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Housing Vacancy and Rental Adjustment: Evidence from Hong Kong

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Summary. The traditional rental adjustment equation is flawed in that the equilibrium paths for the adjustment of rents and vacancy rates cannot hold simultaneously over time. This paper suggests a two-equation model of rental adjustments based on adaptive expectations rather than the single-equation model presented in the traditional literature, and provides empirical tests. Annual data from the housing market in Hong Kong during the 1980–96 period are consistent with the adjustment equation. The results also show that the rate of change of real rents is neutral with respect to inflation.

1. Introduction

In the housing rental market, heterogeneity, imperfect information and friction cause tenants to spend time searching for new units and landlords to hold some units off the market for a period of time. This results in a level of vacancy, known as the natural vacancy rate, which is defined as the rate at which there is neither excess demand nor excess supply and, hence, the real rental level is in equilibrium. Various theoretical papers study rental adjustment in the housing market, emphasising that vacancy rates are directly, inversely and linearly related to rental growth adjusted for changes in operating costs (Eubank and Sirmans, 1979; Rosen and Smith, 1983; Hendershott and Haurin, 1988; DiPasquale and Wheaton, 1992; Belsky and Goodman, 1996). Other recent work is on the office market (for a full discussion see Ball *et al.*, 1998). Hendershott (1995) introduces the concept of equilibrium rents, and relates the rental growth rate to the vacancy rate and the gap between actual and equilibrium rents.

Although a long tradition exists of relating the change in real rents to the difference between the natural and observed vacancy rates, it offers limited insight into how real rents and vacancy rates adjust over time. This paper seeks to improve understanding of the operation of housing markets. The costs associated with adjusting the vacancy rate mean that it is less flexible than suggested by the single-equation model in the existing literature. Thus, a two-equation adaptive expectations model is set up, capable of explaining the rental adjustment process in the context of the institutional structure of the market.

The traditional model proposes that supply and demand factors interact to determine simultaneously the level of rents and the vacancy rate. The model presented in this paper suggests that rental change is driven by

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the gap between the expected and natural rates rather than the actual rate alone or the difference between actual and natural rates. If the expected vacancy rate were to rise, downward pressure on rental changes might be greater than the observed vacancy rate would suggest.

This paper is divided into four sections. Section 2 develops the model used to explain the rental market adjustment. The results of the empirical investigation estimation of this model are reported in section 3. Next, section 4 discusses how certain aspects of market structure may affect the rental adjustment process. Finally, section 5 provides conclusions.

2. The Model

Search Costs and Adjustments

A number of authors have suggested that the rate of change in real rents is a function of the difference between the natural vacancy rate and the one-period lag observed vacancy rate. This formulation treats the market rent as an instantaneous function of housing vacancy rates. However, rents and vacancy rates are subject to different institutional rigidities and will, therefore, adjust independently to supply or demand shocks in the market. In other words, there are asymmetric impacts to the adjustment paths of housing vacancy and rental rates.

In Walrasian micro-foundations, all market trades take place at clearing prices and there is no cost of acquiring information. However, not only is information costly to acquire, but heterogeneous individuals face different costs of acquiring information, and interpret it differently. Nordvik (1995) suggests that expectations can be described as a probability distribution rather than a point expectation. Thus, perfect adjustment is achieved if the distribution of expectations subjectively held by agents is identical to the probability distribution of the variable being forecast, given the available information. For example, if the vacancy rate overshoots the natural vacancy rate, there is a tendency for real rents and vacancy rates, respectively, to adjust to gaps between the equilibrium and actual real rents, and the natural and actual vacancy rates. However, not only are the adjustment paths of real rents and vacancy rates different, but it is unlikely that vacancy rates and the rate of change of real rents can be in equilibrium simultaneously.

It is more helpful to start with the assumption that house rentals and vacancies are subject to different market rigidities. Williams (1986) suggests that a rental market is analogous to an implicit loan market of houses in the sense that tenants are content to 'borrow' dwelling units which provide housing services over a period of time, rather than own them outright. In general, those commodities with inflexibilities in production, processing and transport, and of higher value and durability, are most likely to develop such an implicit loan market. The rental market operates in a stock-flow pattern such that housing services are generated from housing stock during each period of time. As the annual change in the housing stock is relatively small, the stock can be regarded as fixed in the short run (Fair, 1972), and so cannot adjust instantaneously to increased demand. Thus, the vacancy rate may temporarily diverge from the natural rate.

