly demonstrates that most of the planning variables affect housing prices statistically, getting into the step-wise equation in the first few steps.

In order to achieve adequate and affordable housing in future, the government can adjust its planning control by restricting uses, the densities, areas and approval rates of the developments. The implications of this study are as follows:

In view of the above, the Hong Kong government should focus on its planning policy so as to achieve a stable housing market in long term. The government should be aware of the impact of existing planning policy on the existing and future housing market. For example, if the government foresees a demand for housing, it can streamline its planning application procedure, increase the residential zoning areas and increase the allowable development density in order to meet the future demand. Only with sufficient housing supply can the policy of adequate and affordable housing be met.

Usually planning policies do not take immediate effects on housing market as developers require substantial time to develop the site into high-rise residential buildings. Among all planning controls, the zoning method is considered to be the least effective. This is because existing use of building or land is permitted to continue without any planning permission until redevelopment or a change of use takes place, despite change of zonings. The government may consider providing some incentives for the developers to convert the existing use of land when there is a need.

In order to achieve the target of “adequate and affordable housing”, the government should allow flexibility in its planning policy so as to adjust to the changing economic

and demographic environment. Therefore, we recommend the government to set up a forecasting model so as to help estimating the effect of planning policy. As the model is the integration of housing market factors and planning factors, we believe that it can resolve the dilemma between (1) the policy of providing adequate and affordable housing against the shortage of housing supply and (2) the land use regulations for control on residential development.

This study is of value to both academician and professional in the field of real estate and town planning. More importantly, this study addresses a real-life and yet lingering problem in Hong Kong – the long lasting housing problem of providing “adequate and affordable housing” in the face of supply constraints when “suitable sites for housing and opportunities for redevelopment become rarer”. This is also of particular importance to policy makers who is responsible for the formulation of housing and planning policies with a view to providing adequate and affordable housing to the people of Hong Kong

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