Property Value, User Cost, and Rent: An Investigation of the Residential Property Market in Hong Kong

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Abstract

We investigate the adjustment between the user cost of housing capital, rent, and property value using the impulse response analysis. We find that in the Hong Kong residential property market, rent responds to changes in the user cost relatively fast. But the direction of the responses varies. About one third displays incomplete response, another one third over-responds, and the rest displays a negative relationship. Further work is called for to clarify such results.

1.0 Introduction

The theoretical relationship between property rental price and value is straightforward. The value of a property is the discounted value of the expected net rental income generated from the property. In addition, the rental price is directly related with the cost of providing the flow of housing services for rental purpose. This is known in the literature as the *user cost of housing capital*. Given a competitive housing market, and if the landlords must cover their costs of providing housing services, then the rental price will have to bid down to the level of user cost. In the equilibrium, the user cost of housing capital is equal to the rental price; and the rental price is directly translated into the property value. A corollary of this theoretical relationship is that changes in user cost will be reflected in corresponding changes in rental price and property value as in Blackley and Follain (1996).

There is concern, however, over the completeness and speed in which rental price responds to changes in user cost. This concern arises because the completeness and speed of adjustment in rent determine the beneficiaries of public policies that affect user cost of rental housing capital. For example, an increase in the standard deduction on rental income lowers the rental user cost.[1] A slow or less than complete adjustment in rental price means that property owners will benefit while renters are marginally affected. Conversely, a swift and complete adjustment means the benefits will accrue to the renters in the form of lower rental payments.

This paper is an attempt to shed light on the adjustment process among user cost, rent, and property value in Hong Kong. We aim at investigating the adjustment process by employing the impulse response analysis. Impulse response or dynamic multiplier analysis is a common tool for investigating the inter-relationships among the variables over time in economic models. This paper is organized as follows. Section 2 provides a brief literature review on the issue. The data and the methodology for estimating the user cost are introduced in Section 3. Section 4 presents and evaluates the empirical results. Concluding remarks are set out in Section 5.

Readers with comments or questions are encouraged to contact the authors via email.

2.0 A Brief Literature Review

[1] Currently in Hong Kong, individual income is categorized as generated from three separate sources — salary/wage income, rental income, and profit income. The tax on rental income is called the Property Tax, which allows a 20% standard deduction and subject to a 15% tax rate.

Regarding rent and user cost, a fundamental problem that confronts economists is the seemingly invisible link between the two variables. Many attempts have been made to uncover this link. Most of them approach the problem by developing structural equations that describe the rental housing market. For example, Follain, Leavens and Velz (1993) estimate a reduced-form model of the rental housing market. They find that user cost significantly affects construction but not rental price. DiPasquale and Wheaton (1992) examine a similar issue by estimating a two-equation model. The first is a demand equation for rental housing, and the second is an equation specifying the construction of multi-family units. Their results show that rents rise only modestly in response to an increase in user cost.

Alm and Follain (1994) provide a comprehensive theoretical basis on which empirical work on this topic can be done. They develop and analyze a complete structural model of the rental housing market. The objective is to assess the impact of shocks, e.g., a change in tax treatment on rental properties and income, on the values of these properties. They argue that a mere graphical analysis on the trend of rental price is insufficient and propose a dynamic simultaneous equation system that contains a demand equation for rental housing, a supply equation, a construction equation, and an asset price equation. Based on Alm and Follain (1994), Blackley and Follain (1996) examine the strength of the link between rents and user costs and the speed with which rents adjust. They find that only about half of any increase in user cost is ultimately passed along as higher rent and the adjustment speed is extremely slow.

The aforementioned studies primarily look into the housing market in the United States. Studies that examine similar issue outside of the U.S. include Hendershott (1996), who analyzes rental adjustment of the commercial property market in Sydney, a city where office space is often over-supplied. He finds rental adjustment to be relatively fast and complete. Cheung, Tsang and Mak (1995) deviate from the structural model approach by performing causality tests on residential property values and rentals in Hong Kong. The housing market in Hong Kong is further sub-categorized by location and floor size. Among the 40 cases they analyze, causal relationship is found in 11 cases and changes in property values are found to lead rental rate changes in all of these cases. The lag period is one quarter, which suggests the two markets are efficient in cases where causal relationship can be established.

