HONG KONG INSTITUTE FOR MONETARY RESEARCH

RENTAL ADJUSTMENT AND HOUSING PRICES: EVIDENCE FROM HONG KONG'S RESIDENTIAL PROPERTY MARKET

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HKIMR Working Paper No.01/2013

January 2013

Rental Adjustment and Housing Prices: Evidence from Hong Kong's Residential Property Market

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January 2013

Abstract

This paper investigates the interaction between housing prices and housing rentals. Standard economic models treat housing prices as the present discounted value of future rentals with the latter treated as exogenous. Casual observation, however, suggests that changes in rental prices often follow housing price changes. Economic theory also supports the view that rental prices may not be exogenous. Extending the user-cost model of house price determination, we propose that expected returns on alternative investments contribute positively to the rental adjustment process. We estimate an empirical model for Hong Kong house prices and show that a 1% change in the gap between rental yields and equilibrium whole economy capital returns, the return gap, implies a 0.30% change in real rents. One policy implication is that price changes in the housing market can impact the rental adjustment process by changing the return gap. Consequently, variation in the price-to-rent ratio, which is often used to measure the divergence of housing prices from their equilibrium level can underestimate the size of any housing market 'bubble'.

Keywords: Rental Adjustment, Residential Property Market, Price-To-Rent Ratio

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We are grateful to the anonymous referee for providing very valuable comments and Fangzhou Liu for her excellent research assistance for our working paper. All errors are ours.

1. Introduction

The finance paradigm suggests that the fundamental value of a housing unit is its present discounted value of future rental income, just as stock prices can be treated as the present value of future dividends (Case and Shiller, 1989; Gallin, 2006). As such, the rent-price ratio in the housing market is similar to the dividend-price ratio in the stock market (Leamer, 2002). One implication is that housing and share prices do not affect rent and dividends directly. In this sense, rents are exogenous to housing prices. Casual observation of housing markets in general, however, reveal that change in rents often follow housing price changes. This could be because rentals are fixed during rental contract periods and so there is a natural lag in rental adjustments? Or that the housing market is informationally efficient so that any price changes fully reflect future changes in rentals. This paper explores a third explanation: that rental prices are influenced by housing price changes.

Rents are determined by demand and supply in the rental market. The demand for housing services by consumers or tenants is determined by income and demographic growth. On the supply side, landlords seek to maximise the capital return from their housing assets as a part of their investment portfolio (Henderson and Ioannides, 1983). An important difference between stock and housing markets is that if, for whatever reasons, stock prices become ‘too high’ relative to future dividends, the only action stockholders can take is to sell their stocks; there is no mechanism for stockholders to demand higher dividends. By contrast, when housing prices become ‘too high’, investors can either sell their housing assets or demand higher rents. This is because increases in housing supply takes time so tenants have little choice but to pay higher rent in the short term if rents rise. The implication is that increases in housing prices can directly affect changes in rents.

This paper shows how rents can be endogenous to housing prices by investigating a rental adjustment process in which landlords are investors optimizing an investment portfolio. In conventional rental adjustment literature, the gap between the ‘natural’ and actual vacancy rate is almost the sole driver of rental changes (Smith (1974); Eubank and Sirmans (1979); Rosen and Smith (1983); among others). Hendershott (1996) adds a new variable: the gap between equilibrium and actual rental rates but does not explain how rents return to their equilibrium level. This paper extends Hendershott’s work by developing an empirical model in which risk-adjusted rental yields tend to the average capital return in the economy in the long run providing there is no-arbitrage between different assets. During housing price booms and busts, the higher or lower housing price leads actual rental yields to deviate from the equilibrium capital return in the economy and the gap between these two – the so-called return gap - is the driving force for the rental adjustment.

The intuition behind this mechanism is straightforward. During housing price booms, higher housing prices lead to lower rental yields other things equal. Consequently, rental yields implied by higher housing prices are lower than their equilibrium level, which is equivalent to average capital return in the economy. The landlord has two options (if the landlord does not consider potential capital gains in future): sell the property at a high price and use the money to invest in other assets to get the average capital return, or raise rents to increase rental yields. Thus, changes in housing prices can directly affect price adjustment in rental markets.

We test our hypothesis by investigating whether the return gap affects the rental adjustment process using data from the Hong Kong residential property market. The empirical results confirm the conventional rental adjustment theory: that the gap between the natural and actual vacancy rate plays an important role in rental adjustment in Hong Kong. More importantly, they also show that the return gap, between actual rental yields and equilibrium capital returns, has a positive effect on rental adjustment: a 1% change in the return gap implies a 0.30% change in real rents.

The rest of the paper proceeds as follows. Section 2 discusses existing literature. Section 3 presents our empirical model and illustrates the main determinants of the rental adjustment processes. Section 4 studies recent developments in Hong Kong's rental and property markets. Section 5 discusses data and section 6 reports the results from our empirical model. Section 7 provides concluding remarks.

2. A Brief Literature Review

It is well recognized that housing is both a durable consumption good and a financial asset (Henderson and Ioannides, 1983; Piazzesi et al., 2007; Yao and Zhang, 2005). As a consumption good, the price of housing is determined by supply and demand, which is related to factors such as population growth, income and construction costs. On the other hand, as a financial asset, the fundamental value of housing equals to the present value of future housing service flows, which is rent in a well-functioning market (Krainer and Wei, 2004).

2.1 Rental Determinates

A common assumption in the housing literature is that rent is fundamentally determined and the rate of change in rental prices depends upon deviations of the actual vacancy rate from its 'natural' rate - a measure of excess demand or supply (Smith, 1974; Rosen and Smith, 1983). However, empirical evidence for this theoretical model is mixed: both the vacancy rate and property taxes are found to be significant in explaining changes in rental prices in five Canadian cities (Smith, 1974), but the vacancy rate is insignificant in four large U.S. cities due to the low observed vacancy rate (Eubank and Sirmans, 1979). Expanding the sample to seventeen U.S. cities, Rosen and Smith (1983) find the gap between the actual and natural vacancy rate is significant in rental changes.

The mixed empirical findings might be related to the shortcomings of the traditional theoretical model of rents (Wheaton, 1990). Specifically, the rental adjustment model fails to specify why the relationship between rental changes and the vacancy rate is linear. More importantly, as Hendershott (1996) points out, if the linear equation holds, when there is a supply shock in the rental market, it requires substantial overshooting of the natural vacancy rate for the rental rate go back to equilibrium, which is unrealistic. Hendershott (1996) tries to make up for this by proposing a revised model that allows a general adjustment path via the vacancy rate and another path leading real rents to return their equilibrium level. However, the paper does not explain why rental changes can be affected by the difference between equilibrium and actual rents and the micro-foundation behind Hendershott's model is incomplete.

