Wage, Price Level, and Property Price in Hong Kong: A Simple Analytical Model with Forecast

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Abstract

This paper analyzes the determination of wage, price level, and property price in Hong Kong, especially paying attention to the interdependence among them. Relationships among rent, wage, and prices of tradable and nontradable goods are established according to a simple optimization-based general equilibrium model. Comparative static results of the model are obtained for analysis of the impact of policy changes. The fundamental value of property price, assumed as the present value of expected future rents, is calculated for a special case of constant future rent growth. The results include both the case when rental contracts are fully flexible and when there is rigidity in rental contracts. Statistical analysis indicates that the model fits the experience of Hong Kong well for the period 1984Q2-1993Q4. Based on the model, the paper predicts that the current property price in Hong Kong is still about 40% above the fundamental level, and may have downward adjustment in the future.

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1. Introduction

While Hong Kong is still widely considered as one of the freest[2] and most competitive[3] economies in the world today, it has been perplexed by a myriad of problems after the handover and the subsequent Asian financial crisis. High rates of unemployment[4], consecutive recessions, prolonged periods of deflation[5] and unprecedented fiscal deficits[6], these are phrases that one reads constantly in the news media, which point to the poor overall performance of the Hong Kong economy at the present moment.

A critical link in all of the problems that Hong Kong faces today is the collapse of the property price, which had experienced a spectacular rise from the mid 1980's until the last quarter of 1997, when the roller coaster started the dramatic downturn. Since then it has fallen continuously, by about 65 percent.

The property market has a particularly significant role in the Hong Kong economy. Housing is the most important asset of most households. The stock market is dominated, in terms of total capitalization, by a handful of real estate holding companies and banks, whereas mortgages make up a large fraction of Hong Kong banks' assets. In the labor market, property and its related sectors employ a large number of people and contribute importantly to the GDP of Hong Kong.

Precipitous fall of the property price resulted in significant contraction of households' wealth in Hong Kong. Indeed, a large number of homeowners in Hong Kong are burdened with "negative equities" as result of the burst of the property bubble[7]. Reduced wealth will inevitably curtail private consumption spending, and result in weak demand in the economy. In the financial sector, the collapse of the property price leads to a reduction of the value of collaterals for households and businesses. The consequent weakening of the private sector's capital position will likely constrain banks' ability in extending credit to their clients ("balance sheet effect"). This decrease of the extent of financial intermediation may contribute further to the contraction of real economic activities.

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[2] The Heritage Foundation and the Wall Street Journal, in their "2003 Index of Economic Freedom" compiled in November 2002, ranked Hong Kong as No. 1 in the world.

[3] According to the *World Competitiveness Yearbook 2002*, published by the International Institute of Management Development (IMD) in Switzerland, Hong Kong's overall competitiveness ranked 9th in 2002 (6th in 2001).

[4] Unemployment rate reached 7.8% in July 2002. Although it decreased to 7.1% in November 2002, it went slightly up again in December 2002 to 7.2%.

[5] The CPI of Hong Kong has fallen continuously, since 1998, by about 13%.

[6] Budget deficit for the fiscal year ended on March 31 2002 totaled 63.3 billion Hong Kong dollars, being 5.2% of the GDP. Deficit for the period from March 31 to December 2002 is expected to be more than 77 billion Hong Kong dollars.

[7] According to a survey conducted by the Hong Kong Monetary Authority, at the end of March 2002, 67,500 or 14% of mortgage borrowers had negative equities. They involve 21% of the total value of residential mortgage loans.

On top of that, the fiscal position of the government is quite vulnerable to a significant fall of the property price. Due to historical reasons, land premium and property related taxes have been a most important source of income for the Hong Kong government. As such, property price decline has been one of the principal factors responsible for the relatively large budget deficit of the Hong Kong government in the last couple of years. Deficits imply anticipated future increase of taxes or decrease of government spending; both may lead to further contraction of the economy in general.

It is thus extremely important to develop a better understanding of the property price, its change over time, and particularly its relationship with other important variables in the Hong Kong economy. At what level, for example, should a "fundamental" (or "fair", "reasonable") property price be in Hong Kong? What are the principal factors that may affect this "fundamental" level of property price? Through what channels do those factors affect the "fundamental" price? How is the current property price in Hong Kong compared to its "fundamental" level? These questions are evidently of great interest not only in public policy debates, but also to ordinary households and businesses as well.

To find answers to those questions is, nevertheless, not easy. Due to the intense speculative activities and bubbles involved the property market in Hong Kong, just as other asset markets, is highly unpredictable as shown by recent experiences. For this reason perhaps, up to now virtually all studies, albeit few in number, are based on ad hoc non-structural approaches, and they are definitely from a partial equilibrium perspective. Indeed, most papers discussing the property market in Hong Kong are, more or less, of the journalistic nature.

In this paper, we examine changes of the property price in Hong Kong in recent years by analyzing its relationship with other economic variables of Hong Kong, particularly emphasizing the interdependence among wage, price level, and property price. The analytical approach of the paper is based on a simple model with a more accurate and complete description of the relationships among rent, wage, and prices of the tradable and nontradable goods. It is based on microeconomic theory that takes into account the optimizing behavior of households and business firms. The model is also of general equilibrium in nature. Comparative static results of the model are obtained for analysis of the impact of policy changes. The fundamental value of the property price, assumed as the present value of expected future rents, is calculated for a special case of constant future rent growth. The results include both the case when rental contracts are fully flexible and when there is rigidity in rental contracts. Statistical analysis indicates that the model fits the experience of Hong Kong reasonably well for the period 1984Q2-1993Q4. Based on the model, the paper predicts that current property price in Hong Kong is still about 40% above the fundamental level and may have downward adjustment in the future.

The rest of the paper is organized as follows: Section 2 provides a descriptive and schematic analysis of the interdependence among wage, price level, and rent and property price. The simple optimization-based benchmark model is developed in Section 3. Some comparative static analysis of the conclusions obtained from the model is offered in

Section 4. Section 5 discusses the fundamental value of the property price based on present value of future expected rents, where rental contracts are fully flexible and depend on the variables included in the model. Section 6 analyzes property price when there is rigidity in rental contracts. Section 7 provides statistical analysis of the data for Hong Kong and some forecasts. Concluding remarks and possible improvements in further research on the topic of the Hong Kong property price are included in the final section.

2. Interdependence among Wage, Price, Rent and Property Price

Wage, price level, and property price in Hong Kong have gone through some of the most significant changes in their recent history (Figure 1-3). Although the extent of the change differs among them, there is clearly a common downward general trend in the movement of all three variables. Obviously, movements of wage, price level, and property price are not independent. They are interrelated and can affect each other to a great degree. Meanwhile, they can be significantly affected by numerous other factors as well.

Certain factors may conceivably have contributed to, for example, the price decline in Hong Kong. They include, but are not limited to, a weak aggregate demand because of reduced private consumption expenditure and private domestic investment, external deflationary pressure from Mainland China, the United States and Japan, as well as other demand and supply factors. Indeed, under the current monetary arrangement of a linked exchange rate (7.8 HK$s to the US$) established in October 1983, the primary channel through which the Hong Kong economy can accommodate and adjust to various shocks is change of prices.

Likewise, numerous factors can affect the wage rate, the property price, and the property rental price in Hong Kong. Internal relationships and interdependence among these variables, as well as some of the external factors that may influence them, are schematically illustrated in Chart 1. In fact, besides contemporaneous interactions among them, there will undoubtedly be dynamic adjustments along the time dimension as well. The process of dynamic evolution for wage, price and property price can be demonstrated by Chart 2. For the reason of simplicity, in this paper I model the contemporaneous changes first, and do not explicitly model the dynamic adjustment process other than performing some comparative static analysis.

There is clearly also a very close relationship between the property price and rent, which is attributed to the fact that housing is both a consumption good and an asset. For a renter of a housing property, the rental price indicates its cost as a consumption good. As such, it is related to and must be constrained by the prices of other consumption goods. Indeed, when prices of other consumption goods are low relative to the rental price of housing, consumers can substitute the consumption of housing by other goods to a certain extent. This holds true for an own of a housing property too, regardless of whether the owner lives on the property or not. In the case when the property is owner occupied, the rent is merely the implicit (or opportunity) cost.

As for the property price itself, it reflects its value as an asset. The return on housing property, just as any asset, is the present value of the future stream of rents, plus the capital gain or loss when the property is sold. The return on housing therefore is related to and should be constrained by the return on other assets, when risk and liquidity differences are appropriately taken into consideration. In order to establish the relationship between the fundamental property price and other economic variables in Hong Kong, in this paper, we formalize the above-described two relationships. They are (i) The relationship between property rental price and other commodity prices as well as wage rate; (ii) The relationship between rent and property price.