Baryla and Zumpano (1995) show that real estate agents can provide buyers with more accurate information about current market conditions in order to shorten search duration. However, the real estate agent fee represents a search cost to the buyer. In other words, vacancy serves as a buffer stock which minimises transaction costs in the housing market. From the landlord's point of view, there is a trade-off between expected higher real rent and the duration of vacancy (Hendershott and Haurin, 1988). The landlord will hold a unit vacant in search of a tenant who is willing to pay a higher real rent. On the other hand, tenants take time to compare costs of the available rental units, seeking to optimise their housing consumption while minimising their housing search and moving costs. Thus, in the presence of asymmetric information in the housing market, the movement of rents tends to lie between the landlord's minimum reservation and the tenant's maximum offer (Wheaton and Torto, 1994).

Landlords do not have perfect knowledge of all available tenants, and they may be able to gain information only by searching the market. The time spent searching for tenants imposes costs on landlords. Faced with this uncertainty, adjustments in the time spent searching bring about an equilibrium. An increase in search costs will reduce the landlord's reservation rent. However, search theory is not without its shortcomings. First, if a reservation rent is set at a relatively high level, the search time will rise substantially, and this will in turn raise the search cost. It is also possible that the current search time will affect future rents. Secondly, it neglects any advertising effort that will be undertaken by the landlord. Thirdly, it is unlikely that all prospective tenants are completely uninformed about vacant units.

Read (1991) suggests that the full rent search strategy is similar to a matching process. The matching rate is sensitive to the landlord's advertising strategy. Assuming increasing marginal advertising costs, Read's model shows that a landlord tends to overinvest in advertising and so increase vacancy costs. The reservation price changes as the buyer learns more about the price distribution. As tenants may have preferences for particular dwelling units, the tenant's expected search time will be longer or the willingness to accept a unit will be lower if he has more narrowly defined preferences (Read, 1991).

A Model of Adjustment

In this paper, it is argued that representative agents will form expectations about vacancies and rentals and, therefore, the subjective expectation of the change in rental and vacancy rates held by the agents at time t is a probability distribution, given the information available to the agents at time t. This reflects the common-sense idea that the expectation should be based on more currently available information than simply the set of information available at time $t-1$. As expectational errors are costly to those who make them, the agents will try to form expectations in a manner that eliminates errors. Even if all observed vacancies are equilibrium vacancies, it does not imply that all individuals, behaving rationally, know the information and fully adjust. Thus, random errors are committed in the process of adaptive expectations. It is, therefore, appropriate to formulate a housing vacancy model which links the gap between the natural vacancy rate and the expected vacancy rate at time t to the expected rate of change of real rental, such that:

$$\Delta\% R_t^* = \lambda(V_n - V_t^*) + v_t \qquad (1)$$

where, λ is the speed of adjustment of the rental rate in response to the expected vacancy gap, whose expected value is $\lambda > 0$; v_t is the disturbance term which is serially independent, $\Delta\% R_t^*$ is the expected rate of change of real rents; and V_n and V_t^* are the natural vacancy rate and expected vacancy rate, respectively.

Equation (1) is based on an expectations framework which proposes that, although vacancies and market rents will adjust in independent paths, the *expected* rate of change of real rental will be zero when the *expected* vacancy rate is equal to the natural vacancy rate. Hendershott (1995) points out that the traditional model requires the vacancy rate substantially to overshoot the natural rate, thereby creating the force that returns rent to equilibrium. To overcome the problem, he proposes, in a study of the Sydney office market, that the gap between the equilibrium and actual real gross effective rents should be added to the rental adjustment equation. The concept of the equilibrium real gross rental rate as defined by Hendershott (1995) may not be applicable to the Hong Kong rental housing market. In Hong Kong, market rents for housing, to a large extent, reflect land rent, not just the interest rate, depreciation and other expenses. To allow a more general adjustment path of vacancies, the expected vacancy rate here is specified as a partial adaptive function adjusting to the gap between the natural vacancy rate and the lagged vacancy rate:

$$V_t^* - V_{t-1} = \alpha(V_n - V_{t-1}) \quad (2)$$

where, α is the speed of adjustment of the vacancy rate. It is expected that $0 < \alpha < 1$. $\alpha = 0$ implies $V_t^* = V_{t-1}$ and $\alpha = 1$ implies $V_t^* = V_n$.

With this equation, if the vacancy rate in the previous period overshoots the natural vacancy rate, the gap between the currently expected vacancy rate and the previous period's vacancy rate will tend to decrease. Unlike the instantaneous adjustment of vacancy rates assumed in most traditional literature (see, for example, Smith, 1974; Rosen and Smith, 1983; DiPasquale and Wheaton, 1992; and Belsky and Goodman 1996), the market vacancy rate here moves only in response to the expected vacancy rate. Thus, the gap between the expected current vacancy and lagged vacancy rates acts as a force causing the market vacancy rate to return to its equilibrium level. This means that the movement of the market vacancy rates will be based on *ex ante* estimates of vacancy, which may well have more complicated relationships to actual *ex post* data. Such a formulation is consistent with the hypothesis of partial rational expectations (Lucas, 1981). Since expectations are unobservable, a common method in the empirical work of adaptive expectations is to assume that the market forms expectations directly on current and past information (Fair, 1990).