2.2 Dynamics between Housing Prices and Rents

Housing prices are often modelled as the present discounted value of future rental income, either as the rent the owner saves by living in the house or the actual rental income paid by tenants (Himmelberg et al., 2005). The widely-used user cost model defines equilibrium between housing prices and rents as a situation in which individuals are indifferent between renting and owning their house (Poterba, 1984). There have been several empirical studies on whether this holds in the long run, with mixed results. Using U.S. consumer expenditure survey data, Garner and Verbrugge (2007) find a divergence between user costs and rents over extended periods of time. Some studies find that the price-to-rent ratio has no predictive power for housing prices (Case and Shiller (1989); Mankiw and Weil (1989); Campbell et al.(2003)) while others suggest that there is a positive relationships (Capozza and Seguin (1996)). In a recent study, Gallin (2006) finds evidence that, in the U.S., the price-to-rent ratio helps to predict changes in real house prices while the ratio's predictive power for future real rents is small.

In order to make up for the potential problem of using static price-to-rent ratios, time-varying price-to-rent ratios, using different stochastic discount factors, are introduced to assess the compatibility of house prices with fundamentals. Results from the Spanish market suggest that a price-to-rent ratio well above its long-run equilibrium level does not necessarily mean that it is not in line with its short-term adjustment patterns. Similarly, findings that deviations between imputedand actual rents are associated with real interest rate also suggest that there is little evidence of a housing bubble in the U.S. (Himmelberg et al., 2005). On the other hand, it can be shown that if the returns of other assets changes affecting the marginal utility of households, housing prices could change even if the rent does not (Leung and Chen, 2006 and 2010). These mixed results imply that the user cost model cannot fully justify the dynamics between housing prices and rent. It also suggests that the price-to-rent ratio may not be reliable in detecting housing price bubbles. The unsatisfactory performance of the price-to-rent ratio might be due to the mismatch of sales and rental market. However, the problem could also come from the basic assumption that underlines existing models of the price-to-rent ratio: rent is always treated as a fundamentally driven variable with no account taken of the possibility that housing prices directly affect rents.

2.3 Empirical Findings on Hong Kong's Property and Rental Market

Hong Kong is an ideal place to examine the dynamics of the determination of housing prices and rents for several reasons: First, housing prices are highly cyclical: there have been two booms and busts in the last two decades (Yiu and Jin, 2011). Second, housing units for rent and units for sale are homogenous in Hong Kong, unlike in the US where the rental market is quite different to the owner-occupied market[1]. This matches well with the assumption that investors are indifferent between renting and purchasing in equilibrium, mitigating the concern of a mismatch problem in the price-to-rent ratio. Third, since July 1986, most newly created lettings are not covered by rent controls[2] which are commonly used in urban areas in many other countries[3].

Although rent plays an important role in Hong Kong's economy, accounting for 26% of CPI, academic research on its determinants is inadequate. Existing studies find it hard to explain Hong Kong's rental prices. For example, Tse and MacGregor (1999) point out that the rental market in Hong Kong cannot be fully explained by Smith's (1974) model. Moreover, Hendorshott's (1996) model is not applicable to Hong Kong either, since there is no evidence to show that the driving force of rental adjustment comes from changes in interest rates, depreciation or other expenses directly. Instead, rental adjustment is found to be closely associated with land rents, which is a major component of land value housing prices (Tse and MacGregor, 1999). On the other hand, rent is found to be possibly driven by housing prices in Hong Kong. Cheung et al. (1995) shows that housing price changes can lead to rental changes with a one quarter lag in 11 out of 40 cases in the residential property market, which suggests housing prices could impact rent directly. This causal relationship, however, lacks of the support of a theoretical framework.

Similar to housing market studies in other economies, rent in Hong Kong is treated as a fundamental determinant of housing prices. However, the relationship between housing prices and rents may not be a linear function (Tse and Webb, 1999). Recent studies indicate that the housing market response to external shocks may be regime-dependent due to the fact that small open economies, such as Hong Kong and Singapore, are subject to regime-switching in asset returns (Chang et al, 2011, 2012). This may be the reason for why many empirical studies based on the conventional price-to-rent ratio to measure housing valuations show mixed results. For example, while Yiu and Jin (2011) finds strong upward price pressure from 2009 to 2011 in the housing market, Ahuja and Porter (2010) show that the level of house prices in Hong Kong does not seem to be significantly higher than would be justified by underlying fundamentals during the same period. On the other hand, price dispersion and trade volumes are found to be useful in predicting housing returns in Hong Kong due to cognitive biases from both loss averse sellers and anchoring buyers (Leung and Tsang, 2012b). The results suggest that the user cost model and price-to-rent ratio may not be able to explain the dynamics between housing prices and rents.

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1 For example, in the US 88% of all owner-occupied homes are single-family properties, while these homes make up only 33% of all rented properties. Instead, the rental market is dominated by condos, which account for a total of 62% of all rented homes. That compares with just 6% in the owner-occupied market (Dales, 2011). This is also the reason why BLS residential rent index might not be an appropriate measure of the dividend on housing (Case and Shiller, 1989).

2 After July 1986, less than 2,200 tenancies, covered by Part I of the Landlord and Tenant (Consolidation) Ordinance, were still protected by rent controls, which was less than 1% of new created lettings in Hong Kong.

3 For example, in the US, many cities with a large share of tenant population, such as New York City, San Francisco, Los Angeles, Washington, D.C. along with many small towns in New Jersey, have rent controls in effect. These are also common in Europe and developing countries (Malpezzi, 1993).

3. An Empirical Model of Rental Adjustment

In the early literature, researchers understood that rental prices are determined in the market by demand and supply. The simplest way to show this is to use the housing vacancy rate, which is directly observable and recorded. The empirical model takes the form:

$$\Delta R_{t+1}/R_t = a + b(V^* - V_t) + \varepsilon_{t+1} \tag{1}$$

where R_t is the rent per unit of floor area in period t, $\Delta R_{t+1} = R_{t+1} - R_t$, V_t is the actual vacancy rate, and V^* is the so-called natural vacancy rate, typically taken as a constant. When the vacancy rate is high, supply exceeds demand, and rents tend to fall. Therefore, the coefficient b should be positive. In the literature, there are arguments that the linear relationship between rental adjustment and the vacancy rate is just a first order approximation.