The study by Cheung *et al.* (1995) is valuable in three particular aspects. First, it represents the first effort that focuses on the relationship between property value and rent *in Hong Kong's property market*. Second, it provides an alternative way to find the links among variables that measure property values. Furthermore, their result that property value changes lead rental rate changes is interesting, as it suggests the two markets are substitutes in nature. Finally, as suggested by Blackley and Follain (1996), it is probably easier to identify a link between housing rent and user cost by using data for smaller market areas like the metropolitan housing market. Studying the case of Hong Kong is likely to generate a better identification between the two.

However, as reported in Cheung *et al.* (1995), the evidence that a causal relationship exists between property value and rent is not pervasive to all types of housing units. Causal relationships are detected primarily in flats with larger floor areas, which amounts to just about 5% of all residential units. While one may explain that the lack of a causal relationship in most instances is the result of segmentation in the housing market (owner-occupied and rental markets), it is also possible that the attempt to establish a causal relationship between property value and rent is itself problematic. As we note above, it is the change in user cost rather than property value that drives property owners to raise or lower rental price. If there is a change in property value, it will first be reflected in a change in the user cost of housing capital and subsequently the level of rent. To establish a direct relationship between property value and rent without considering the user cost is likely to miss out an important link that relates with the two variables.

3.0 Data

The series of property rental prices and values are obtained from the *Hong Kong Property Review* published by the Rating and Valuation Department of the Hong Kong Government. The *Hong Kong Property Review* contains the average rentals of fresh lettings and average transaction prices of private domestic units that are scrutinized by the department for stamp duty purpose during a quarter. The units are categorized by sizes and districts. Five classes of size are defined: Class A refers to premises with saleable area not exceeding $39.9m^2$, $40m^2$ to $69.9m^2$ for Class B, $70m^2$ to $99.9m^2$ for Class C, $100m^2$ to $159.9m^2$ for Class D, and $160m^2$ or above for Class E. The premises locate in one of four districts, namely, Hong Kong Island, Kowloon, New Kowloon, and the New Territories. Crudely speaking, Hong Kong Island and Kowloon are where the commercial and residential centers locate. These are also the districts where record property transactions have been consistently reported. New Kowloon and the New Territories contain new towns, industrialized areas, and the suburbs.

As a result of the above categorizations, there are twenty series of rental and property prices that date back to 1982 and up to 1995. This period captures a highly volatile period in the real estate market in Hong Kong when political uncertainties caused events like currency devaluation in 1983, massive emigration during the 1980s and early 1990s, a double digit inflation and negative real interest rate in the early 1990s, and severe speculative activities over the real estate market in 1993 and 1994. Summary statistics of the data are presented in Table 1. Figure 1 shows the indices of rental prices and property values for the period 1982 to 1995. As can be observed, these series in general have an upward trend. We shall test whether these series are trend-stationary or difference-stationary after the discussion of the estimation of the user cost. While not reported here, we have also examined the correlation among the growth rates of the two series in the five size classes across the four districts. The correlation structures are the same as the ones in Cheung *et al.* (1995): Correlation between changes in values and rents for the same size class across different districts is not strong, thereby providing justification for district-based analysis as follows.

4.0 Estimation of the User Cost

The user cost of owning a home is a function of the interest and opportunity costs of housing equity, the expected appreciation of property value, and other housing expenditures including property tax, depreciation and maintenance. Unlike the U.S., mortgage interest payment is not tax deductible under the tax system in Hong Kong. The user cost of housing services per unit expense, *uc*, is thus defined as:

$$uc = i + T + d - g, \qquad (1)$$

where i is the mortgage interest rate, T is the rates assessed on the property value,[2] d is the sum of maintenance and depreciation cost, and g is the expected capital gains.

Residential mortgages in Hong Kong are predominantly adjustable rate mortgages in which the Best Lending Rate (BLR) is used as a reference. Mortgage lenders, until recently, charged a premium up to 4% over the BLR. Assuming a 70% loan-to-value ratio, then the interest cost, i, is:

$$i = BLR + 0.028.$$

Rates are assessed once every three years. Upon assessment, the Rating and Valuation Department determines the annual rental value of a premise as at July 1 of the assessment year. This annual rental value is known as the Rateable Value, on which the Rates are applied. The Rateable Value becomes effective for three years beginning from the second quarter of the subsequent year until the next assessment is carried out. The Rates payable by the landlord range from 5% to 7.5% of the Rateable Value during the 1980s and 1990s. Hence the actual tax obligation per dollar expense on housing is the Rates (in percentage) multiplied by the ratio between Rateable Value and house value. This is the represented in equation (1) as T. Finally, following Gill and Haurin (1991), we assume the sum of maintenance and depreciation cost, d, to be 3.5%.