Unlike the rational expectations hypothesis that analyses the change of expectations held by agents, the rationale for an adaptive expectations model is that it is unlikely that all prices adjust instantaneously to new information. Nerlove (1972) states that the adaptive expectation is the conditional expectation of the future values of the variable being forecast. However, the adaptive expectations depend on market forces rather than on policy changes (Lucas, 1981; Holden and Peel, 1990). The assumption of rational expectations will produce a different value for rental change than will adaptive expectations if some future change in policy is known. In the context of rational expectations, forecasts will be correct on the average, and forecasting errors will be as small as possible. Rational expectations are, however, the limiting case of adaptive expectations.

The traditional rental adjustment model (for example, Smith, 1974) assumes that the rate of change of house rents adjusts instantly in response to any gap between the natural and actual vacancy rates. In contrast, in this paper it is assumed that rental change adjusts only gradually in response to supply or demand shocks. For instance, changes in interest rates, income and political risks would be shocks to the vacancy rate and rents. These would, in turn, trigger an adjustment in the system of structural equations. Rental adjustment, however, is not instantaneous because landlords may choose a longer search time rather than reduce the offer rent. The backward-looking expectations model is based mainly on patterns of past behaviour in the market, whereas the rational expectation model assumes that the agents can correctly predict the effects of market changes. Neither of these two approaches is realistic.

For the purpose of this study, an adaptive expectations approach is taken (see the Appendix). Such a hypothesis assumes that expectations of future rental change are formed on the basis of current and past values of the variables (Friedman, 1957). This means that the expectations are not only formed by looking at past values of the variable, but also all the available information. A common practice in empirical work is to assume that expected future values of a variable are a function of the current and past values of the variable. Following this background, a gradual adjustment to the rental rate, as presented by equation (3), is incorporated into the model. It is assumed that the current rate of change of real rents ($\Delta\% R_t$) depends on both the expected current equilibrium rate of change of real rents ($\Delta\% R_t^*$) and the rate of change of real rents observed in the previous period ($\Delta\% R_{t-1}$).

$$\Delta\% R_t = \beta \Delta\% R_t^* + (1 - \beta)\Delta\% R_{t-1} \quad (3)$$

where, β is the rate at which $\Delta\% R_t$ converges to $\Delta\% R_t^*$. The hypothesis is: $0 < \beta < 1$. The variables $\Delta\% R_t$ and V_t are endogenous and the two lagged endogenous variables, $\Delta\% R_{t-1}$ and V_{t-1}, are predetermined. Combining equations (1), (2) and (3), the complete rental adjustment specification for empirical estimation is:

$$\Delta\% R_t = \lambda\beta(1-\alpha)V_n - \lambda\beta(1-\alpha)V_{t-1} + (1-\beta)\Delta\% R_{t-1} + u_t \quad (4)$$

The required specification can be written as:

$$\Delta\% R_t = a + bV_{t-1} + c\Delta\% R_{t-1} + u_t \quad (5)$$

where, $a = \lambda\beta(1-\alpha)V_n$; $b = -\lambda\beta(1-\alpha)$; and $c = 1-\beta$. Thus, it is expected that $a > 0$, $b < 0$ and $0 < c < 1$. Note that $u_t = bv_t + \varepsilon_t$ if an error term ε_t is included in equation (3).[1] One of the distinct features of equation (5) is that the real rental rate can be exactly expressed as a lag distribution of vacancy rates.[2] Alternatively, equation (5) can be expressed as

$$\Delta\% R_t = \lambda\beta(1-\alpha) \times \left(V_n - \sum_{i=0}^{\infty}(1-\beta)^i V_{t-i-1}\right) + \sum_{i=0}^{\infty}(1-\beta)^i u_{t-i} \quad (6)$$

Thus, the real growth rate of the house rents can be written as a weighted average of observed vacancy rates. Note that the weight of the distributed lags diminishes over time: $(1-b)^T \to 0$ for $0 < b < 1$ as $T \to \infty$. In order to estimate the lag pattern empirically, a number of lagged exogenous or endogenous variables can be introduced into the model. However, one of the difficulties in the first procedure is the selection of the point of truncation because in practice econometricians cannot incorporate all the prior information in empirical tests (Chetty, 1971). The distributed-lag model of expectation formation has been widely used in the study of the demand for money during periods of hyperinflation.

Clapp *et al.* (1995), using the influence of lagged price changes, demonstrate that the spatial diffusion of information is important in real estate markets. They argue that transaction prices of comparable units provide important information used by both sides of the market to set reservation prices. This implies that past price changes influence current prices because the information set used in any negotiation is necessarily lagged. That part of the lag structure of $\Delta\% R_{t-1}$ in equation (5) arising from the formation of expectations, thus, indicates that the agents respond to the variables with a one-period lag. However, the model indicates that the reduced-form equation (5) still relates the real rate of rental change to lagged vacancy rate.