Economists have long recognized that (1) does not really explain changes in rental prices. Changes in rental prices are not caused by changes in the vacancy rate, instead both are determined by the same demand and supply forces. Hendershott (1996) and Hendershott et al. (2002) derive an empirical model from the user-cost theory:

$$\Delta R_{t+1}/R_t = a + b(V^* - V_t) + cRCgap_t + \varepsilon_{t+1} \tag{2}$$

where RCgap_t is the replacement cost-based gap, defined as:

$$RCgap_t = RC_t(g_t^* - g_t) \tag{3}$$

RC_t is the replacement cost of a unit floor area, $g_t = \frac{R_t}{PC_t}\frac{1-V_t}{1-V^*}$ and $g_t^* = r_t + d_t + e_t$ with r_t being the interest rate, d_t being the depreciation rate, and e_t the operation expense rate. Hendershott's empirical model represents the most popular model in the empirical literature. It models two driving forces of the real rental rate: the first one is the pressure from the housing space market itself: the gap between natural and actual vacancy rate $(V^* - V_t)$. This gap summarizes demand and supply information in the housing space market (Wheaton and Torto 1988). The second picks up the pressure from the capital market: landlords are investors seeking at least the average capital return in the economy.

The point of departure of our model is that the replacement cost is perhaps out-dated in a fast-changing housing market. From an investor's point of view, the actual housing price is perhaps more relevant. We define a price-based gap as:

$$Pgap_t = P_t(g_t^* - g_t) \tag{4}$$

where P_t is the housing price per unit floor area.

The definition of g_t^* assumes that the alternative investment opportunity to investing in housing market is bank deposits (or similar short-term fixed income securities). This assumption obviously overlooks many other possibilities. Besides the price-based gap, we consider two more issues that capture the notion of alternative investment opportunities. One is based on the expected housing capital gain, $E_t Hcap_{t+1}$. The other is based expected stock market returns, $E_t Sret_{t+1}$. The latter is easy to understand and requires no further explanation. The former is based on the observation that rental contracts are typically locked in for one or two years so when landlords and tenants make deals the expected housing price appreciation (or depreciation) will be taken into account. The corresponding definitions are as follows:

$$Sgap_t = P_t(E_t Sret_{t+1} + d_t + e_t - g_t) \tag{5}$$

The empirical models for the rental growth rate are then:

$$\Delta R_{t+1}/R_t = a + b(V^* - V_t) + c_1 Pgap_t + c_2 E_t Hcap_{t+1} + \varepsilon_{t+1} \tag{6}$$

or

$$\Delta R_{t+1}/R_t = a + b(V^* - V_t) + c_1 Sgap_t + c_2 E_t Hcap_{t+1} + \varepsilon_{t+1} \tag{7}$$

4. Hong Kong's Residential Property Market

4.1 Hong Kong's Property Market and Economy

The property sector plays an important role in Hong Kong's economy as housing is the most important form of savings to many households in the city. About half of domestic credit goes to various mortgage loans in the property market and taxes from the real estate industry have been a significant source of government revenue (Peng et al. 2002). However, the property market has been very volatile and the real economy has been shocked by booms and busts in Hong Kong in the last three decades. Fluctuations in property prices affects the cost of living given that the housing rental component accounts for 26% of the Composite Consumer Price Index (CCPI).

Since 2009, property prices have increased sharply in Hong Kong, and the residential price index was above its 1997 peak in April 2011. Inflation (CCPI) has also picked up strongly to an annual rate of 5.3% in 2011. Since 2004, housing price inflation and general inflation have moved together, although this co-movement pattern was not so obvious before that (especially for the period 1995Q4 to 1997Q3 when inflation remained quite stable despite a surge of almost 70% in property prices). This suggests that the current cycle is different to that during the 1997 boom.One significant difference between the two property booms is the level of confirmor transactions. In the current property boom, the share of confirmor transactions as a share of total registration is much lower than in 1997. On the other hand, both booms are characterised by low or negative real interest rate. In both the current boom and the 1997 boom, it is likely that persistent negative real interest rates played animportant role in driving rapidly rising housing prices.

4.2 Property Price and Rent

In general, the relationship between changes in rental and housing prices is close. However, during booms in housing prices rental prices tend to lag housing prices (Figure 1). For example, the property price surged almost 70% from 1995Q4 to 1997Q3, while rent only increased by 20%. During the current boom property prices rose by 50% between 2009Q3 and 2010Q4, compared to a 35% increase in rent over the same period.

An alternative way to look at the dynamics between property prices and rents is the so-called price-rent ratio, which is widely used as an indicator in the real estate industry. The price-rent ratio varies in different categories and districts in Hong Kong. There are five categories of private residential units located in four districts according to "The Property Review" published by the Hong Kong Government[4]. In the current housing boom, the price-rent ratio for luxury units seems to have risen more quickly than low-end units, which differs from the 1997 property boom. The changing pattern in the price-rent ratio also suggests there could be other factors at play influencing the dynamics of housing prices and rents.

4.3 Rent and Vacancy Rate

Among other factors, the vacancy rate is traditionally considered as an important determinant of rent. Specifically, the difference between actual and the 'natural' vacancy rate is an indicator of demand and supply in the rental market. The vacancy rate in Hong Kong is low compared with other economies. Even after the Asian financial crisis it peaked at just 6.8%. In recent years, the vacancy

[4] The five categories are classified according to sizes: Category A: floor area of 39.9m^2 and below, Category B: 40-69.9m^2, Category C: 70-99.9m^2 , Category D: 100-159.9m^2, Category E: over 159.9m^2. The four districts are Hong Kong Island, Kowloon, New Kowloon, and New Territories.

rate has been trending down and touched a decadelow level of 4.3% at the end of 2011, which is below the estimated natural vacancy rate (4.35%) in Hong Kong (Tse and MacGregor, 1999)[5].

The low vacancy rate can be explained by various factors. From the supply side, a limited number of new units can result in a low vacancy rate. From Figure 2 we can see the correlation clearly: the supply of more completed units between 1998 and 2002 seems to have driven the vacancy rate to a high level in 2003, whilst the sharp decline in the supply after 2004 has driven the vacancy rate down in recent years. From the demand side, rising demand for housing services due to high income growth also impacts the vacancy rate. High income growth before Asian financial crisis might explain a low vacancy rate during that period, while lower income growth after 1998 can help to explain the increase in the vacancy rate between 1997 and 2003. In recent years income growth and the vacancy rate have moved in the same direction, which suggests that simply looking at demand and supply in the rental market may not provide a full picture of the dynamics of the vacancy rate.

As mentioned earlier, the vacancy rate plays an important role in empirical studies of the rental adjustment processes. Prior to the Asian financial crise, rent and housing prices rose strongly, while the vacancy rate remained low and vice versa in the years following the crisis In more recent years, the vacancy rate has trended downwards as housing prices and rents have risen, which suggests that the vacancy rate is a key indicator of the underlying determinants of housing and rental prices.

4.4 Rent and the Gap of Returns

As we discussed, properties are just a part of a investment portfolio to landlords and they need to compare rental yields with the return offered by other investments (such as bond, stock and other assets). In equilibrium the expected return from housing investment must equal the expected return on other investments available in the economy after adjusting for risk. When landlords experience a decline in rental yields (due to higher housing prices) relative to the expected return on alternative investments available in the economy, they face two choices: sell the property and invest the proceeds in other assets to earn expected returns, or request a higher rent.