[2] As noted in Footnote 1, in Hong Kong the term *Property Tax* is referred to the tax on property rental income. The tax that is similar to the property tax in the United States is termed as the *Rates*, represented by T in equation (1).

The final input to user cost in equation (1) is the expected appreciation of property value, g. Since g is usually not observable, we will estimate it in two ways. The first specification is that the expected appreciation follows an ARIMA model. Experimentation with various ARIMA models indicated that a four-quarter autoregressive model lagged one period is the most suitable model. The second approach is that the agents are assumed to form their expectations rationally, thereby the difference between the realized appreciation and the expected appreciation will be unpredictable. To compare significantly with the first approach, which is commonly used in the literature, we assume that the rational expectations are equal to the actual appreciations, i.e., agents actually have a perfect foresight.

Property rental income is separately taxed at 15% after allowing for a 20% deduction of the total rental income. Therefore, in the equilibrium, the user cost should equal to the after-tax rental income:

$$uc = R\,(1 - t)\,(1 - \alpha). \qquad (2)$$

where R is the gross rental income, t is the rental income tax rate at 15%, and α is the standard deduction rate of 20% on rental income. The following sections will examine the adjustment process in reaching equation (2).

5.0 Empirical Analysis

5.1 Testing for Unit Roots

Unit root tests provide an easy method of testing whether a time series is non-stationary. The rejection of the unit root hypothesis provides the necessary condition to conclude that a series is stationary.[3] Consequently, if the unit root hypothesis is not rejected, then we can conclude that the series is non-stationary.

There are many tests for possible existence of unit roots and most of them are based on the assumption of at most one unit root in the series considered. Although most time series seem to be best approximated as integrated processes of order 1, denoted as I(1), there are some series, especially nominal series such as prices, money balances and the like, that appear to be more smooth and more slowly changing than what is normally observed for I(1) variables. Such series may contain (explosive) rational bubbles and thus potentially be integrated of order higher than 1. Simulation results reported by Dickey and Pantula (1987) indicate serious size distortions for some commonly used unit root tests when the process has more than one unit root. For these reasons, Dickey and Pantula (1987) suggest a sequential test for the existence of multiple unit roots.

Cheung *et al.* (1995) have presented some potential evidence of higher order of integration in the property value and rent series in Hong Kong. Therefore, following the suggestion of Dickey and Pantula (1987), the case of at most 3 unit roots is examined as follows: First regress $\Delta^3 y_t$ on $\Delta^2 y_{t-1}$, then on $\Delta^2 y_{t-1}$ and Δy_{t-1}, and finally on $\Delta^2 y_{t-1}$, Δy_{t-1} and y_{t-1} where Δ^p denotes p-th difference of the series. One proceeds with this sequence until the most recently added variable is insignificantly different from zero, which is determined by examining the augmented Dickey–Fuller (ADF) statistics using the tabulated values.

The results of the sequential Dickey–Pantula tests are reported in Table 2. Unlike Cheung *et al.* (1995), these results indicate that the property value, rent, and user costs have only one unit root in general. There are three cases where the property value series may be an I(2) process: Class D of the Hong Kong Island, categories A and E of the New Territories.[4] As for the user cost series constructed using AR(4) process, there are 9 out of 20 cases that do not reject the null hypothesis that it is an I(1) process. Therefore, the data will be appropriately differenced on the basis of these results in the following analysis. While not reported here, the first difference of all the series considered reject the null hypothesis of a unit root.

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[3] However, since unit root tests do not test for constant moments of the distribution, which is required by the assumption of a weak stationary series, the rejection of the unit root hypothesis is not *sufficient* to conclude a series is stationary.

[4] However, the null hypothesis of I(2) will be rejected if we allow for a little higher significance levels. That is, the I(2) hypothesis is "accepted" only marginally for these series.

5.2 Impulse Response Analysis

5.21 Vector Autoregressive (VAR) Model Representation

Consider a K-dimensional vector autoregressive (VAR) model of the form

$$y_t = A_1 y_t + \ldots + A_p y_{t-p} + u_t\ , \tag{3}$$

where $y_t = (y_{1t}, \ldots, y_{Kt})'$, the A_i are $K \times K$ coefficient matrices, and u_t is Gaussian white noise (i.e., u_t and u_s are independent for $s \neq t$ and $u \sim N(0, \Sigma_u)$ for all t. The covariance matrix Σ_u is assumed to be positive definite.