3. The Data and Empirical Results

Data

The vacancy rate, which is equal to the number of vacant units divided by the total housing stock at the end of that year, reflects the balance between demand and supply forces in the space market. The natural vacancy rate is often assumed to be a constant over time and it can easily be shown that $V_n = -a/b$ (from equation (5)).

The rental data for Hong Kong are not affected by rent controls as data for government-built rented accommodation are not included. The rents are net—that is, rates, management and other charges are excluded. The effects of rent-free periods and other concessions are taken into account. If this were not done, the index would tend to understate market trends because face rents tend to decline slowly in soft markets, due to the fact that landlords offer longer rent-free periods and other concessions, which reduce the net effective rental. When rents are adjusted to reflect the standard terms of agreement, they tend to be lower than the quoted rentals when the market is moving downwards and vice versa.[3] Annual average rents are based on an analysis of effective (not contract) rental information recorded for fresh lettings effective in the year being analysed.

Average rents may change from one

Table 1. The empirical results

Constant	V_{t-1}	$\Delta\% R_{t-1}$	P_t	I_t	Adjusted R^2	SSE	DW	V_n
42.87 (6.13)	− 8.50 (5.06)				0.606	5.31	1.20	5.04
33.55 (5.75)	− 7.14 (5.38)	0.362 (2.92)			0.728	3.99	1.79	4.70
30.17 (3.83)	− 6.94 (4.98)	0.325 (2.34)	0.362* (0.66)		0.715	4.08	1.83	4.35
36.51 (5.41)	− 7.63 (4.77)	0.413 (2.65)		− 0.077* (0.178)	0.705	4.51	1.79	4.79
31.87 (3.60)	− 7.17 (4.18)	0.377 (2.31)	0.539* (0.83)	− 0.203* (0.439)	0.697	4.57	1.86	4.45

Notes: The data are from *Property Review* (various issues), The Rating and Valuation Department, Hong Kong. The data of inflation (P_t) are based on the consumer price index (CPI), and interest rate (I_t) are based on the prime (best lending) rate. The real rentals just equal to the effective rentals deflated by consumer price index (CPI). The rate of change of real rentals ($\Delta\% R_t$) equals (real rental at time $t -$ real rental at time $t - 1$)/real rental at time $t - 1$. DW refers to the Durbin-Watson statistics. T-statistics are in parentheses. See the text for exact definition of the variables.

* T-statistics not significant at the 0.1 confidence level.

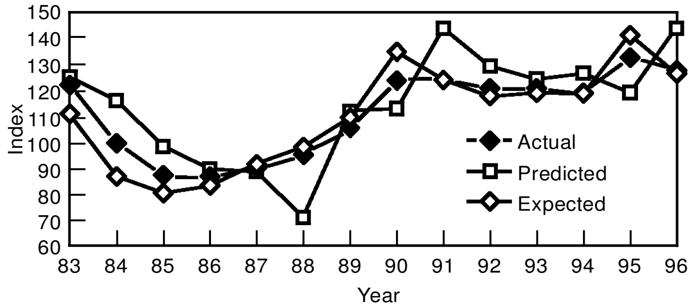

Figure 1. Real housing rental values in Hong Kong, 1983–96.

period to another not only because of value changes, but also because of shifts in quality. In order to control for quality, the indices measure rent divided by the rateable value of the subject properties rather than rent per square metre. Vacancies in respect of all private premises completed during the review year, and those completed earlier but not yet assessed for rating purposes, are determined by inspection at the end of the year.

Empirical Results for the Proposed Model

When the data are used to estimate equation (5) for the 1980–96 period, all signs are as expected, and the parameters are statistically significant at all conventional confidence levels (see Table 1). When the Durbin-*h* statistic is applied to the lagged variable $\Delta\% R_{t-1}$ in equation (5), the *h* value is 0.495, indicating no serial correlation in the disturbance term.[4] The implied natural vacancy rate for the first estimate is 4.7 per cent [33.55/7.14], and the speed of adjustment of the real rental rate (β) is 0.638 [1–0.362]. When equation (5) is estimated in the absence of the term $\Delta\% R_{t-1}$, the coefficient of correlation decreases and the standard error increases. Moreover, the natural vacancy rate estimated tends to be unstable over time—that is, the natural vacancy rate changes significantly when different periods are employed. Thus, dropping of the lagged term gives an unstable structure.