Of course, the real world is not so simple for several reasons: first, if landlords choose to sell their properties and walk away from the rental market, they need to pay transaction costs. Second, if they choose to walk away, they will lose future capital gains if property price rise further down the road. Third, if they choose to stay and ask for higher rent, tenants may not be able to satisfy them fully, and the landlord may need to find new tenants if the tenant chooses to leave.

Therefore, in reality rents tend to increase with housing prices, but at a relatively lower rate, especially during housing booms. In other words, rental yields are expected to be lower during housing booms because of the growth differential between rents and housing prices. Empirical data supports the

[5] The estimated natural vacancy rate ranges from 4.35% to 5.04% in Hong Kong depending on different specifications (Tse and MacGregor, 1999).

above prediction. when housing prices and rents began to rise in the early1990s, rental yields declined. They reached a record low of 3.55% as housing prices peaked in mid-1997[6]. After the property bubble burst in 1998, rental yields picked up quickly to reach a peak in 2003 as housing prices troughed. More recently, rental yields have declined to historically low levels of 3.2%, as housing prices have overtaken their 1997 peak.

On the other hand, the rental adjustment process is related to the gap between rental yields and the price-based return gap, defined as the product of real housing prices and the sum of risk free rate, risk premium, depreciation rate and operation expense. Following Himmlberg (2005), we assume that the risk premium is 2% and the depreciation rate is 2.5%. The operation expense is set at 0.5% given that there is little property tax in Hong Kong. For the risk-free rate we use the 10-year US Treasury bond yield as a proxy for the long-term risk-free rate available in Hong Kong[7]. Since we focus on relative variations of the return gap, housing prices are normalized by setting 1999 housing prices to one and deflating to real terms using the Hong Kong CCPI index.

The gap between expected alternative investment returns and rental yields is closely related to rent dynamics over our sample period (Figure 4). In the early 1990s, rents increased rapidly as the gap picked up quickly, and the pressure of rental growth eased as the gap declined starting from 1996. The same pattern can be observed during the Asian financial crisis and the Global financial crisis. One interesting observation is that the gap remains relatively stable compared to large variations in real rents during the global financial crisis, which suggests only gaps in return and the vacancy rate might not be able to capture the full picture of rental changes during crises.

5. Data

The set of data used in this study is quarterly data, which mainly comes from the Hong Kong Property Review published by R&VD and the sample period ranges from 1980Q4 to 2011Q4. Since we focus on residential property and the rental market, the property price and rental data we use hereafter are all residential as outlined below.

5.1 Housing Price

The housing price data used in this paper are published by R&VD, and cover five categories of private residential units in three areas according to size: from the smallest class A to the largest class E, and representing floor areas of 39.9 m^2 and below (A), 40.0 to 69.9 m^2 (B), 70.0 to 99.9 m^2 (C), 100,0 to

[6] We choose the rental yield for Class B units since it is the most popular unit in Hong Kong.

[7] Some people suggest that the 5-year exchange-fund bill yield can be used as a proxy for the risk-free rate. However, the market for long-term exchange fund bill is not liquid, and the yield is not a good measure of the long-term risk-free rate in Hong Kong. We discuss the reasons for this in next section.

159.9 m^2 (D), and over 159.9 m^2 (E), respectively. The three areas are Hong Kong Island, Kowloon and the New Territories[8].

R&VD publish two types of housing price data: average prices and a price index. Average prices are based on an analysis of transactions scrutinized by R&VD for stamp duty purposes. Since housing prices may change from one period to another not only because of value changes but also because of variations in quality, average prices may not represent pure price changes in the market. The price index, on the other hand, is designed to measure price changes with quality kept constant. The price index is derived from the same data that are used to compile average prices and it measures value changes by reference to the factor of price divided by rateable value of the subject properties rather than by reference to the rent or price per square meter of floor area. In effect, by utilizing rateable value, allowance is made not only for floor area but also other qualitative differences between properties (R&VD). Since housing price indices have been adjusted for variations in the quality of different housing units, we choose to use price indices instead of average prices in this empirical study. Figure 1 plots the time series of the price index for the sample period 1984 to 2010.

5.2 Rent

Similar to housing prices, R&VD also publishes rental price and indices in different areas for different categories of private residential units. Rents are based on an analysis of rental information recorded by R&VD for fresh lettings effective in the quarter being analysed. Rents are analysed on a net basis i.e. exclusive of rates, management and other charges. As with average housing prices, rents at a certain period depend to a large extent on the special characteristics, including quality and location, of the premises which are leased or sold during the period.

In order to deal with this issue, a rental index is constructed designed to measure rent changes with constant quality. The rental index, however, tends to understate market trends. Although all rents are analysed on a net basis, allowances is not made for the value equivalent of other contractual terms that are unknown to R&VD. In a tenant's market for example, landlords are usually prepared to make concessions to tenants such as refurbishment or the granting of extended rent-free periods. If rents were adjusted to reflect standard terms of agreement, these would tend to be lower than quoted rents when the index is moving downwards and vice versa. However, since we focus on the residential rental market, the common practice in Hong Kong for rent-free periods ranges from one to two weeks, which accounts for a small part of rent, compared to a two-year rental contract. The time-series of the rent index is also plotted in Figure 1, along with the price index. As shown, the two index series share the same ups and downs during the sample period.

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8 Before 1999, R&VD publish the quarterly housing price data in four areas: Hong Kong Island, Kowloon, New Kowloon, and the New Territories. After 1999, New Kowloon was not listed as an independent area any more.

5.3 Vacancy Rate

By definition, the vacancy rate equals to the number of vacant units divided by the total housing stock at the end of that year (Tse and MacGregor, 1999). R&VD publishes an annual vacancy rate for five categories of private residential units according to size after 1994. However, vacancy rate data are available from 1979 at an aggregate level. Vacancy defined by R&VD means that a unit was not physically occupied at the time of the survey conducted at the end of the year, and premises under decoration are classified as vacant as well. The vacancy data are obtained from management offices, owners, occupiers or by inspection of R&VD (R&VD, Property Review 2012).

We plot the time-series of the housing vacancy rate in Figure 2 along with land supply data. The vacancy rate is highly correlated with the land supply, implying that it is the supply side more than the demand side that is driving the vacancy rate.