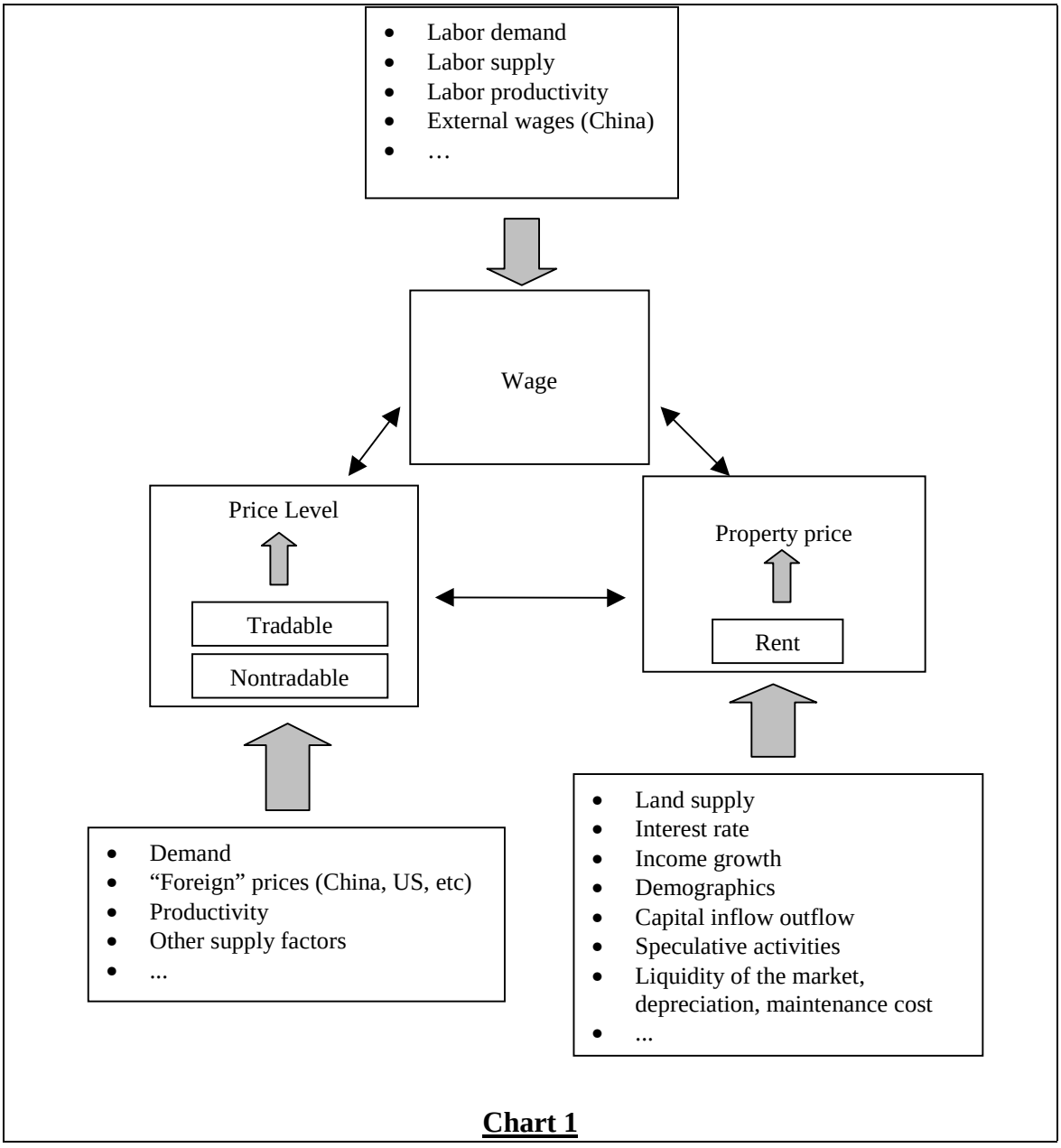

Chart 1

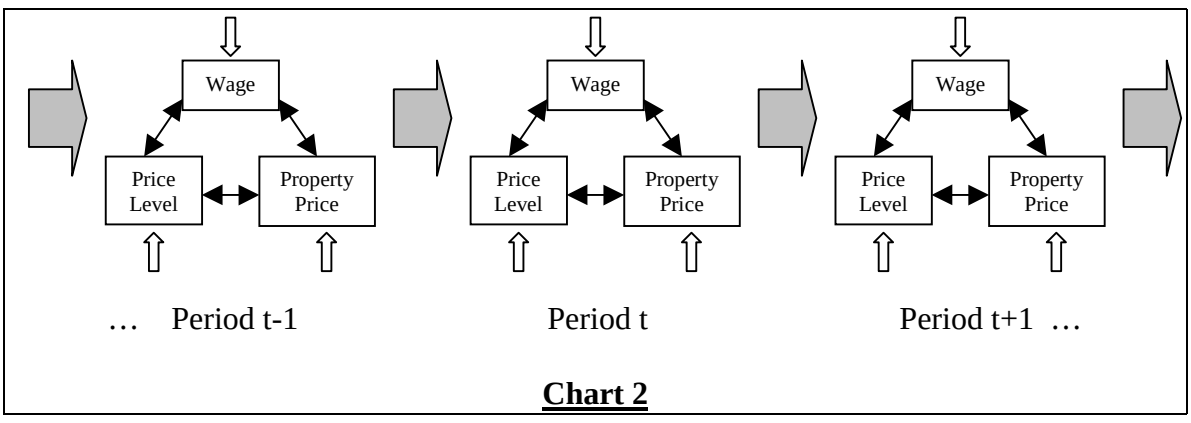

Chart 2

3. A Simple Optimization-Based General Equilibrium Model

Our analysis starts by establishing a benchmark model of the interdependence among rent, wage, and the price of tradable and nontradable goods. The model assumes that all markets continuously clear in response to changing conditions of supply and demand, and there is no price rigidity or market failure in the economy.

The economy is assumed to produce two composite commodities, tradable goods and nontradable goods. There are two types of households. The first type is an owner, while the second type a renter, of housing properties. For simplicity, assume there is only one producer[8], which produces both commodities using labor as the only variable input in the short run. The notations used in the model of this paper are as follows:

T : Tradable goods;
P^T : Price of tradable goods;
P^{T*} : Price of tradable goods abroad, measured in the foreign currency;
N : Nontradable goods;
P^N : Price of nontradable goods;
E : Nominal exchange rate (number of domestic currency units per foreign currency unit).
n_1 : Total number of type 1 households;
n_2 : Total number of type 2 households;
n : Total number of households of both types, $n = n_1 + n_2$;
λ : The percentage of type 1 households, $\lambda = \frac{n_1}{n_1 + n_2}$;
$\bar{h}$: Average amount of housing properties owned by type 1 household;
$\overline{H}$: The total amount of housing stock[9] in the economy, $\overline{H} = n_1 \bar{h}$;
R : Rental price of housing properties;
P^H : Price of housing properties;
w : Wage rate;
$\bar{l}$: Time endowment of each household;
H_1 : Type 1 household's demand for housing;
H_2 : Type 2 household's demand for housing;

[8] More realistically, there should be many producers that produce in a competitive environment until profit is zero for all. Assuming constant returns to scale in production, the proportional uses of labor in the production of the two composite commodities are the same regardless of whether there is one producer or many producers.

[9] The total amount of supply of housing properties adjusts relatively slowly in response to price changes. We thus assume in this paper that amount to be exogenously determined. In fact, the quantity should be endogenously and jointly determined by property developers and the Hong Kong government. Possible further studies of investment behavior of property developers and the government are described at the of this paper.

L_1 : Type 1 household's supply of labor;
L_2 : Type 2 household's supply of labor;
L_T : Labor demand of the producer for production of tradable goods;
L_N : Labor demand of the producer for production of nontradable goods;
α_T , α_N , α_H , α_L : Parameters of households' utility function;
A_T , β_T , A_N , β_N : Parameters of producer's production function.

Type 1 Household:

For type 1 household, an owner of housing property, with a constant elasticity of substitution utility function, the welfare maximization problem is

$$\text{Max} \quad U(T_1, N_1, H_1, \bar{l} - L_1) = T_1^{\alpha_T} N_1^{\alpha_N} H_1^{\alpha_H} (\bar{l} - L_1)^{\alpha_L}, \ \alpha_T + \alpha_N + \alpha_H + \alpha_L = 1$$
$$\text{S.t.} \quad P^T T_1 + P^N N_1 + R H_1 = w L_1 + R\bar{h}$$

Solutions are

$$T_1 = \frac{\alpha_T}{P^T}(w\bar{l} + R\bar{h})$$
$$N_1 = \frac{\alpha_N}{P^N}(w\bar{l} + R\bar{h})$$
$$H_1 = \frac{\alpha_H}{R}(w\bar{l} + R\bar{h})$$
$$L_1 = (1-\alpha_L)\bar{l} - \frac{\alpha_L}{w} R\bar{h}$$

Since this household owns $\bar{h}$ amount of housing properties, it will supply the excess amount to the rental market

$$\bar{h} - H_1 = (1-\alpha_H)\bar{h} - \alpha_H \frac{w\bar{l}}{R}$$

Type 2 Household:

For type 2 household, a renter of housing property, with the same constant elasticity of substitution utility function, the welfare maximization problem is

$$\text{Max} \quad U(T_2, N_2, H_2, \bar{l} - L_2) = T_2^{\alpha_T} N_2^{\alpha_N} H_2^{\alpha_H} (\bar{l} - L_2)^{\alpha_L}, \ \alpha_T + \alpha_N + \alpha_H + \alpha_L = 1$$
$$\text{S.t.} \quad P^T T_2 + P^N N_2 + R H_2 = w L_2$$

Solutions are

$$T_2 = \frac{\alpha_T}{P^T} w\bar{l}$$
$$N_2 = \frac{\alpha_N}{P^N} w\bar{l}$$
$$H_2 = \frac{\alpha_H}{R} w\bar{l}$$
$$L_2 = (1-\alpha_L)\bar{l}$$

Housing Market Equilibrium:

The rental housing market is in equilibrium when the total supply by owners is equal to the total demand by renters

$$S^H = D^H$$

Since λ is the fraction of households that own housing properties

$$\lambda(\bar{h} - H_1) = (1-\lambda)H_2$$

From that, we get

$$\frac{w}{R} = \frac{1-\alpha_H}{\alpha_H} \cdot \frac{\lambda\bar{h}}{\bar{l}}$$