As can be seen, the model appears to perform better than the other specifications considered, and works well for Hong Kong's rental market. Hong Kong's housing market is relatively homogeneous, thus intrametropolitan differences in the rent adjustment process are expected to be insignificant. Moreover, the housing rental market in Hong Kong is very competitive, as it depends upon a large number of small landlords to supply private rented dwellings. Clapp *et al.* (1995) argue that higher population density tends to foster more, better and prompter information. The effect is to increase the average magnitude of the rental adjustment coefficient, indicating that there is less friction in the rental housing market in Hong Kong.

Hendershott (1995) argues that large temporal variation in US natural vacancy rates may simply reflect continuing market disturbances. As a further check on the specification for the partial adjustment model, the regression was run using different time-periods including the very volatile periods in the early 1980s and 1990s, and it was found that the estimate of the natural vacancy rate is stable. Thus, the model is relatively robust, and there should be no serious problems arising from the assumption of a constant natural vacancy rate in the Hong Kong market over the estimation period.

From equation (3), the expected rental rate can be expressed as:

$$\Delta\% R_t^* = 1.56\Delta\% R_t - 0.567\Delta\% R_{t-1} \qquad (7)$$

The expected, actual and fitted values of the real rents and rental change over the period 1983–96 are depicted in Figures 1 and 2. The actual and predicted series tend to move together. It appears that the Hong Kong data

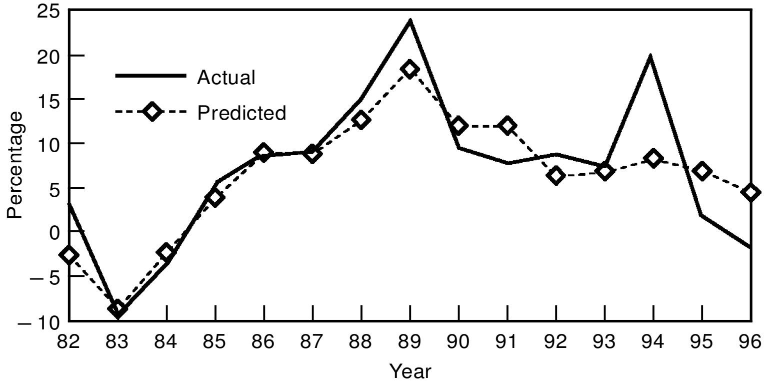

Figure 2. Rates of change in housing rental values in Hong Kong, 1982–96.

conform well to a linear rental adjustment model.

Furthermore, it can be shown that:

$$\lambda = -b/\beta(1-\alpha) = 11.19/(1-\alpha)$$

To estimate the value of α, the variance:

$$\Sigma(V_t^* - V_t)^2 = \Sigma(\alpha V_n - V_t + (1-\alpha)V_{t-1})^2$$

is minimised, implying that:

$$\hat{\alpha} = \Sigma(V_t - V_{t-1})(V_n - V_{t-1})/\Sigma(V_n - V_{t-1})^2$$

It follows that:

$$V_t^* - V_{t-1} = 0.413(4.70 - V_{t-1}), \quad \hat{\alpha} = 0.413, \ \hat{\lambda} = 19.1 \tag{8}$$

The expected and actual values of the vacancy rate are illustrated in Figure 3. The vacancy rate peaked at 6 per cent in 1982 and thereafter decreased to 2.9 per cent in 1988. By contrast, the expected vacancy rate peaked at 5.5 per cent in 1983 and, thereafter, decreased to about 3.5 per cent in 1989. Equations (7) and (8) comprise a system termed extrapolative expectations. The adjustment parameter λ depends on the combined effects of the adjustment speeds of the rental and vacancy equations. Igarashi (1991) argues that the relationship between rents and vacancy may be ambiguous because housing markets are continuously adjusting from the short run to the long run. Thus, it is possible for the observed rents and vacancies to move in opposite directions in the short run but the same direction in the long run because they have different adjustment paths. This supports the arguments presented in this paper that in the short run, vacancy rates and rents are unlikely to be in equilibrium simultaneously.

The Impact of Inflation

Titman (1982) argues that real rental rates must decrease if the anticipated rate of inflation increases. DiPasquale and Wheaton (1992) found that real rents are affected by inflation. They calculate that real rent drops by 0.6 per cent for every 1 per cent increase in inflation. However, the estimates give a very low Durbin–Watson statistic, indicating that there is serial correlation in the error term. The result, thus, weakens their arguments. They also find that a 1 per cent increase in the capital cost of home-ownership, on average, brings about a 0.9 per cent increase in the demand for rental housing. DiPasquale and Wheaton (1992) argue that rising inflation reduces the real capital cost of home-ownership, which in turn reduces the demand for rental housing. This interpretation seems to suggest that inflation plays a role in affecting tenure mode as inflation makes home-ownership more attractive than renting. It has also been argued that inflation tends to raise the real after-tax return to housing (Feldstein, 1980; Follain, 1982; Kau