The quantities of interest here are the impulse responses or dynamic multipliers that represent the effects of shocks in the variables of the system. They are most easily obtained from the representation (3) and may be defined as:

$$\Phi_n = (\phi_{ik,n}) = \sum_{j=1}^{n} \Phi_{n-j} A_j$$

for $n = 1, 2, \ldots$, where $\Phi_0 = I_K$, $A_j = 0$ for $j > p$ and $\phi_{ik,n}$ is the ik-th element of Φ_n and represents the response of y_i to a unit shock in variable k, n periods ago. In many econometric studies, including this paper, responses to *orthogonalized* impulses are preferred. They are defined as $\Theta_n = (\theta_{ik,n}) = \Phi_n P$, where P is the lower triangular Choleski decomposition of Σ_u, i.e., $\Sigma_u = PP'$. Again, $\theta_{ik,n}$ is interpreted as the response of y_i to a unit shock in variable k, n periods ago. These impulses can be thought of as transformed residuals of the form $w_t = P^{-1} u_t$ which have identity covariance matrix, $\mathrm{E}(w_t w_t') = I_K$. Thus, a unit impulse has size one standard deviation in this case. Other quantities of potential interest are accumulated impulse responses

$$\Psi_m = I_K + \sum_{n=1}^{m} \Phi_n \text{ and } \Xi_m = \sum_{n=0}^{m} \Phi_n\ .$$

See Lütkepohl (1990) for a detailed discussion on estimation and asymptotic distributions of these quantities. In this paper, $K = 3$ where we set y_{1t} as the user cost, y_{2t} as the house price and y_{3t} as the rent.

It may also be worth noting the relation between the impulse responses and Granger-causation. In a bivariate system with variables y_{1t} and y_{2t}, the latter variable is not Granger-causal for y_{1t} if and only if $\phi_{12,n} = 0$ for $n = 1, 2, \ldots$ Denoting the upper right-hand element of A_i in equation (3) by $\alpha_{12,i}$, $I = 1, \ldots, p$, this condition for non-causality is equivalent to $\alpha_{12,i} = 0$, $i = 1, \ldots, p$. Therefore, this paper may be viewed as an alternative test to that of Cheung *et al.* (1995).

6.0 Interpretation of Results

As mentioned above, we construct two user cost series based on the perfect foresight and a four-quarter autoregressive model (lagged one period) in formulating expected property value appreciation. Similar results are found using either series and they are summarized in Table 3.

The results generated by the orthogonalized impulse response estimation are interesting. Recall that our focus is the speed and the completeness in the change in rental price and value in response to a change in the user cost. On the speed of response in rent to a shock in the user cost, we find that the effects in most cases are instantaneous and they do not tend to linger. As shown in Table 3 only in one case, the Class C premises in New Kowloon, is the effect, though small, still present after 7 quarters. In all other cases, the most severe impacts are within the same quarter and the effects generally diminish relatively fast after one to five quarters. The significant instantaneous response in rent to a user cost shock is not consistent with the findings in most other research. This is probably due to the fact that the rental series are average rentals collected from *new* lettings reported to the Rating and Valuation Department during a quarter and hence the rental reflects the most recent shocks to the user cost. For similar reason, the impacts diminish fast because they are mostly manifested in the current period.

On the completeness of the impact, six cases are found to have a magnitude between zero and 100%. They are the Class E premises on Hong Kong Island (20%), Class D premises in Kowloon and the New Territories (50% and 80%), Class C premises in New Kowloon (45%), and Class B premises in New Kowloon and the New Territories (25% and 40%). The user costs of Class A premises in New Kowloon are not found to have any lasting impact on the rent. For the rest 14 cases, they are either negative or above 100%. The case of Hong Kong Island is the most puzzling. Except the Class E premises, all display negative impact on rent by user cost. Perhaps a possible explanation is that since the supply of flats on the Hong Kong island is relatively rare, an increase in the expected property value lowers the user costs on the one hand. It drives up current housing price on the other, which in turn causes rent to follow, hence displaying a rather perverse result between the user cost and rent.