5.4 The Replacement Cost-Based Return Gap

In real estate literature, long-term treasury bond yields are often used as a proxy for the risk-free interest rate (Poterba et al. 1991; Hendshott, 1996; Himmelberg et al, 2005; among others). However, the government bond market has not developed much in Hong Kong and there is no active market participation, restraining the growth of the overall debt market (Chan, 2009). There are two reasons. First, while large corporations have traditionally relied on the US-dollar bond markets for raising funds, investors are also happy to take up US-dollar bonds as proxies for Hong Kong-dollar bonds under the linked exchange rate system. Second, the government has no fiscal need to issue bonds. Therefore, instead of using yields from illiquid exchange fund bill markets, the linked exchange rate system provides a more reasonable measurement: long-term US treasury bond yields (Zhao et al, 2005).

From the specified interest rate, we compile a time-series of the RCgap which is shown in Figure 3, alongside the rental growth rate. The two series are not highly correlated over time.

5.5 The Housing Price-Based Return Gap

From the housing price index and other variables used for constructing the replacement cost-based return gap, we construct the housing price-based return gap, Pgap. The time series of the Pgap is plotted in Figure 4 along with rental growth. Pgap differs from RCgap in that Pgap is constructed with the housing price as the multiplier of the return difference between bonds and rental. The figure shows that the housing price-based return gap fluctuates with the rental growth more closely than the replacement cost-based return gap shown in Figure 3. However, there are still substantial differences between the housing price-based return gap and the rental growth.

5.6 Construction of Expected Housing Capital Gain and Sgap

We construct the expected housing capital gain as follows. We take the growth rate of the housing price index, denoted as $Z_t = \ln P_t - \ln PC_{t-1}$. At each quarter t, we run a time-series ARMA(p,q) model with data up to t. The model generates a forecast of Z_{t+1}, this forecast is used as the expected capital gain on housing property. The model is estimated using standard statistic criteria first and our own judgement later to decide the order (p,q). The model we finally choose is:

$$Z_t = c + \sum_{i=1}^{4}\gamma_i (Z_{t-i} - c) + e_t + \sum_{j=1}^{6}\theta_i e_{t-j} \qquad (8)$$

The model parameters are reported in Table 1. The time-series plot of the housing capital gain, E_t Hcap $_{t+1}$, is plotted in Figure 5, along with the rental growth. The figure shows that E_t Hcap $_{t+1}$ and rental growth fluctuate closely.

The discount factor used in RCgap and Pgap is based on the risk free rate with a constant risk premium adjustment to reflect the opportunity cost of the capital for investors. This discount factor may not necessarily reflect investor's actual perception in terms of opportunity cost of capital and the appropriate risk-weighting for rent. Hong Kong's bond market is relatively small, and due to Hong Kong's fixed exchange rate system with the US, the risk-free rate, as measured using the yield of a long-term US Treasury bond yield, may not truly reflect a Hong Kong investor's sentiment towards risk. Equities are by far the dominant asset class for retail investors in Hong Kong. Thus, it may be more appropriate to calculate the return gap by using returns on the Hang Seng Index (HSI) instead of the risk-free rate with risk premium.

In order to forecast the expected rate of return on HSI, we fit a VAR model using HSI return and the expected capital returns of housing. The annualized quarterly return of the HSI was calculated assuming dividends are reinvested. The housing capital gain is also used in our VAR model to increase the predictive power of the model. An optimal lag structure of 4 was chosen according to the Akaike Information Criterion, Final Prediction Error, and the sequential modified LR test statistic criterions. Thus, our VAR model can be expressed as follows:

$$Sret_t = c + \sum_{i=1}^{4}\gamma_i Sret_{t-i} + \sum_{j=1}^{4}\theta_j Z_{t-i} + e_t \qquad (9)$$

The coefficients of the estimates are shown on Table 2. Note that only the terms for the γ_3 and θ_1 are statistically significantly different from zero at the 10% level. Thus, we set all other coefficients equal to zero to obtain the forecast for the returns during the next quarter and annualize returns by multiplying the value by four. The estimated model parameters are reported in Table 2 and the constructed stock return-based gap is plotted in Figure 6, along with the rental growth. The plot also shows that rental growth and the expected stock return fluctuate closely.

6. Regression Results

We now use regression analysis to formally test the importance of the various return gaps in predicting rental adjustment in Hong Kong. Hong Kong experienced various economic shocks over our sample period, including the Asian financial crisis in 1997, the SARS crisis in 2003, and the global financial crisis in 2008. We add a dummy variable in the regression model to capture other factors beyond the return gaps we consider here.

Table 3 reports the regression results using RCgap and Pgap. The results are consistent with the predictions of our theoretical model. First, as the conventional rental adjustment theory predicts, the vacancy rate plays an important role in explainign changes in real rents. We first run a conventional rental adjustment regression which only includes the vacancy rate, and the results indicate the lagged vacancy rate significantly impact real rent changes (1% vacancy rate change in last period implies 0.534% change in real rent) and its implied natural vacancy rate is about 4.76% (Column 1, Table 3). After adding the dummy crisis, the impact from the vacancy rate becomes more significant and the explanation power of the model improves a lot from 0.02 to 0.207, which implies the crisis dummy is necessary to the empirical model.

Second, when we add Pgap to the model, the impact from the vacancy rate becomes a little bit less, but still very, significant statistically. As predicted, the other driving force of rental adjustment, the return gap has a positive impact: a 1% change in the return gap implies a 0.302% change in real rent (Column 3, Table 3). Not surprisingly, the explanatory power of the new model with the return gap increases from 0.207 to 0.240, and the implied natural vacancy rate drops from 5.38% to 3.28% [9]. The decline in the implied natural vacancy rate suggests that the rental adjustment pressure from the vacancy gap might not be as large as the conventional model suggests.

Third, we run the same regression using the RCgap as defined in the existing literature after controlling for the vacancy rate gap and crisis, and the result shows that the impact from the gap becomes insignificant with a wrong sign (Column 4, Table 3), which means the new measurement in this study appears to be a better choice for capturing the impact from the return gap. However, the insignificance may also be due to the large variances of estimators caused by a relatively small sample size, which we address below.

[9] The relatively small size of the adjusted R^2 in these regressions is due to two factors. First, there was a large change in rents following the Asian financial crisis and other crises. If we run the same model using annual data before 1997, the adjusted R^2 would be around 0.7, which is similar to the results in Tse and MacGregor (1999). Second, the vacancy rate data is only available annually, which lowers the explanatory power of the model given that other data are quarterly.

6.1 Results from Different Housing Categories

One way to deal with large variances in estimated parameters is to increase the sample size. As we discussed before, R&VD also publish price and rental indices for different sizes of residential units. However, for Category D and E, a price index is only available after 1993, so we focus on Category A, B and C. The results of the regression are shown in Table 4.