Producer:

For the producer with Cobb-Douglas production functions, assuming that physical capital and commercial properties used in production are fixed in the short run, and are included as a fixed cost term $\overline{C}$, the profit maximization problem is

$$\begin{aligned} \text{Max} \quad & \pi = P^T T + P^N N - w(L_T + L_N) - \overline{C} \\ \text{S.t.} \quad & T = A_T L_T^{\beta_T} \\ & N = A_N L_N^{\beta_N} \end{aligned}$$

Optimization entails

$$\frac{\partial \pi}{\partial L_T} = \frac{\partial \pi}{\partial L_N} = 0$$

Solutions to the above problem, i.e., labor demand in the production of tradable and nontradable goods are, respectively

$$L_T = \left(\frac{\beta_T A_T P^T}{w} \right)^{\frac{1}{1-\beta_T}}$$

$$L_N = \left(\frac{\beta_N A_N P^N}{w} \right)^{\frac{1}{1-\beta_N}}$$

In terms of supply of the two goods, they are

$$T = A_T \left(\frac{\beta_T A_T P^T}{w} \right)^{\frac{\beta_T}{1-\beta_T}}$$

$$N = A_N \left(\frac{\beta_N A_N P^N}{w} \right)^{\frac{\beta_N}{1-\beta_N}}$$

Total supply of labor is the sum of labor supply by two households

$$n[\lambda L_1 + (1-\lambda)L_2] = n\lambda \left[(1-\alpha_L)\bar{l} - \frac{\alpha_L}{w} R\bar{h} \right] + n(1-\lambda)(1-\alpha_L)\bar{l}$$

Total demand for labor

$$L_T + L_N = \left(\frac{\beta_T A_T P^T}{w} \right)^{\frac{1}{1-\beta_T}} + \left(\frac{\beta_N A_N P^N}{w} \right)^{\frac{1}{1-\beta_N}}$$

Labor Market Equilibrium:

The labor market is in equilibrium when the total supply of labor by both types of households is equal to the total demand for labor by the producer, in the production of both the tradable and nontradable goods

$$S^L = D^L$$

Namely

$$n\left[(1-\alpha_L)\bar{l} - \frac{\lambda\alpha_L}{w} R\bar{h} \right] = \left(\frac{\beta_T A_T P^T}{w} \right)^{\frac{1}{1-\beta_T}} + \left(\frac{\beta_N A_N P^N}{w} \right)^{\frac{1}{1-\beta_N}}$$

Equilibrium in the Nontradable Goods Market:

The nontradable goods market is in equilibrium when its total supply by the producer is equal to the total demand by both types of households

$$S^N = D^N$$

Namely

$$A_N\left(\frac{\beta_N A_N P^N}{w}\right)^{\frac{\beta_N}{1-\beta_N}} = n\left[\lambda\frac{\alpha_N}{P^N}(w\bar{l}+R\bar{h})+(1-\lambda)\frac{\alpha_N}{P^N}w\bar{l}\right]$$

We get

$$\frac{w}{P^N} = \beta_N A_N\left(\frac{1-\alpha_H}{\alpha_N\beta_N n\bar{l}}\right)^{1-\beta_N}$$

$$\frac{w}{P^T} = \beta_T A_T\left(\frac{1-\alpha_H}{(\alpha_T+\alpha_N-\alpha_N\beta_N)n\bar{l}}\right)^{1-\beta_T}$$

In a small open economy such as that of Hong Kong, assuming purchasing power parity holds for tradable goods, *i.e.*

$$P^T = EP^{T*}$$

Wage, rental price of properties, and the price of nontradable goods are, respectively

$$w = \phi_w\frac{A_T EP^{T*}}{(n\bar{l})^{1-\beta_T}}$$

$$R = \phi_R\frac{A_T EP^{T*}}{n_1\bar{h}}(n\bar{l})^{\beta_T}$$

$$P^N = \phi_N\frac{A_T}{A_N}(n\bar{l})^{\beta_T-\beta_N}EP^{T*}$$

All parameters in those expressions are positive and they are as follows

$$\phi_w = \beta_T\left(\frac{1-\alpha_H}{\alpha_T+\alpha_N-\alpha_N\beta_N}\right)^{1-\beta_T}$$

$$\phi_R = \frac{\beta_T \alpha_H}{1-\alpha_H}\left(\frac{1-\alpha_H}{\alpha_T+\alpha_N-\alpha_N\beta_N}\right)^{1-\beta_T}$$

$$\phi_N = \frac{\beta_T(\alpha_N\beta_N)^{1-\beta_N}(1-\alpha_H)^{\beta_N-\beta_T}}{\beta_N(\alpha_T+\alpha_N-\alpha_N\beta_N)^{1-\beta_T}}$$

4. Comparative Static Analysis

Wage, Rent and the Price of Nontradable Goods:

$\frac{\partial w}{\partial(EP^{T*})} > 0$, $\frac{\partial R}{\partial(EP^{T*})} > 0$, $\frac{\partial P^N}{\partial(EP^{T*})} > 0$

An increase of the foreign tradable goods price, or a devaluation of the domestic currency, leads to higher wage rate, higher rent and higher nontradable goods price.

$\frac{\partial w}{\partial A_T} > 0$, $\frac{\partial R}{\partial A_T} > 0$, $\frac{\partial P^N}{\partial A_T} > 0$ *(Balassa-Samulson effect),* $\frac{\partial P^N}{\partial A_N} < 0$

An increase of the productivity in the tradable sector leads to higher wage rate, higher rent and higher nontradable goods price. An increase of the productivity in the nontradable sector leads to lower nontradable goods price.

$\frac{\partial w}{\partial(n\bar{l})} < 0$, $\frac{\partial R}{\partial(n\bar{l})} > 0$. *While* $\frac{\partial P^N}{\partial(n\bar{l})} < 0$ *(or* > 0*) if* $\beta_T < \beta_N$ *(or* $\beta_T > \beta_N$*)*

An increase of the total number of households will bid down wage and bid up rent. As a result, household's income decreases, which leads to a lower demand and thus lower price for nontradable goods. On the other hand, an increase of the total number of households will result in greater demand for nontradable goods and thus leads to higher P^N*. The overall effect on* P^N *is ambiguous and it depends on the sign of* $\beta_T - \beta_N$*.*

Consumer Price Index:

The CPI is a weighted average of the price of tradable and nontradable goods, and the rental price of housing

$$\left(P^T\right)^{\gamma_T}\left(P^N\right)^{\gamma_N}(R)^{\gamma_R},\ \gamma_T+\gamma_N+\gamma_R=1$$

Where γ_T, γ_N, γ_R are their proportional weights in the price index, which are assumed to be fixed constants. They are preset according to their respective importance in the

consumption bundle of a typical consumer and are not adjusted but after an extended lapse of time.

$$P = \phi_N^{\gamma_N} \phi_R^{\gamma_R} \frac{A_T^{\gamma_N+\gamma_R}}{A_N^{\gamma_N}} \cdot \frac{(n\bar{l})^{\beta_T(\gamma_N+\gamma_R)-\beta_N\gamma_N}}{(n_1\bar{h})^{\gamma_R}} EP^{T*}$$

$\frac{\partial P}{\partial (EP^{T*})} > 0$ *An increase of the foreign tradable goods price, or a devaluation of the domestic currency, leads to higher wage rate, higher rent and higher nontradable goods price, and thus higher CPI.*

$\frac{\partial P}{\partial A_T} > 0$ *An increase of the productivity in the tradable sector results in higher nontradable goods price and higher rent (Balassa-Samulson effect), which will lead to higher CPI.*

(Remark: If the profit margin in the tradable sector decreases, say, due to the decline of Hong Kong's role as the "Middle Man", means a decrease of A_T. This will result in decreases of wage, rent, the price of nontradable goods, as well as the general price level.)

$\frac{\partial P}{\partial A_N} < 0$ *An increase of the productivity in the nontradable sector leads to lower nontradable goods price, and thus lower CPI.*

$\frac{\partial P}{\partial (n_1\bar{h})} < 0$ *An increase of the total supply of housing stock leads to lower rent, and thus lower CPI.*

$\frac{\partial P}{\partial (n\bar{l})} > 0$ *(or* < 0*) if* $\beta_T(\gamma_N+\gamma_R) > \beta_N\gamma_N$ *(or* $\beta_T(\gamma_N+\gamma_R) < \beta_N\gamma_N$*)*

An increase of the total number of households leads to higher rent but it may lead to higher or lower nontradable goods price, thus the effect on the CPI is ambiguous and it depends on the sign of $\beta_T(\gamma_N+\gamma_R) - \beta_N\gamma_N$.

Real Wage Rate:

$$\frac{w}{P} = \frac{\phi_w}{\phi_N^{\gamma_N}\phi_R^{\gamma_R}} A_T^{\gamma_T} A_N^{\gamma_N} \frac{\left(n_1\bar{h}\right)^{\gamma_R}}{\left(n\bar{l}\right)^{1-\beta_T\gamma_T-\beta_N\gamma_N}}$$

$\frac{\partial (w/P)}{\partial A_T} > 0$, $\frac{\partial (w/P)}{\partial A_N} > 0$

Increase of productivity in both the tradable and nontradable sector leads to higher real wage rate.