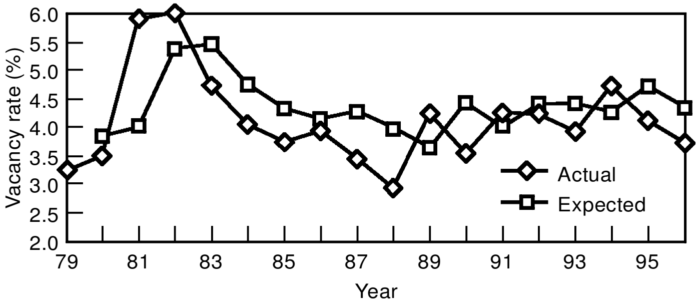

Figure 3. Expected and actual housing vacancy rates in Hong Kong, 1980–96.

and Keenan, 1983; Follain and Ling, 1988; Rose and La Croix, 1989).

If the above is the case, in an inflationary environment, as there is a switch from renting to owning, vacancy in the rental sector would rise for a given total housing demand. This, in turn, would exert a downward pressure on house rentals. Together with the negative inflation effect on real rental change, a declining real rent should be observed in such a hypothetical case. To examine the impact of the inflation rate on the rate of change of real rents, the inflation rate (P_t) is included as an independent variable to equation (5).[5] However, as reported in Table 1, the estimate of the coefficient for P_t is small and insignificant. Contrary to DiPasquale and Wheaton's finding, it indicates that real rent is unaffected by inflation. The implied natural vacancy rate decreases slightly to 4.35 per cent, whereas β increases slightly to 0.675. As expected, a lower natural vacancy rate is accompanied by a higher speed of rental adjustment. While inflation tends to push up operating costs of rental housing, such as maintenance and repair, it remains unclear why such an increase in operating costs is not passed on in the form of higher rents to tenants (see Eubank and Sirmans, 1979, for a related discussion). If inflation reduces the real rental growth rate, the supply of rental housing would decline eventually, because the decline in net real income could not persist. When P_t is replaced by interest rate (I_t), the estimate of I_t is again insignificant. When both P_t and I_t are included, the associated coefficients are also insignificant (see Table 1). This equation was compared with equation (5) by using variance ratio tests, and obtained the F-statistic $= 0.357$ at the 0.71 significance level, indicating that inflation and interest rates do not affect equation (5).

While there is not much empirical support for the effects of inflation on real rents, it is useful to explain why different structures of rental markets may have significantly different sensitivities to inflation. House rent normally comprises two components: rent for the building; and land rent which reflects the scarcity of land resources and serves a function in allocating land uses. While building structures will depreciate over time, land rent tends to move with general prices. Moreover, once a house is built, the construction cost is an historical cost and, thus, the rental change is expected to be less sensitive to inflation. When the house price exceeds construction costs, profits mainly reflect the land rent. In Hong Kong, since construction costs account for a small proportion of total cost, the change of house rent should mostly reflect land rent changes. For example, in Hong Kong, the building structure cost accounts for only a small percentage (about 20 per cent) of total costs and land price is normally the major cost for developers. If the building depreciation rate is 2 per cent each year and the share of construction cost in house rent is 20 per cent, then the component reflecting change in rent will be just 0.4 per cent (2 per cent $\times$ 0.2).

4. Factors Affecting the Adjustment Process

Vacancy theory has mostly been analysed within the context of models in which the market is homogeneous. In reality, housing can be viewed as a collection of attribute-different buyers with different housing preferences and facing a variety of spatially as well as sectorally distributed dwelling alternatives which may not comprise a single market (Maclennan and Tu, 1996). Normally, the natural vacancy rate will vary significantly across different cities. In the adjustment rule, the rate of change of rents remains above or below its equilibrium level for as long as a gap persists between the actual and natural vacancy rate, but the speed of adjustment varies and depends upon the particular characteristics of individual housing markets. The operational structure of the market will give rise to different degrees of disequilibrium. Although it is not really possible to test the model directly without making appropriate assumptions, this review section features the most important aspects of market friction that can affect rental adjustments. The following paragraphs discuss the essential problems, and how the results presented in this paper would be affected when these problems are present.

Heterogeneity of the Market

Heterogeneity causes mismatch of tenants and dwelling units. The effect of heterogeneity on rents is non-linear. Different specific sub-markets have populations that demand differing specific attributes. Furthermore, small-scale landlords tend to be more willing than large-scale landlords to trade off lower rents for higher occupancy rates and to induce tenants to stay longer (Belsky, 1992). The large-unit market that faces larger adjustment costs for occupancy variations tends to have a greater reluctance to adjust occupancy levels to changing economic climates (Grenadier, 1995). However, heterogeneity of the housing market is small in Hong Kong, because most of the residential units built (over 95 per cent) are multifamily (a large number of flats in one building). In addition, small-scale landlords have remained predominant in the market, and there were virtually no changes in concentration of ownership over the period of analysis.