The empirical results from different categories in levels are similar to what we reported in Table 3. There are at least two major driving forces in rental adjustment: the gap between the natural and actual vacancy rate, and the gap between actual rental yields and the average capital return (Row 1 and 3, Panel A, Table 4). All estimated parameters on the gap are statistically significant, and size of coefficients range from 0.280 to 0.566 in different categories and the average size is 0.398, which means that 1% change in the return gap implies 0.398% change in real rents (Row 3, Column 1, Panel A in Table 4).

The results in Panel B using the alternative gap measurement are generally similar to what we observed in Panel A. First, the impact from the vacancy gap is statistically significant as a whole, but not significant in each sub-sample. Second, the crisis is always significant across different samples. The return gap is significant across the whole sample period, but not for all sub-samples. All coefficients in the Panel A are significant, and the variations across sub-sample is also smaller than that in Panel B, which implies that new return gap measurement might be a better choice compared to the conventional one.

The vacancy gap was not statistically significant in both Panel A and B. This could be explained by two reasons. First, the vacancy rate data is only available annually, and there is not much variation in the vacancy rate between quarters when we run regressions in first differences. Second, the vacancy rates used in Table 4 are aggregate vacancy rates for all categories.

6.2 Results using Hcap and Sgap

Table 5 reports the regression results using expected housing capital gain and Sgap to predict rental growth. In Panel A, the expected housing capital gain is added to the previous model and in Panel B the expected stock return-based gap is included.

From the table, the estimated coefficients of the expected housing capital gain and Sgap are all very significant. The overall predictive power of the model is increased after including capital gains, as evidenced by a higher R^2. The results indicate that alternative investment opportunities are more useful in predicting rental growth than in traditional models based on replacement costs and bond market returns only.

The fact that expected housing capital gain has a significant positive impact on rental growth suggests that landlords tend to price future housing capital gain into the rent when the rental contract is assigned, because the rental rate will be fixed for at least one or two years. This is in contrast to what people might think: since the landlord will get capital gain in future, they would give more discount to tenants in rent when they rent out the unit. The rational behind this is the landlord has no incentive to give tenants more discount when the rental market is tight.

The positive impact from Sgap indicates the return gaps. Regardless of whether we use Pgap or Sgap, all have a significant positive impact on rental growth. This suggests that during housing price booms and busts, the higher or lower housing price leads actual rental yields to deviate from the equilibrium capital return in the economy, and the gap between these two is a driving force for rental adjustment.

7. Concluding Remarks

The goal of this paper is to investigate whether price variations could impact the rental adjustment process, which is motivated by the mixed evidence for this in the existing literature. Higher housing prices leading to higher rents (and vice versa) is a well-known phenomenon to practitioners in the real estate industry. The link between housing price variation and rental adjustment suggests that housing prices may directly affect movements in rents. This implies that a widely used indicator in the real estate industry, the price-to-rent ratio, could underestimate risks in the housing market.

We investigate this question empirically. We argue that the return gap between actual rental yields and the average capital return from alternative investments could be a major driving force of rental adjustment. The key here is that higher housing prices will lower actual rental yields, and vice versa. We show that housing price variations can affect rental adjustment.

We estimate several econometric models based upon the empirical framework to test whether return gaps play a big role in rent adjustment after controlling for other factors. The estimation results show that the return gaps are a major driving force of the rental adjustment process, together with another conventional factor, the vacancy gap. Specifically, a 1% change in the return gap implies 0.30% change in real rents, and a 1% change in vacancy rate implies 0.66% change in real rents.

While this paper provides an intuitive explanation and empirical evidence for the argument that housing price variations can impact rental adjustment, it does not provide a precise mechanism explaining how housing prices affects rental adjustment. For example, the return gaps are shown to be major driving forces for rental adjustment, but how would landlords negotiate with tenants to enable this to happen? Why will tenants be willing to accept rental adjustments? To what extent will rent be adjusted during the negotiations given that the rental adjustment has to be constrained by the tenants's affordability? Questions like these remain unsolved, and could potentially be good research topics for future research.

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Table 1. Estimation of Housing Capital Gain

This table presents the coefficient for an ARIMA housing price model, which we use to obtain estimates for expected capital gains. We use an ARIMA(4,1,6) based on AIC, BIC, and Hannan Quin criteria. The time series model is thus of the form

$$Z_t = c + \sum_{i=1}^{4}\gamma_i (Z_{t-i} - c) + e_t + \sum_{j=1}^{6}\theta_i e_{t-j}$$

where $Z_t = ln(P_t) - ln(P_{t-1})$ is the housing capital gain in each quarter.

Coefficient	Value	Std. Error	t	$P>\|t\|$
γ_1	-0.531	0.109	-4.874	0.000
γ_2	-1.167	0.119	-9.810	0.000
γ_3	-0.290	0.104	-2.790	0.006
γ_4	-0.572	0.131	-4.354	0.000
θ_1	1.250	0.096	12.988	0.000
θ_2	1.943	0.051	38.387	0.000
θ_3	1.532	0.050	30.929	0.000
θ_4	1.405	0.089	15.849	0.000
θ_5	0.719	0.051	14.122	0.000
θ_6	0.130	0.049	2.637	0.010
$Cons$	0.015	0.006	2.679	0.019
R^2	0.483			
$AdjustedR^2$	0.433			

Table 2. VAR Estimate for Return on Hangseng Index

This table presents the VAR estimates for the Hangseng Index, using the expected housing returns we obtained from our ARIMA model as an additional estimating parameter. The VAR model can be expressed in the form

$$Sret_t = c + \sum_{i=1}^{4} \gamma_i Sret_{t-i} + \sum_{j=1}^{4} \theta_j Z_{t-i} + e_t ,$$

where $Z_t = ln(P_t) - ln(P_{t-1})$ is the housing capital gain in each quarter.

Coefficient	Value	Std. Error	t
γ_1	-0.126	0.097	-1.296
γ_2	-0.144	0.102	-1.403
γ_3	0.187	0.102	1.827
γ_4	-0.160	0.102	-1.567
θ_1	0.683	0.218	3.133
θ_2	-0.279	0.250	-1.117
θ_3	-0.019	0.248	-0.075
θ_4	-0.190	0.202	-0.937
$Cons$	2.930	3.523	0.832
R^2	0.156		
$Adjusted R^2$	0.091		

Table 3. Model with RCgap and Pgap

This table presents the results from our regressions using real rental growth $\Delta R_{t+1}/R_t$ as the dependent variable. The regressions are performed using a combination of independent variables including the vacancy rate (V_t), the economic-crises dummy variable ($Crisis_t$), the price-based return gap ($Pgap_t$), and the replacement cost-based gap, (RCgap). The symbols *, **, *** denote statistical significance at a 10%, 5% and 1% level respectively. Numbers in parentheses are standard errors.