$\frac{\partial(w/P)}{\partial(n_1\bar{h})} > 0$ *A increase of housing supply results in lower rent, which leads to decrease of the CPI and thus increase of the real wage rate.*

$\frac{\partial(w/P)}{\partial(n\bar{l})} < 0$ *An increase of the total number of households leads to decrease of the real wage rate.*

$\frac{\partial(w/P)}{\partial(EP^{T*})} = 0$ *There is no effect of an increase of the foreign tradable goods price, or a devaluation of the domestic currency, on the real wage rate.*

5. Rent and the Fundamental Value of Property Price

Up to this point, we have developed a model of the relationship among rent, wage and the price of tradable and nontradable goods, *etc*. In order to understand more directly the relationship between the property price itself and those other variables, we have to examine the asset nature of housing properties by investigating the determination of property price vis-à-vis rent.

Suppose rents are paid at the end of the period, and δ is the property's constant rate of physical depreciation, or the repair and maintenance cost as a constant fraction of the total value of the property, the holding period return for housing property is

$$\frac{[E_t(P_{t+1}^H) + R_t - \delta P_t^H] - P_t^H}{P_t^H}$$

Assuming an investor has capital that can be invested either in Hong Kong properties or in US treasury securities. The holding period return for Hong Kong properties should therefore be equal to the interest yield on the US treasury security, i_t, and more realistically, plus a risk premium r_R and a liquidity premium r_L. Both r_R and r_L may change over time in response to changing market conditions. The liquidity premium r_L, moreover, ought to be a function of the turnover rate ζ in the property market, and other variables related to transaction cost involved in property market turnover.

$$r_L = r_L(\zeta), \qquad \frac{\partial r_L}{\partial \zeta} < 0$$

Thus

$$\frac{[E_t(P_{t+1}^H)+R_t-\delta P_t^H]-P_t^H}{P_t^H}=i_t+r_R+r_L$$

Or

$$E_t(P_{t+1}^H)-(1+i_t+r_R+r_L+\delta)P_t^H+R_t=0$$

Actual price of housing is equal to the fundamental price of housing, $\tilde{P}_t^H$, plus a bubble term, B_t

$$P_t^H=\tilde{P}_t^H+B_t$$

$$E_t(\tilde{P}_{t+1}^H)-(1+i_t+r_R+r_L+\delta)\tilde{P}_t^H+R_t=0$$

Rational bubbles can be characterized by all solutions to

$$E_t(B_{t+1})-(1+i_t+r_R+r_L+\delta)B_t=0$$

If we assume that interest rate i, risk premium r_R, and liquidity premium r_L are all constant over time, then the fundamental price of properties should be the present discounted value of all expected future rents

$$\tilde{P}_t^H=\frac{1}{1+i+r_R+r_L+\delta}R_t+\frac{1}{1+i+r_R+r_L+\delta}E_t(\tilde{P}_{t+1}^H)=\cdots$$

$$=\frac{1}{1+i+r_R+r_L+\delta}\sum_{j=0}^{\infty}\frac{E_t(R_{t+j})}{(1+i+r_R+r_L+\delta)^j}$$

Since

$$R=\phi_R\frac{A_T EP^{T*}}{n_1\bar{h}}(n\bar{l})^{\beta_T}=\frac{\phi_R}{\phi_w}w\frac{n\bar{l}}{n_1\bar{h}}$$

The growth rate of rent is

$$g_R=\frac{\Delta R}{R}=\frac{\Delta w}{w}+\frac{\Delta(n\bar{l})}{n\bar{l}}-\frac{\Delta(n_1\bar{h})}{n_1\bar{h}}=g_w+g_{n\bar{l}}-g_{n_1\bar{h}}$$

Where g with a variable in the subscript denotes the growth rate of that variable. If the rent growth rate is constant, then

$$R_{t+j} = R_t(1+g_R)^j$$

$$\tilde{P}_t^H = \frac{1}{1+i+r_R+r_L+\delta}\sum_{j=0}^{\infty}\frac{E_t(R_{t+j})}{(1+i+r_R+r_L+\delta)^j} = \frac{R_t}{1+i+r_R+r_L+\delta}\sum_{j=0}^{\infty}\frac{(1+g_R)^j}{(1+i+r_R+r_L+\delta)^j}$$

Namely

$$\tilde{P}_t^H = \frac{R_t}{i+r_R+r_L(\zeta)+\delta-g_w-g_{n\bar{l}}+g_{n_1\bar{h}}}$$

Comparative Static Analysis of Property Price:

The fundamental property price is affected by the nominal interest rate, the risk and liquidity premium, the growth rate of the nominal wage, the growth rate of the total number of households and the growth rate of the total amount of housing.

$\frac{\partial\tilde{P}_t^H}{\partial i} < 0$ *Increase of the nominal interest rate leads to lower property prices.*

$\frac{\partial\tilde{P}_t^H}{\partial r_R} < 0$ *Increase of the risk in the property market leads to lower property prices.*

$\frac{\partial\tilde{P}_t^H}{\partial\zeta} = \frac{\partial\tilde{P}_t^H}{\partial r_L}\cdot\frac{\partial r_L}{\partial\zeta} > 0$

Increase of the turnover rate in the property market reduces the liquidity premium, and thus leads to higher property prices.

$\frac{\partial\tilde{P}_t^H}{\partial g_w} > 0$ *Increase of the wage growth rate leads to higher property prices.*

$\frac{\partial\tilde{P}_t^H}{\partial g_{n\bar{l}}} > 0$ *Increase of the growth rate of the total number of households leads to higher property prices.*

$\frac{\partial\tilde{P}_t^H}{\partial g_{n_1\bar{h}}} < 0$ *Increase of the growth of the total amount of housing properties leads to lower property prices.*

Since nominal wage is not exogenous, its growth is a combined result of growth in productivity, increase of the price level, growth of the total amount of housing stock, and growth of the number of households, *i.e.*

$$w = \phi_w \frac{A_T E P^{T*}}{(n\bar{l})^{1-\beta_T}} = \frac{\phi_w}{\phi_N^{\gamma_N}\phi_R^{\gamma_R}} A_T^{\gamma_T} A_N^{\gamma_N} \frac{\left(n_1\bar{h}\right)^{\gamma_R}}{\left(n\bar{l}\right)^{1-\beta_T\gamma_T-\beta_N\gamma_N}} P$$

$$g_w = g_{A_T} + g_E + g_{P^{T*}} - (1-\beta_T) g_{n\bar{l}} = g_P + \gamma_T g_{A_T} + \gamma_N g_{A_N} + \gamma_R g_{n_1\bar{h}} - (1-\beta_T\gamma_T - \beta_N\gamma_N) g_{n\bar{l}}$$

We have alternative representations of the fundamental property price as

$$\tilde{P}_t^H = \frac{R_t}{i + r_R + r_L(\zeta) + \delta - g_P - \gamma_T g_{A_T} - \gamma_N g_{A_N} - (\beta_T\gamma_T + \beta_N\gamma_N) g_{n\bar{l}} + (1-\gamma_R) g_{n_1\bar{h}}}$$

And

$$\tilde{P}_t^H = \frac{R_t}{i + r_R + r_L(\zeta) + \delta - g_{A_T} - g_E - g_{P^{T*}} - \beta_T g_{n\bar{l}} + g_{n_1\bar{h}}}$$

The fundamental property price is hence also affected by productivity in both the tradable and nontradable sector, the domestic and foreign inflation rate, the pace of the devaluation or revaluation of the domestic currency, and the real interest rate.

$\frac{\partial \tilde{P}_t^H}{\partial g_{A_T}} > 0$, $\frac{\partial \tilde{P}_t^H}{\partial g_{A_N}} > 0$

Increase of productivity in both the tradable and nontradable sector leads to higher property prices.

$\frac{\partial \tilde{P}_t^H}{\partial g_{P^{T*}}} > 0$, $\frac{\partial \tilde{P}_t^H}{\partial g_E} > 0$, $\frac{\partial \tilde{P}_t^H}{\partial g_P} > 0$

Increase of the foreign inflation rate on tradable goods, accelerated pace of devaluation of the domestic currency, and increase of the domestic inflation rate lead to higher property prices.

$\frac{\partial \tilde{P}_t^H}{\partial (i - g_P)} < 0$ *Higher real interest rate leads to lower property prices.*

6. Property Price with Rigidity in Rental Contracts

It is quite possible that there may be rigidity in the property rental market, and the rental price does not adjust instantaneously to changing market conditions. More concretely,

there may be a lagged response of rent to the changes of supply and demand. For example, this will be the case if all rental contracts last for two years, and thus only half of the contracts come up for renewal each year.