Dispersion in Rents

An increase in the mismatch between the location of housing demand and the location of supply tends to increase search time and the natural vacancy rate. The geographical mismatch will lead to wider ranges of rents, and thereby slower rental adjustments despite the high vacancy rates, because households will be less likely to substitute between sub-markets. If the housing sub-markets are similar, there will be a higher level of substitution between them, and the overall market will be more stable (Maclennan and Tu, 1996; Tse, 1998).

Heterogeneity of the housing market also increases the dispersion in rents, making the housing market ‘thin’. A thin housing market will give rise to a higher search time for tenants and will, therefore, result in a higher natural vacancy rate (Rosen and Smith, 1983; Read, 1991; Arnott, 1989; Belsky and Goodman, 1996). For instance, a large-unit market is always ‘thinner’ than a small or medium one. It takes longer to fill vacant units because there are fewer searchers in the large-unit market. It is estimated that the ratio of housing stocks of small/medium-units to large-unit markets was 12:1 in 1997. Thus, the large-unit market is relatively a small market. McAfee (1995) shows that a multi-goods market tends to generate an equilibrium price dispersion very differently from a single-good market. A larger rent dispersion would induce landlords and tenants to search further, raising natural vacancy rates above the equilibrium rate when fuller information is available. A larger rent dispersion would therefore lead to a lower speed of adjustments. However, owing to the small size and high population density of Hong Kong, geographical mismatch of the housing market is less significant.

Tenant Mobility

An increase in tenant mobility will cause larger average rent increases, since landlords are more inclined to raise rents when tenancy turns over (Belsky and Goodman, 1996). Thus, non-moving tenants generally pay lower rents than moving tenants. Moreover, the natural vacancy rate will increase with greater mobility or greater market turnover of tenants, and will be higher in areas of rapid growth where there is relatively more construction ahead of demand than in areas of slow growth (Rosen and Smith, 1983). However, there is little evidence to suggest that rental mobility in Hong Kong's housing market became suddenly greater during the estimation period. The vacancy rate which appears to be quite stable lay between 2.9 per cent in 1988 and 6 per cent in 1982. If most of the vacant stock were old and not easily let, the natural vacancy rate would rise. However, the natural rate will return to its normal level in the long run when more new dwelling units are built.

Legal Restrictions

While natural vacancy performs a socially useful role in expanding an entering household's choice set (Arnott, 1989), market imperfection will worsen if a relatively high level of natural vacancy rate is created due to legal restrictions.

Shilling *et al.* (1992) show that uncertainties created by a subject-to-resale contingency tend to exact an implicit cost on the housing market. Consequently, an apartment which is subject to a tenancy agreement can normally be sold at a lower average selling price than a vacant unit. In Hong Kong, a tenant or sub-tenant enjoys security of tenure while s/he remains in occupation. A tenancy will not come to an end unless a tenant or sub-tenant agrees to surrender the tenancy or sub-tenancy. The tenant may apply to the Lands Tribunal for a new tenancy if the landlord does not agree to renew the current tenancy. The Lands Tribunal will order the granting of a new tenancy unless the landlord successfully opposes the application on specified grounds such as for self-occupation. However, the rent for the new tenancy will be the prevailing market rent of the premises.[6] Even if a property is transferred to a third party, the Ordinance is still binding. In Hong Kong, a home-purchaser would normally prefer a vacant unit to an occupied unit because an occupied unit is restricted in tenure choice. In anticipation of asset appreciation, speculators would prefer to hold a vacant apartment, though it is costly to do so, in order to bypass the legal restrictions imposed by the Landlord and Tenant (Consolidation) Ordinance. Furthermore, the imposition of more tenancy restrictions would raise the rental cost. One reason rental rates in Japan are so high is that a lease confers on the tenant rights tantamount to ownership after five years of occupancy. The tenant cannot be forced to terminate the tenancy agreement, even upon expiry of the lease, unless reasonable compensation is offered by the landlord (Bacow, 1990).

The tax code may also have an effect on the size of the natural vacancy rate. Hendershott and Haurin (1988) have shown that about two-thirds of the increase in the natural vacancy rate of offices in the US were due to the passage of the 1981 Tax Act.

5. Conclusions

This paper suggests a two-equation model of rental adjustment based on adaptive expectations rather than the single-equation model presented in the previous literature. The model presented here represents an advance over the traditional rental adjustment equation. First, as the representative agents will form expectations about vacancies and rentals, the equilibrium equation links the gap between natural and expected vacancy rates to the expected rate of change of real rents. Secondly, as rents and the vacancy rate are subject to different institutional rigidities, they are able to adjust independently to supply or demand shocks. When the housing vacancy rate drops sharply, expectations lead to the lagged adjustment of the real rate of change of rentals. The empirical results based on the data from Hong Kong's housing market are supportive of the expectations model. The results also indicate that the rate of change in real rents is neutral with respect to inflation.