The impulse response from house value on rent displays a positive relationship except in the case of Class E premises in the New Territories. Moreover, a one percent increase in value causes rent to increase by more than one percent in most cases (except Class C premises in New Kowloon). Also, the instantaneous response is not as strong. Thirteen out of the twenty cases display stronger impacts in the first quarter than in the zero (current) quarter.

7.0 Concluding Remarks

This paper presents some preliminary findings about the user cost, rent and property value in Hong Kong's residential property market. There are at least two areas where further work can be done. First, since the real property value appreciation has been high during most of the periods in the 1980s and 1990s, the user cost of housing capital, once incorporating the expectation of housing price appreciation, can easily become negative. We suspect the negative user cost might have distorted some of the results. Therefore, we need to examine the estimation of the appreciation expectation formation mechanism more carefully. Second, one possible extension is to examine the Granger-causality more formally using the cointegration framework in the current study. 🕮

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Table 1: Summary statistics of the data

		Hong Kong Island	**Kowloon**	**New Kowloon**	**New Territories**
Class A					
Value	Mean	22715.4	20370.1	19505.0	20422.6
	Std. Dev.	16128.2	13164.4	12705.4	12977.3
Rent	Mean	131.5	137.0	116.8	96.5
	Std. Dev.	61.5	55.7	43.1	36.5
Class B					
Value	Mean	24611.8	18163.3	19584.5	20274.2
	Std. Dev.	19110.3	13065.9	14913.6	13506.5
Rent	Mean	134.3	116.8	107.9	88.4
	Std. Dev.	65.9	48.7	48.4	35.7
Class C					
Value	Mean	26703.3	22254.1	21843.6	20138.1
	Std. Dev.	22054.7	16561.4	16307.0	13138.7
Rent	Mean	158.0	132.1	125.1	100.3
	Std. Dev.	87.2	59.0	60.3	48.0
Class D					
Value	Mean	27503.9	20867.1	24191.4	22783.8
	Std. Dev.	22559.6	14493.6	18684.5	16910.7
Rent	Mean	177.5	133.4	138.4	121.3
	Std. Dev.	96.3	64.8	66.8	69.6
Class E					
Value	Mean	29058.8	27276.7	27538.3	22180.8
	Std. Dev.	24311.0	22755.0	21504.5	17980.2
Rent	Mean	187.5	133.7	116.2	116.1
	Std. Dev.	96.1	53.2	54.0	65.8

Notes: Classes A to E represent floor areas of 39.9m^2 and below (A), 40.0 to 69.9m^2 (B), 70.0 to 99.9m^2 (C), 100.0 to 159.9m^2 (D), 160.0m^2 and over (E), respectively.

Table 2: Unit root tests for the data

Hong Kong Island	**Class**	**Price**	**Rent**	**UCPF**	**UCAR**
Three unit root:	A	–7.277*	–12.848*	–10.026*	–3.566*
	B	–7.679*	–10.193*	–11.223*	–19.435*
	C	–8.836*	–11.033*	–13.622*	–6.592*
	D	–8.686*	–7.619*	–13.728*	–7.877*
	E	–9.913*	–7.527*	–12.862*	–11.895*
Two unit roots:	A	–2.951**	–3.003**	–7.103*	–7.025*
	B	–2.945**	–4.912*	–5.915*	–4.639*
	C	–3.024**	–4.265*	–5.377*	–4.271*
	D	–2.561	–2.754***	–4.391*	–3.759*
	E	–3.028**	–3.308*	–7.275*	–3.964*
One unit root:	A	–0.651	0.168	–0.770	–2.568
	B	–0.584	0.452	–1.619	–3.695*
	C	–0.505	–0.056	–2.459	–5.524*
	D	–0.918	–0.646	–3.221	–5.507*
	E	–0.727	–0.239	–1.627	–4.860*
Kowloon	**Class**	**Price**	**Rent**	**UCPF**	**UCAR**
Three unit root:	A	–9.229*	–9.686*	–11.436*	–16.085*
	B	–12.493*	–9.108*	–13.367*	–9.964*
	C	–9.895*	–13.181*	–12.342*	–10.099*
	D	–7.307*	–15.374*	–9.427*	–16.431*
	E	–10.334*	–8.480*	–11.857*	–9.601*