Suppose, more formally, rental contracts are staggered and a fraction θ of all rental contracts are renewed each period. In this case, the actual rental price $\hat{R}_t$ should be a weighted-average of its value $\hat{R}_{t-1}$ in the previous period, and the current equilibrium value R_t that is determined by the supply and demand

$$\hat{R}_t = (1-\theta)\hat{R}_{t-1} + \theta R_t$$

Thus

$$\hat{R}_{t+j} = (1-\theta)\hat{R}_{t+j-1} + \theta R_{t+j} = (1-\theta)^2 \hat{R}_{t+j-2} + \theta(1-\theta)R_{t+j-1} + \theta R_{t+j} = \cdots$$

$$= (1-\theta)^{j+1}\hat{R}_{t-1} + \theta\sum_{k=0}^{j}(1-\theta)^k R_{t+j-k}$$

The fundamental price of properties is therefore (See details of the derivation in the Appendix)

$$\tilde{P}_t^H = \frac{1}{1+i+r_R+r_L+\delta}\sum_{j=0}^{\infty}\frac{E_t(\hat{R}_{t+j})}{(1+i+r_R+r_L+\delta)^j}$$

$$= \frac{1}{1+i+r_R+r_L+\delta}E_t\sum_{j=0}^{\infty}\frac{(1-\theta)^{j+1}\hat{R}_{t-1} + \theta\sum_{k=0}^{j}(1-\theta)^k R_{t+j-k}}{(1+i+r_R+r_L+\delta)^j}$$

$$= \frac{(1+i+r_R+r_L+\delta)}{(i+r_R+r_L+\delta+\theta)(i+r_R+r_L+\delta-g_R)}\hat{R}_t + \frac{(1-\theta)(1+g_R)}{(i+r_R+r_L+\delta+\theta)(i+r_R+r_L+\delta-g_R)}\hat{R}_{t-1}$$

Rent to property price ratio is

$$\frac{\hat{R}_t}{\tilde{P}_t^H} = \frac{(i+r_R+r_L+\delta+\theta)(i+r_R+r_L+\delta-g_R)\hat{R}_t}{(1+i+r_R+r_L+\delta)\hat{R}_t + (1-\theta)(1+g_R)\hat{R}_{t-1}}$$

Notice that if all rental contracts last for one period, *i.e.*, $\theta = 1$, then

$$\hat{R}_t = (1-\theta)\hat{R}_{t-1} + \theta R_t = R_t$$

$$\frac{\hat{R}_t}{\tilde{\tilde{P}}_t^H} = \frac{(i + r_R + r_L + \delta + 1)(i + r_R + r_L + \delta - g_R)\hat{R}_t}{(1 + i + r_R + r_L + \delta)\hat{R}_t + (1-1)(1+g_R)\hat{R}_{t-1}} = i + r_R + r_L + \delta - g_R$$

We get the case that we have analyzed extensively in the previous section.

7. Preliminary Statistical Analyses and Forecast

According to the conclusions that are obtained in Section 5, the ratio of rent to fundamental property price, $\frac{R_t}{\tilde{\tilde{P}}_t^H}$, should be equal to the sum of the nominal interest rate, the risk and liquidity premium, the depreciation maintenance cost ratio, and the growth rate of the total amount of housing, but subtracted by the growth rate of the nominal wage and the growth rate of the total number of households. Namely,

$$\frac{R_t}{\tilde{\tilde{P}}_t^H} = i + r_R + r_L + \delta - g_w - g_{n\bar{l}} + g_{n_1\bar{h}}$$

Actual rent to property price ratio in Hong Kong from 1981 to 2002 is plotted in Figure 4. Its movement has followed a downward trend from 1984 until 1997, when it started to move up steadily. This increase is due to the substantial decline of the property price from 1997-1999. Although rent declined too, it did to a less extent vis-à-vis the property price *per se*.

The U.S. federal funds rate and the 3-month HIBOR rate are shown in Figure 5, while the growth rate of the nominal wage, the growth rate of the total number of households (less the number of public housing units), and the growth rate of the total amount of housing (private housing units plus subsidized sales flats) are plotted, respectively, in Figure 6-8.

To fix ideas, let us make a simplifying assumption that the depreciation rate, the risk and the liquidity premium all remain constant over time, and suppose further that $r_R + r_L + \delta = 10$. The magnitude of $i_t + 10 - g_{wt} - g_{n\bar{l}t} + g_{n_1\bar{h}_t}$, the level at which the rent price ratio should be, is plotted in Figure 10. Although the nominal interest rate, represented by the U.S. federal funds rate, has been rather low in recent years, the magnitude of $i_t + 10 - g_{wt} - g_{n\bar{l}t} + g_{n_1\bar{h}_t}$ has shown an upward trend since 1994, whereas the actual rent to price ratio continued on a downward trend from 1994 to 1997. From the figure, there is clearly a high correlation between $\frac{R_t}{P_t}$ and $i_t + 10 - g_{wt} - g_{n\bar{l}t} + g_{n_1\bar{h}_t}$ from the 1980's to 1994. The two curves started to diverge widely from 1994 on, although the gap has narrowed significantly since 2000. A scatter plot of these two quantities in Figure 14 confirms the results. Similar conclusions are also obtained in the case when there is rigidity in rental contract, as shown in Figure 15.

Figure 10 reveals that the actual rent to price ratio has been low relative to the fundamental value represented by $i_t + 10 - g_{wt} - g_{n\bar{l}_t} + g_{n_1\bar{h}_t}$, particularly since 1997, which signals that the ratio should move up. If rent has been moving down, as was the case since late 1997[10], it implies that property price will move down faster than the rent did, and at a rate that is determined by the change of $i_t + 10 - g_{wt} - g_{n\bar{l}_t} + g_{n_1\bar{h}_t}$. But how much should the property price move? The answer is offered by some simple statistical analysis.

Assuming $r_R + r_L + \delta = 10$, the following equation is estimated for the sample period 1984Q2-1993Q4 (39 observations) by OLS. The results are listed in Table 1.

$$\frac{R_t}{P_t^H} = C_0 + C_1(i_t + r_R + r_L + \delta - g_{wt} - g_{n\bar{l}_t} + g_{n_1\bar{h}_t}) + \varepsilon_t$$

Coefficient	Std. Error	t-Statistic	Prob.
C0 = 0.942911	0.074832	12.60030	0.0000
C1 = 0.089969	0.008657	10.39242	0.0000
R-squared		0.744832	
Adjusted R-squared		0.737935	

Table 1

Considering rigidities in rental contracts, the following equation is estimated for the same sample period by OLS, while assuming $r_R + r_L + \delta = 10$, and $\theta = 1/8$ (fraction of time of a quarter in a 2-year contract). The results are listed in Table 2.

$$\frac{\hat{R}_t}{P_t^H} = C_0 + C_1 \frac{(i_t + r_R + r_L + \delta + \theta)(i_t + r_R + r_L + \delta - g_{wt} - g_{n\bar{l}_t} + g_{n_1\bar{h}_t})\hat{R}_t}{(1 + i_t + r_R + r_L + \delta)\hat{R}_t + (1-\theta)(1 + g_{wt} + g_{n\bar{l}_t} - g_{n_1\bar{h}_t})\hat{R}_{t-1}} + \varepsilon_t$$

[10] The average actual rental growth rates in recent years are:

1997Q4-2002Q3	-2.5 %;
1999Q1-2002Q3	-1.3 %;
1999Q1-2001Q4	-0.845 %.

The average value of $g_{wt} + g_{n\bar{l}_t} - g_{n_1\bar{h}_t}$ from 1999Q1 to 2001Q4 is equal to –0.25%.

Coefficient	Std. Error	t-Statistic	Prob.
C0 = 1.203374	0.059436	20.24651	0.0000
C1 = 0.115550	0.012614	9.160303	0.0000
R-squared		0.693990	
Adjusted R-squared		0.685720	

Table 2

About three-quarters of the variations in $\frac{R_t}{P_t^H}$ can be explained by $i_t - g_{wt} - g_{n\bar{l}_t} + g_{n_1\bar{h}_t}$. Without having tried other alternatives to $\theta = 1/8$, it appears that there are no gains by including rigidity of rental contracts in the consideration. The following equation is subsequently estimated for the same sample period by OLS. The results are listed in Table 3.

$$\frac{R_t}{P_t^H} = D_0 + D_1 i_t + D_2 g_{wt} + D_3 g_{n\bar{l}_t} + D_4 g_{n_1\bar{h}_t} + \varepsilon_t$$

Coefficient	Std. Error	t-Statistic	Prob.
D0 = 1.294974	0.130893	9.893368	0.0000
D1 = 0.135824	0.009973	13.61894	0.0000
D2 = -0.066601	0.009048	-7.361202	0.0000
D3 = 0.063808	0.053826	1.185453	0.2441
D4 = -0.013565	0.013653	-0.993576	0.3274
R-squared		0.903333	
Adjusted R-squared		0.891960	

Table 3

About 90% of the variations in $\frac{R_t}{P_t^H}$ can be attributed to the explanatory variables. In addition, it appears that $g_{n\bar{l}_t}$ and $g_{n_1\bar{h}_t}$ are both insignificant, which is understandable, since

$$w = \frac{\phi_w}{\phi_N^{\gamma_N}\phi_R^{\gamma_R}} A_T^{\gamma_T} A_N^{\gamma_N} \frac{\left(n_1\bar{h}\right)^{\gamma_R}}{\left(n\bar{l}\right)^{1-\beta_T\gamma_T-\beta_N\gamma_N}} P$$

Changes of the nominal wage rate have thus already included information about the changes of the number of households and the changes of the total amount of housing supply. Namely, these three variables are not independent ones. In other words, in terms

of their effects on the rent to property price ratio, the nominal wage is a "sufficient statistic" that captures all relevant fundamental aspects of the economy. After dropping the two insignificant variables, the following equation is estimated for the same sample period by OLS. The results are listed in Table 4.

$$\frac{R_t}{P_t^H} = D_0 + D_1 i_t + D_2 g_{wt} + \varepsilon_t$$

Coefficient	Std. Error	t-Statistic	Prob.
D0 = 1.336147	0.106619	12.53198	0.0000
D1 = 0.141725	0.009001	15.74593	0.0000
D2 = -0.066102	0.008602	-7.68457	0.0000
R-squared		0.895243	
Adjusted R-squared		0.889423	

Table 4

We use the coefficients obtained in Table 4, Table 3 and Table 1 to plot and forecast the rent to property price ratio, the property price index, and the deviation of actual property price from what is predicted by the model. The results are shown in Figure 17 to Figure 25. The figures indicate that the parsimonious model fits the experience of Hong Kong well for the period 1984Q2-1993Q4 for the rent to property price ratio and for the property price itself. Based on the model, it is predicted that the current property price in Hong Kong is still about 40% above the fundamental level based on Table 4 (about 25 % based on Table 3, and more than 65% based on Table 1, as of 2001Q4). It is very likely that the property price will move further downward in the future.