Dependent variable: $Rrent\_g_{t+j}$

Variables	**(1)**	**(2)**	**(3)**	**(4)**
V_t	-0.534*	-0.720***	-0.664***	-0.716**
	(0.314)	(0.283)	(0.279)	(0.285)
$Crisis_t$		-5.663***	-6.217***	-5.646***
		(1.023)	(1.027)	(1.030)
$Pgap_t$			0.302**	
			(0.122)	
$RCgap_t$				-0.037
				(0.174)
Constant	2.541*	3.876***	2.179	4.061**
	(1.541)	(1.379)	(1.515)	(1.631)
Obs	124	124	124	124
Adjusted R^2	0.020	0.207	0.240	0.201
Implied V^*	4.76%	5.38%	3.28%	5.67%

Table 4. Model with RCgap and Pgap for Different Categories

Results of regression model using data from different housing categories. The dependant variable is real rental growth, $\Delta R_{t+1}/R_t$, and the independent variables are the same as in Table 3. Panel A shows the results using Pgap $_t$ and Panel B shows the results using RCgap. Category A, B, and C apartments have a floor area of 39.9 m ^{2} and below, between 40.0 to 69.9 m ^{2} , and between 70.0 to 99.9 m ^{2} , respectively. The symbols *, **, *** denote statistical significance at a 10%, 5% and 1% level respectively. Numbers in parentheses are standard errors.

Panel A: Benchmark models using Pgap $_t$

Variables	Pooled sample	Category A	Category B	Category C
V_t	-0.402**	-0.302	-0.462	-0.538*
	(0.170)	(0.271)	(0.295)	(0.321)
Crisis $_t$	-6.099***	-4.566***	-6.097***	-7.753***
	(0.614)	(0.936)	(1.066)	(1.182)
Pgap $_t$	0.398***	0.280**	0.335**	0.566***
	(0.073)	(0.126)	(0.129)	(0.129)
Constant	0.553	0.566	1.134	0.405
	(0.935)	(1.568)	(1.633)	(1.686)
Obs	354	118	118	118
Adjusted R^2	0.252	0.183	0.232	0.309

Panel B: Models using alternative RCgap $_t$

Variables	Pooled sample	Category A	Category B	Category C
V_t	-0.423**	-0.467	-0.520*	-0.387
	(0.181)	(0.290)	(0.312)	(0.340)
Crisis $_t$	-5.532***	-4.355***	-5.657***	-6.742***
	(0.630)	(0.961)	(1.088)	(1.213)
RCgap $_t$	0.308**	0.043	0.171	0.718***
	(0.127)	(0.206)	(0.223)	(0.241)
Constant	0.865	2.354	2.018	-1.412
	(1.243)	(2.038)	(2.180)	(2.263)
Obs	354	118	118	118
Adjusted R^2	0.202	0.148	0.191	0.251

Table 5. Results with Hcap and Sgap

Panel A shows the results of the model with the Pgap and the expected housing capital gain, *Hcap* $_{t+1}$, taken into consideration. Panel B shows the results of the model with both *Hcap* and the expected stock return-based gap, *Sgap*. The symbols *, **, *** denote statistical significance at a 10%, 5% and 1% level respectively. Numbers in parentheses are standard errors.

Panel A: Benchmark models using Pgap $_t$ and Hcap $_{t+1}$

Variables	(1)	(2)	(3)	(4)
V_t	-0.776**	-0.875***	-0.733**	-0.813***
	(0.302)	(0.275)	(0.301)	(0.266)
Hcap $_{t+1}$	0.201***	0.169***	0.205***	0.173***
	(0.038)	(0.035)	(0.038)	(0.034)
Crisis $_t$		-4.809***		-5.474***
		(0.957)		(0.949)
Pgap $_t$			0.196	0.348***
			(0.126)	(0.114)
Constant	3.215**	4.165***	2.064	2.258
	(1.429)	(1.312)	(1.600)	(1.412)
Obs	117	117	117	117
Adjusted R^2	0.207	0.352	0.224	0.402

Panel B: Benchmark models using Sgap $_t$ and Hcap $_{t+1}$

Variables	(1)	(2)	(3)	(4)
V_t	-0.776**	-0.875***	-0.160	-0.284
	(0.302)	(0.275)	(0.268)	(0.253)
Hcap $_{t+1}$	0.201***	0.169***	0.133***	0.114***
	(0.038)	(0.035)	(0.034)	(0.032)
Crisis $_t$		-4.809***		-3.482***
		(0.957)		(0.859)
Sgap $_t$			0.074***	0.062***
			(0.010)	(0.010)
Constant	3.215**	4.165***	-1.522	-0.215
	(1.429)	(1.312)	(1.348)	(1.301)
Obs	117	117	117	117
Adjusted R^2	0.207	0.352	0.430	0.506

Figure 1. Housing Index

This figure shows the rental index (dashed line) and the housing index (solid line).

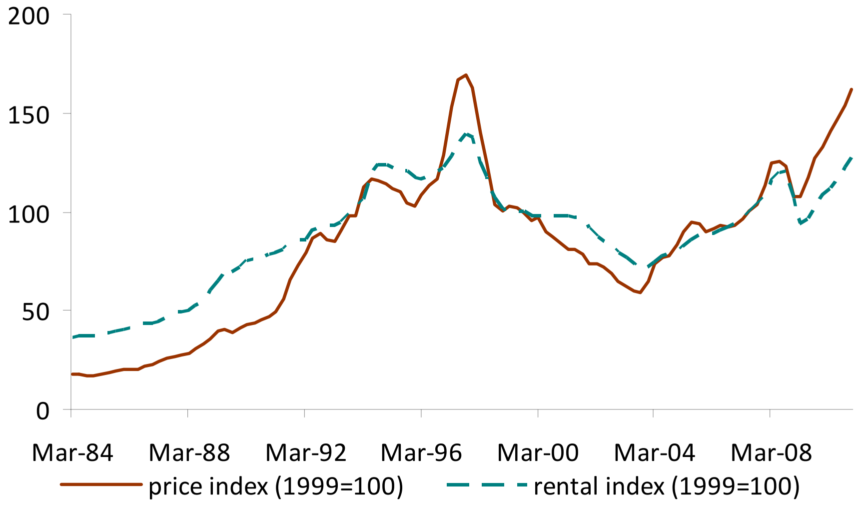

Figure 2. Land Supply and Vacancy Rate

This figure shows Hong Kong's land supply (dashed line) and the vacancy rate (solid line).