This paper shows that an expectation of housing rents can be formed by bringing together expectations about demand and supply, or the vacancy rate. The underlying economic theory in the model suggests that there are costs of adjusting vacancy which make it more flexible than the single-equation model. The model helps to specify the structural relationships of a rental market in a way that can lead to more appropriate estimation. The main advantage of the model presented in this paper is that it requires very little extra information. The model is capable of being more specific than the previous models and it provides new theoretical as well as testable empirical hypotheses. Further research, with more data such as land rents, tenant mobility, dispersion in rents, legal restrictions and other economic and demographic factors, can help in giving better estimates of the parameters, refining the results, and verifying the existence of the adjustment paths of housing vacancy rates and rental growth rates.

Vacancy is a consequence of the asymmetry between the effects of adjustment costs and benefits of searching. For instance, the limited scope for a landlord to abandon an existing tenancy contract implies that vacancy rates cannot vary by termination of a tenancy when the demand for rental housing is high. Thus, inertia tends to be larger when the vacancy rate is at a relatively low level. It would be interesting to explore whether there are asymmetric impacts to the two adjustment paths when housing rents and vacancy rates are determined simultaneously by other variables. A treatment of expectations in studying housing rental market is clearly an important area for future work.

Notes

1. $E(u_t) = 0$ for $E(v_t) = E(\varepsilon_t) = 0$ and $Var(u) = b^2 Var(v) + Var(\varepsilon_t)$ for $cov(v, \varepsilon) = 0$. Therefore, all the assumptions will still hold.
2. The model proposed in equation (5) assumes that the rate of change of rent is independent of changes in operating costs. The inclusion of the rate of change of operating costs, to adjust the rate of change of nominal rent used in the vacancy model, has been adopted by Eubank and Sirmans (1979) and Rosen and Smith (1983). However, both failed to find a statistically significant relationship between the rental change and vacancy rates. The work of DiPasquale and Wheaton (1992) also failed to establish a statistically significant effect when real rents were used. Accordingly, operating costs are not included in this model.
3. See technical notes of *Property Review*, Department of Rating and Valuation, Hong Kong.
4. The h-statistic $= (1 - DW/2)\sqrt{n/(1 - nVar(c))}$ is approximately normally distributed with unit variance, where n is the number of observations and $Var(c)$ represents the variance of the estimator of c. Its critical value at the 0.05 level is 1.645 (for a one-tailed test).
5. Data are obtained from various issues of *Annual Digest of Statistics* of the Census and Statistical Department of Hong Kong.
6. See *A Simple Guide to The Landlord and Tenant (Consolidation) Ordinance*, Rating and Valuation Department of Hong Kong.

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Appendix

In a rational expectations framework:

$$\Delta\% R_t - \Delta\% R_t^* = e_t,\ E(e_t) = 0,$$
$$\Delta\% R_t^* = E(\Delta\% R_t / I_{t-1}) \tag{A1}$$

where, I_{t-1} is the information set in $t-1$. Subtracting $\Delta\% R_t^*$ from equation (3) and re-arranging gives:

$$\Delta\% R_t - \Delta\% R_t^* = e_t = (1-\beta) \times (\Delta\% R_t - \Delta\% R_t^*) \tag{A2}$$

Thus:

$$E(e_t) = (1-\beta)E(\Delta\% R_{t-1} - \Delta\% R_t^*) = (1-\beta)(E(\Delta\% R_{t-1}) - E(\Delta\% R_t^*)) = 0 \tag{A3}$$

since $\mathrm{E}(\Delta\% R_t^*) = \mathrm{E}(\Delta\% R_t) = \mathrm{E}(\Delta\% R_{t-1})$, given the rational expectations framework.

Note that

$$e_t = (1-\beta)^T(\Delta\% R_{t-T} - \Delta\% R_t^*) \tag{A4}$$

Hence, $e_t \to 0$ as $T \to \infty$, since $0 < \beta < 1$, implying that the disturbance term is also asymptotically zero.

If an error correction model of the form is applied, we have

$$\Delta\% R_t - \Delta\% R_{t-1} = d(\Delta\% R_t^* - \Delta\% R_{t-1}^*) + g(\Delta\% R_{t-1}^* - \Delta\% R_{t-1}) \quad (A5)$$

combining equation (1) gives the following specification:

$$\Delta\% R_t = \mu_0 + \mu_1 V_{t-1} + \mu_2 V_{t-2} + \mu_3 \Delta\% R_{t-1} \quad (A6)$$

However, OLS generates insignificant coefficient μ_2.