8. Concluding Remarks and Possible Future Research

In this paper, we examined changes of the property price in Hong Kong in recent years through a simple optimization-based general equilibrium model, which captures the interdependence among rent, wage, and the price of the tradable and nontradable goods.

The approach of this paper offers a structured view of the relationship between the property price and other economic variables in Hong Kong. Comparative static results of the model are obtained, which provide a framework that is useful for public policy evaluation and analysis in Hong Kong. The paper also suggests a succinct method to estimate the fundamental value of the property price. Statistical analysis indicates that the model fits the experience of Hong Kong well for the period 1984Q2-1993Q4. Based on the model, the paper predicts that current property price in Hong Kong is still about 40% (or from 25% to more than 65%, according to other estimates), above the fundamental level and may have downward adjustment in the future.

Further study can be undertaken in following directions to improve our understanding of the critically important issues associated with the property market in Hong Kong.

- Although the total supply of housing adjusts relatively slowly in response to price changes, it does indeed play an extremely important role, especially in Hong Kong's property market. In this paper we have assumed that the supply of housing is exogenously determine outside the model. In fact, housing supply should be endogenously and jointly determined by property developers and the Hong Kong government. We should more carefully investigate and examine the investment behavior in the property development sector, employing for example Tobin's q-theory. This can in fact be accommodated in the model if we assume the producer is also involved the housing property development.

- The paper assumes that there is no government sector in the economy. Given the primary importance of fiscal deficit in recent years, we can include a government sector and investigate how its revenues and expenses change in response to changes of the property price in Hong Kong.

- We did not examine the balance of trade in this paper. Given the linked exchange rate and the endogenous change of money supply with continuous unsterilized foreign exchange intervention, we can investigate the consequences of changes of property price on the exchange rate and balance of payments, and vice versa, based on the portfolio balance approach.

Appendix:

Since

$$\hat{R}_{t+j} = (1-\theta)\hat{R}_{t+j-1} + \theta R_{t+j} = (1-\theta)^{j+1}\hat{R}_{t-1} + \theta\sum_{k=0}^{j}(1-\theta)^{k} R_{t+j-k}$$

Let $r_R + r_L + \delta = \Gamma$, the fundamental price of properties

$$\tilde{P}_t^H = \frac{1}{1+i+\Gamma}\sum_{j=0}^{\infty}\frac{E_t(\hat{R}_{t+j})}{(1+i+\Gamma)^j}$$

$$= \frac{1}{1+i+\Gamma}E_t\sum_{j=0}^{\infty}\frac{(1-\theta)^{j+1}\hat{R}_{t-1} + \theta\sum_{k=0}^{j}(1-\theta)^{k} R_{t+j-k}}{(1+i+\Gamma)^j}$$

$$= \left[\frac{1-\theta}{1+i+\Gamma}\sum_{j=0}^{\infty}\left(\frac{1-\theta}{1+i+\Gamma}\right)^j\right]\hat{R}_{t-1} + \frac{\theta}{1+i+\Gamma}\sum_{j=0}^{\infty}\left[\frac{1}{(1+i+\Gamma)^j}\sum_{k=0}^{j}(1-\theta)^{k} R_{t+j-k}\right]$$

$$= \frac{1-\theta}{i+\Gamma+\theta}\hat{R}_{t-1} + \frac{\theta}{1+i+\Gamma}\sum_{j=0}^{\infty}\sum_{k=0}^{j}\left[\frac{(1-\theta)^k}{(1+i+\Gamma)^j}R_{t+j-k}\right]$$

$$= \frac{1-\theta}{i+\Gamma+\theta}\hat{R}_{t-1} + \frac{\theta}{1+i+\Gamma}\sum_{k=0}^{\infty}(1-\theta)^{k}\sum_{j=k}^{\infty}\left[\frac{R_{t+j-k}}{(1+i+\Gamma)^{j-k}}\right]$$

$$= \frac{1-\theta}{i+\Gamma+\theta}\hat{R}_{t-1} + \frac{\theta}{1+i+\Gamma}\sum_{k=0}^{\infty}\left(\frac{1-\theta}{1+i+\Gamma}\right)^k\sum_{j=0}^{\infty}\frac{R_{t+j}}{(1+i+\Gamma)^j}$$

$$= \frac{1-\theta}{i+\Gamma+\theta}\hat{R}_{t-1} + \frac{\theta}{i+\Gamma+\theta}\cdot\frac{1+i+\Gamma}{i+\Gamma-g_R}R_t$$

$$= \frac{1-\theta}{i+\Gamma+\theta}\hat{R}_{t-1} + \frac{\theta(1+i+\Gamma)}{(i+\Gamma+\theta)(i+\Gamma-g_R)}\left[\frac{\hat{R}_t - (1-\theta)\hat{R}_{t-1}}{\theta}\right]$$

$$= \frac{(1+i+\Gamma)}{(i+\Gamma+\theta)(i+\Gamma-g_R)}\hat{R}_t + \frac{(1-\theta)(1+g_R)}{(i+\Gamma+\theta)(i+\Gamma-g_R)}\hat{R}_{t-1}$$

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Figure 1
Hong Kong: Consumer Price Index
(10/1999-9/2000=100)

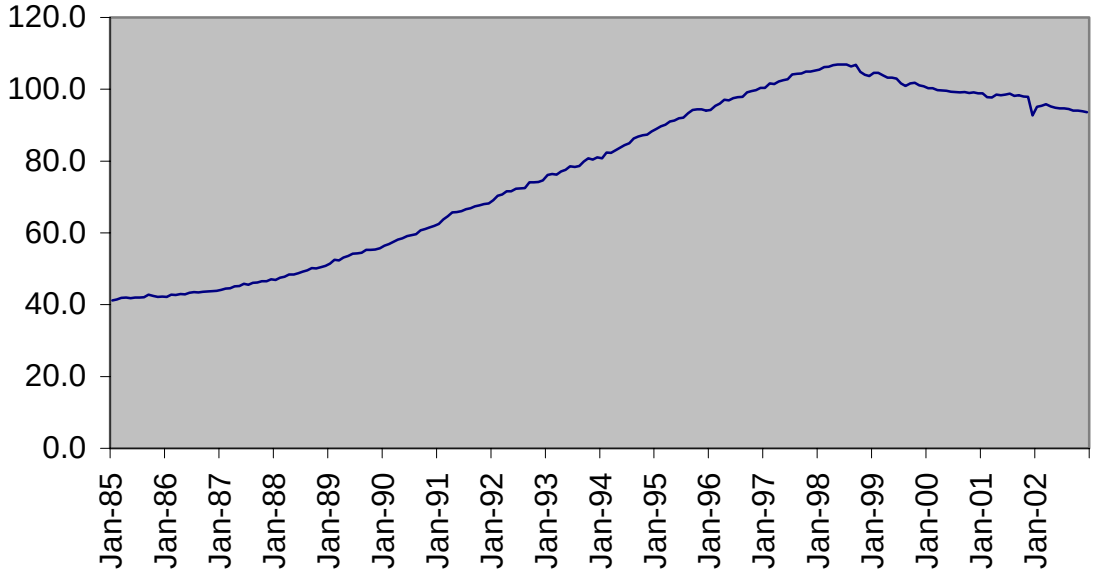

Figure 2
Hong Kong: Nominal Wage Index
(1992=100)

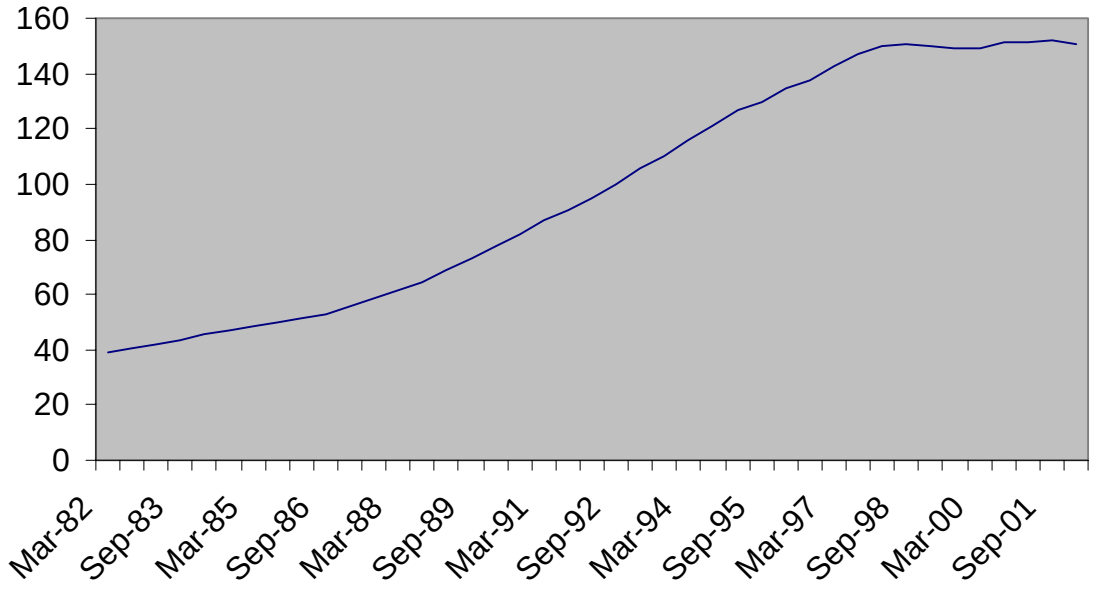

Figure 3
Hong Kong: Private Domestic Property Price and Rental Price Index (1999=100)