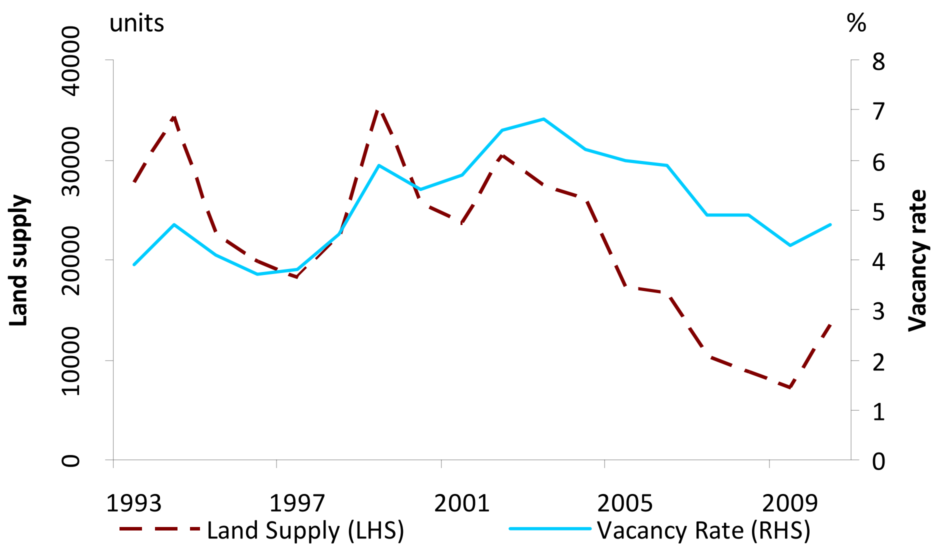

Figure 3. Rent Growth and Rcgap

This figure shows the rent growth rate (dashed line) and the replacement cost-based gap (RCgap, solid line).

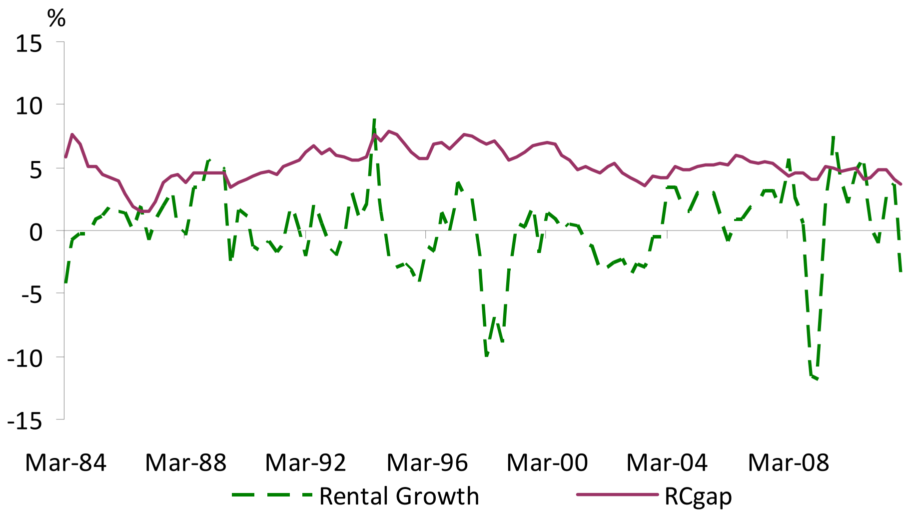

Figure 4. Rent Growth and the Pgap

This figure shows the rent growth rate (dashed line) and the housing price-based return gap (Pgap, solid line).

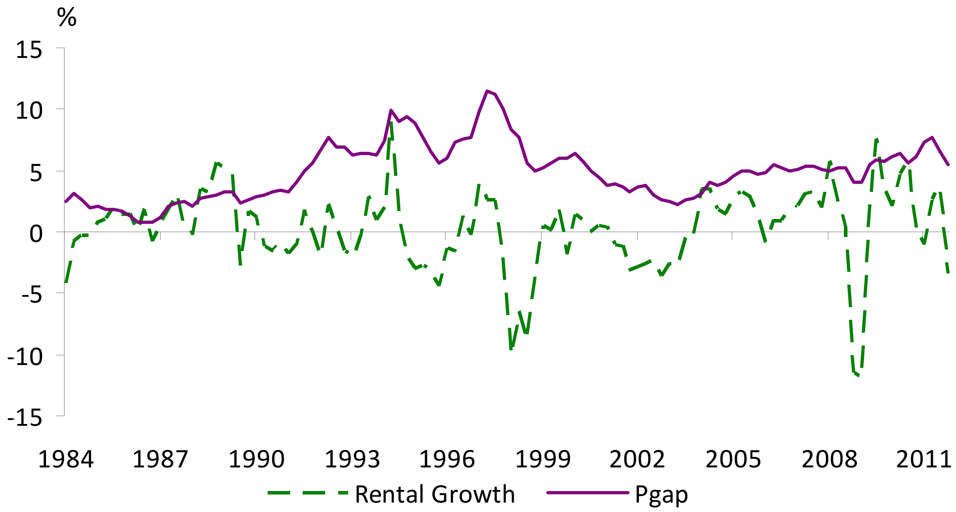

Figure 5. Rent Growth and the Hcap

This figure shows the rent growth rate (dashed line) and expected housing capital gain (Hcap, solid line).

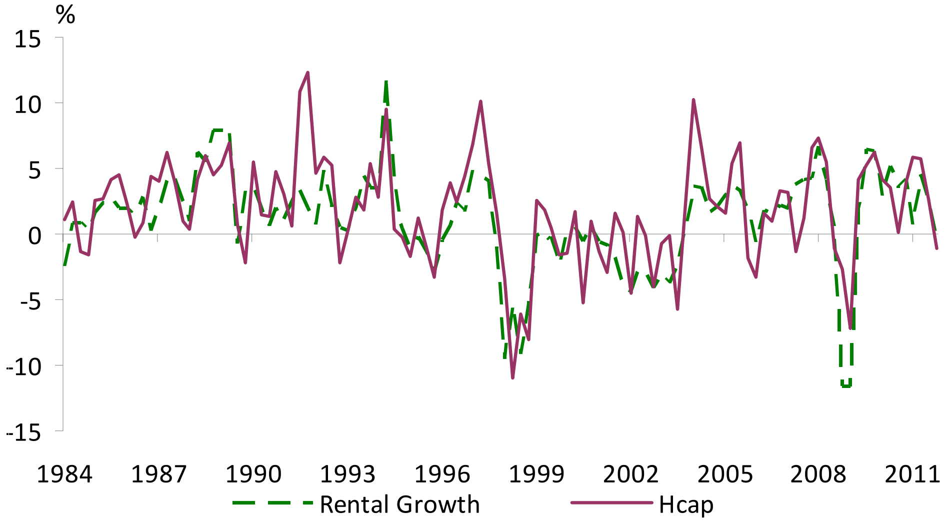

Figure 6. Rent Growth and the Sgap

This figure shows the rent growth rate (dashed line) and the expected stock return based gap (Sgap, solid line) where the expected stock return is based on Hang Seng Index.