Two unit roots:	A	–3.710*	–8.504*	–9.218*	–9.422*
	B	–4.508*	–6.428*	–9.718*	–10.702*
	C	–4.112*	–7.112*	–8.461*	–6.894*
	D	–5.552*	–5.894*	–11.361*	–7.362*
	E	–6.211*	–3.031**	–8.426*	–5.603*
One unit root:	A	–0.396	0.626	–0.923	–1.894
	B	–0.156	0.272	–1.951	–2.260
	C	0.078	0.143	–1.157	–1.473
	D	0.379	1.227	–1.471	–2.217
	E	–0.832	–1.006	–3.988*	–3.620*
New Kowloon	**Class**	**Price**	**Rent**	**UCPF**	**UCAR**
Three unit root:	A	–10.116*	–12.321*	–12.584*	–15.832*
	B	–13.262*	–12.013*	–15.588*	–13.012*
	C	–14.025*	–14.230*	–15.185*	–10.679*
	D	–11.015*	–21.469*	–15.616*	–12.951*
	E	–9.696*	–11.893*	–11.548*	–8.857*
Two unit roots:	A	–3.639*	–6.406*	–8.356*	–7.216*
	B	–3.453**	–5.468*	–9.195*	–5.745*
	C	–2.686***	–10.368*	–7.573*	–6.874*
	D	–3.996*	–4.783*	–7.137*	–4.934*
	E	–5.665*	–4.364*	–7.319*	–11.975*
One unit root:	A	–0.351	0.519	–0.538	–1.592
	B	–0.092	0.205	–0.507	–2.168
	C	–0.848	1.040	–1.861	–2.049
	D	–0.128	–0.351	–2.515	–2.829***
	E	–0.075	–0.619	–1.849	–1.501
New Territories	**Class**	**Price**	**Rent**	**UCPF**	**UCAR**
Three unit root:	A	–9.492*	–10.345*	–14.118*	–12.860*
	B	–9.159*	–11.444*	–12.392*	–6.777*
	C	–10.900*	–11.503*	–13.371*	–7.510*
	D	–15.387*	–11.999*	–19.171*	–12.991*
	E	–10.441*	–11.409*	–15.053*	–15.439*
Two unit roots:	A	–1.929	–6.720*	–5.216*	–5.190*
	B	–2.059**	–6.602*	–5.702*	–5.742*
	C	–3.666*	–5.589*	–8.586*	–7.025*
	D	–2.893***	–3.975*	–7.058*	–16.120*
	E	–1.572	–4.906*	–6.955*	–13.273*
One unit root:	A	–1.199	–1.529	–1.323	–3.034**
	B	–1.188	–1.204	–1.397	–2.522
	C	–0.219	–0.601	–1.588	–3.337**
	D	–0.831	–0.838	–2.017	–1.441
	E	–1.678	–0.257	–0.395	–2.883***

Notes: *, ** and *** represent significance levels at 1%, 5% and 10%. UCPF and UCAR are the user costs estimated using perfect foresight and AR(4) models. Classes A to E represent floor areas of 39.9m^2 and below (A), 40.0 to 69.9m^2 (B), 70.0 to 99.9m^2 (C), 100.0 to 159.9m^2 (D), 160.0m^2 and over (E).

Table 3: Summary of impulse response analysis

Impact of user cost on rent

Class	*Hong Kong Island*	*Kowloon*	*New Kowloon*	*New Territories*
A	3 / –0.4	3 / 2.6	1 / 0.0	2 / –0.5
B	4 / –1.5	1 / 1.0	2 / 0.2	4 / 0.4
C	2 / –1.2	3 / –0.6	7 / 0.4	5 / –1.1
D	4 / –0.3	5 / 0.5	5 / 1.0	4 / 0.8
E	2 / 0.2	1 / 2.2	4 / 2.2	4 / 2.3
Impact of value on rent				
Class	*Hong Kong Island*	*Kowloon*	*New Kowloon*	*New Territoris*
A	7 / 2.6	2 / 1.9	1 / 1.8	6 / 3.0
B	5 / 3.4	2 / 1.8	5 / 2.4	5 / 3.3
C	2 / 2.5	5 / 2.9	7 / 0.4	7 / 1.7
D	5 / 3.4	4 / 1.7	7 / 1.9	5 / 2.7
E	4 / 3.8	2 / 1.8	7 / 7.0	5 / –1.5

Notes: The first number is the number of quarters that there is a significance response to an orthogonalized impulse and the second number is the long-run response.

Figure 1: Time series plot of property value index and rental index