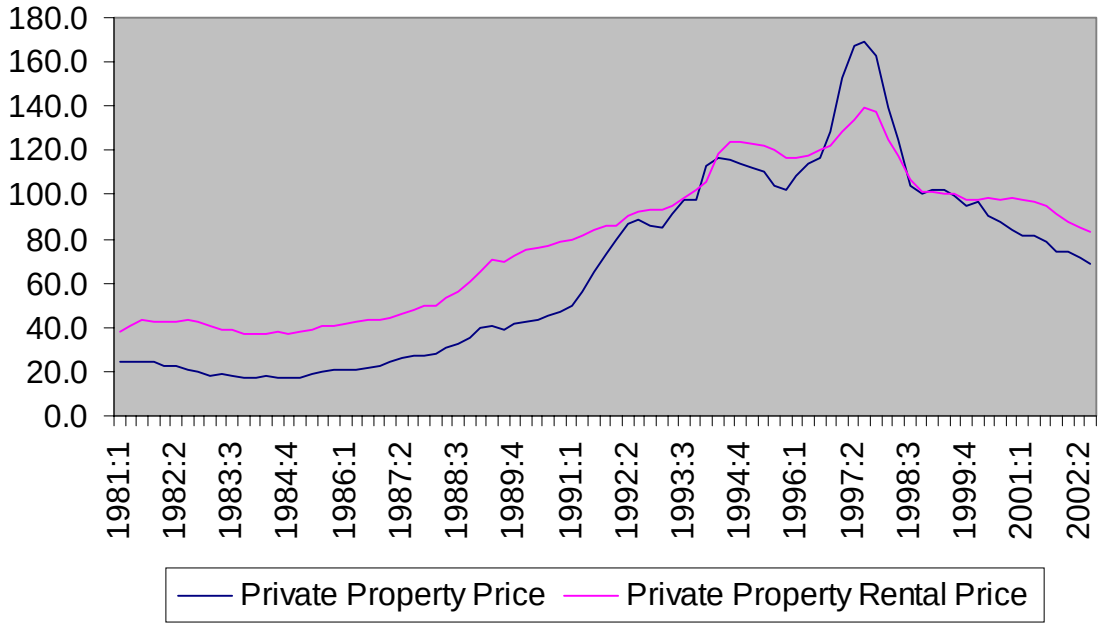

Figure 4
Hong Kong: Rent to Property Price Ratio (1999=1)

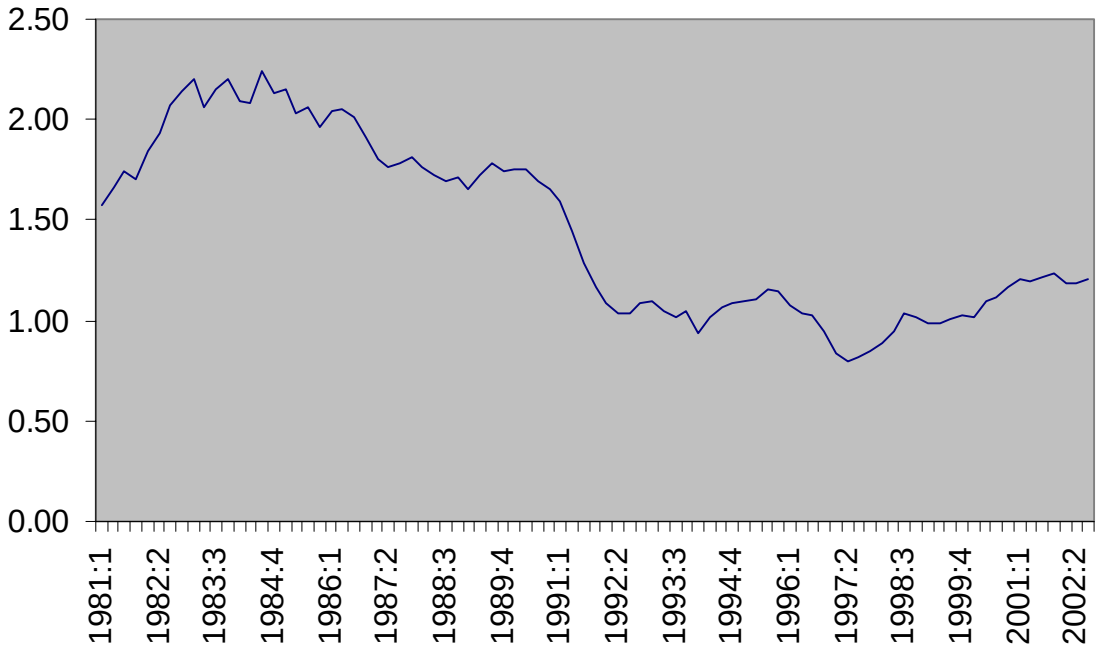

Figure 5
3 Month HIBOR and Fed Funds Rate

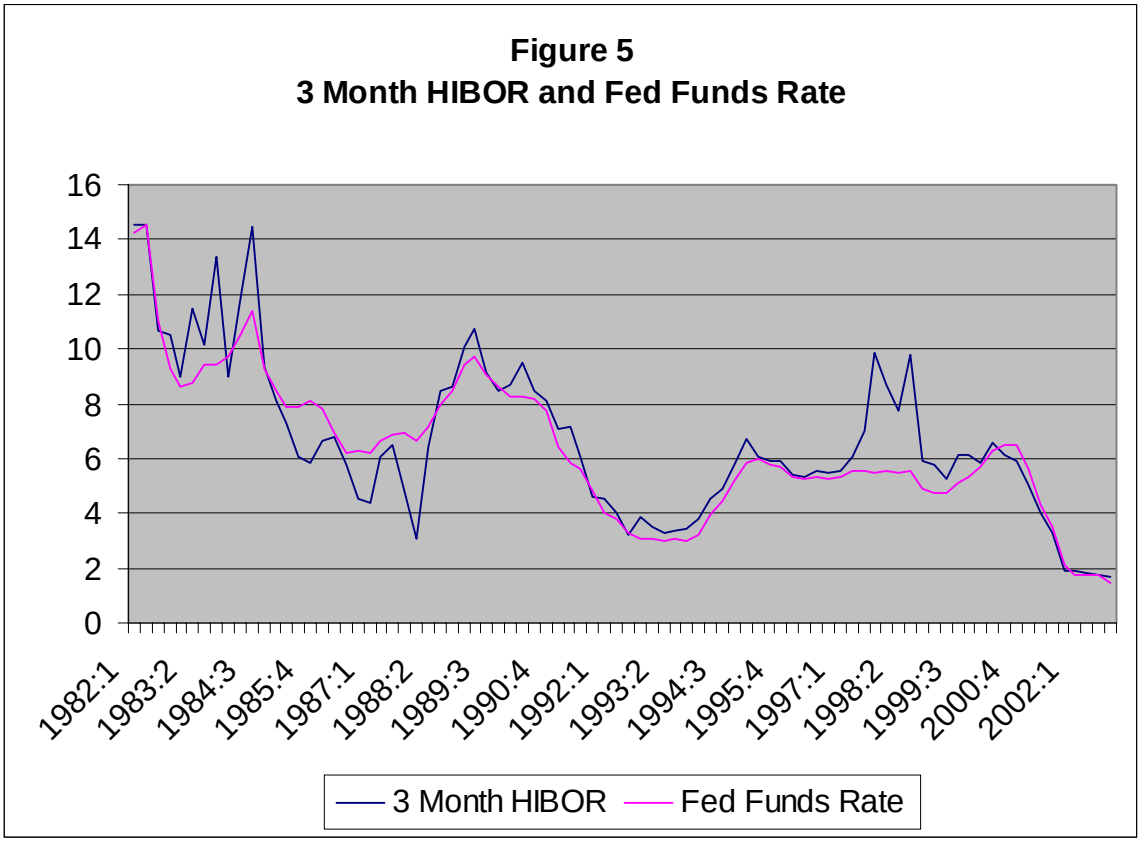

Figure 6
Hong Kong: Nominal Wage Growth Rate

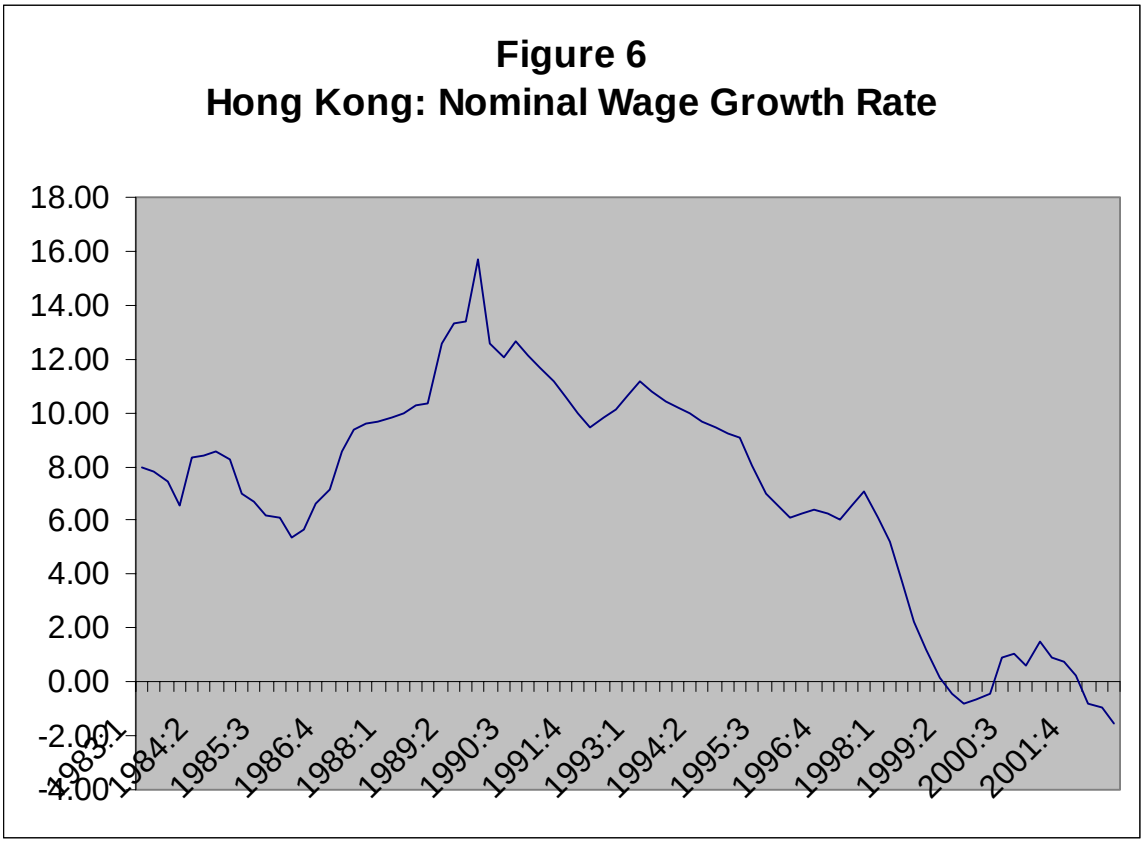

Figure 7: Growth Rate
Number of Households in Excess of Number of Public Rental Housing Units

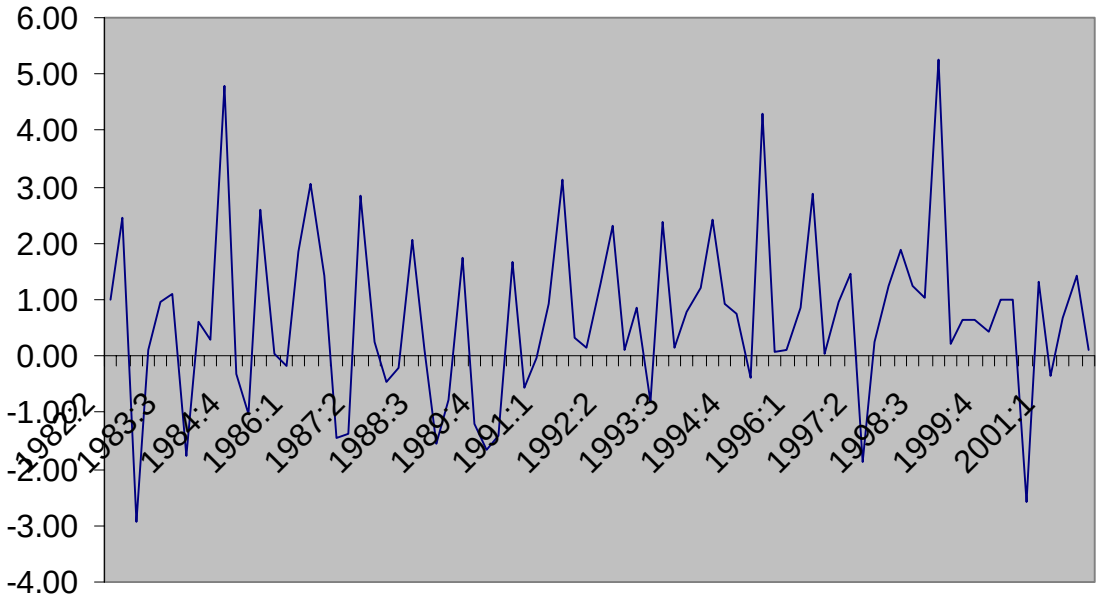

Figure 8: Growth Rate
Number of Private Domestic Premises and Subsidized Sales Flats

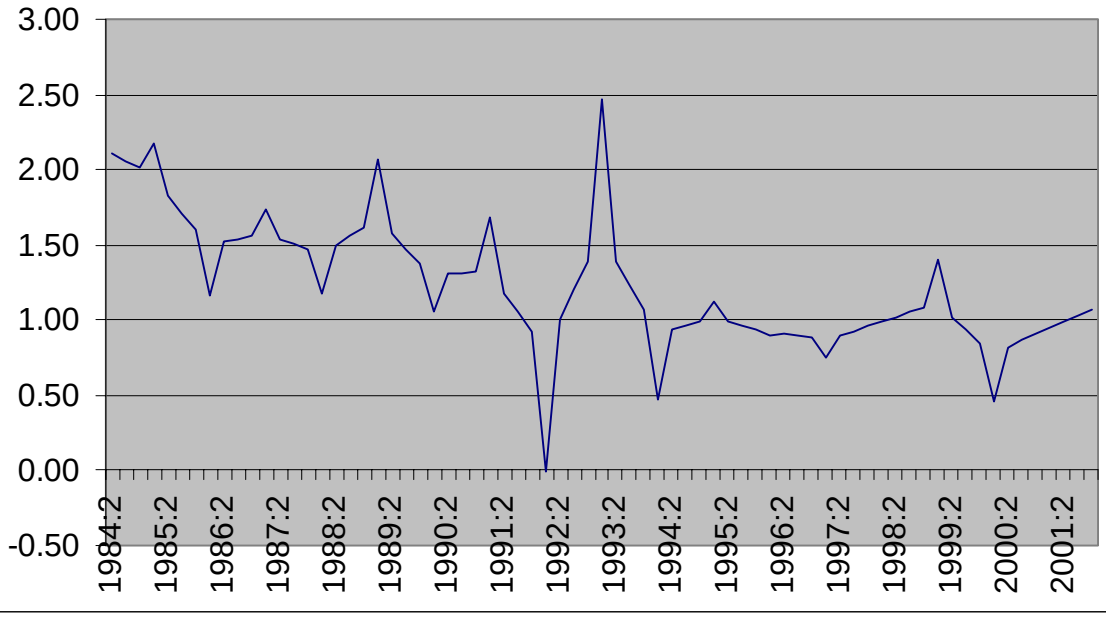

Figure 9
Number of Sales and Purchase Agreement

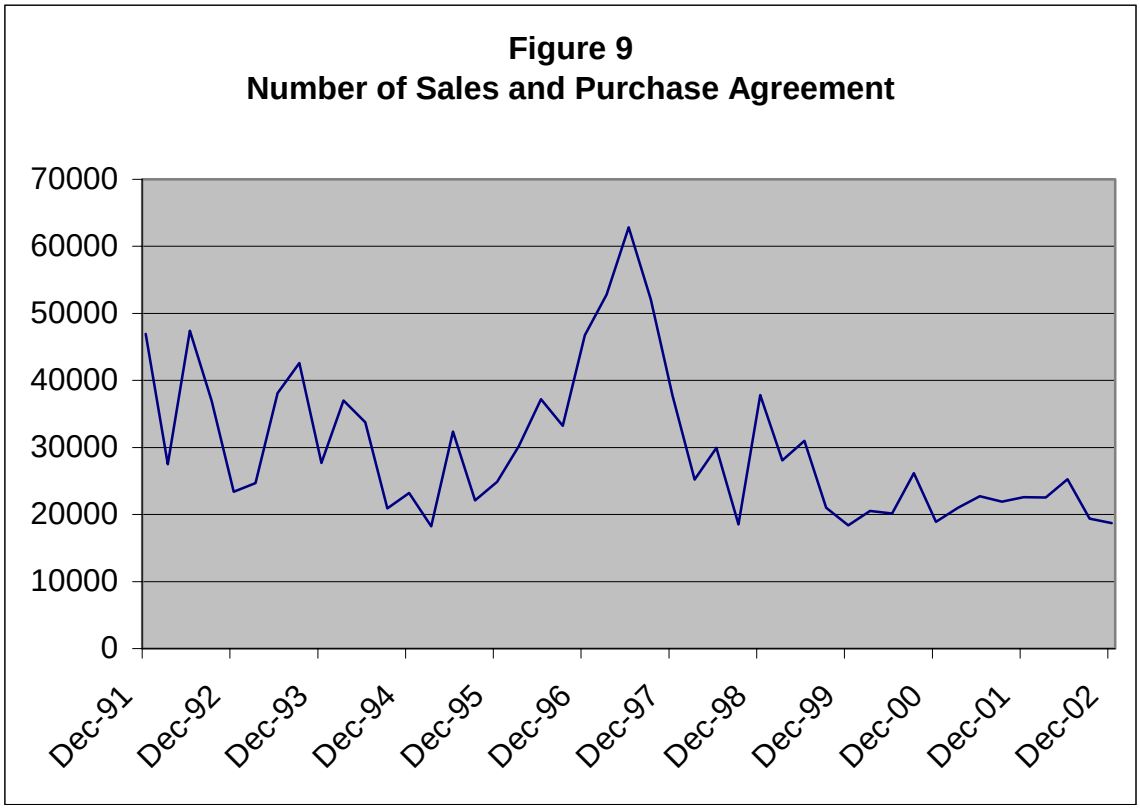

Figure 10
dR/R=dW/W+dN/N-dH/H