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Determinants of Residential Property Prices in Hong Kong: A Cointegration Analysis

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Abstract

Based on simple investment principles and the consideration of excess liquidity, a model on Hong Kong residential property prices has been developed. By using quarterly data of Hong Kong from 1984Q1 to 2009Q4, it is found that housing rental, excess liquidity, stock price and interest rate are significant factors affecting the prices of residential housing units in Hong Kong. The former three have positive relationship whereas the latter one has negative relationship with the residential property prices.

Keywords: Property prices, Excess Liquidity

1. Introduction

Property and asset prices in Hong Kong are not only a concern of Hong Kong residents but also of Hong Kong government. Since the beginning of the global financial tsunami in 2008, a number of economies have introduced expansionary fiscal measures and eased their monetary policies, resulting in a surge in global liquidity. Actually, large amounts of capital have been attracted into the emerging economies in Asia (including Hong Kong), and that have stimulated investment activities in the asset and property markets. As pointed out by the Financial Secretary in 2010, "Since the fourth quarter of 2008, the amount of inflow of funds has exceeded $640billion, increasing the potential risk of creating asset-price bubbles. We are also concerned that if capital flows were to reverse or interest rates rebound, asset prices would become more volatile. This in turns may affect the stability of our financial system and the recovery of the real economy." (The 2010-11 Budget)

After entered into 2012 and added to the influence of European sovereign debt crisis, a moderate fall in Hong Kong residential prices has been recorded. However, the Financial Secretary still reminded Hong Kong citizens, "Despite the recent stabilization of the property market, the low-interest environment persists, and the developed countries may again resort to quantitative easing policies to boost their sluggish economies. I shall, therefore, continue the strategy that has proven to be effective in facilitating the healthy and stable development of the property market." (The 2012-13 Budget)

2. Previous Literature

Studies on real estate prices are mainly focused on two areas: (a) real estate bubbles and (b) changes in real estate prices. The former investigates the definition and measurement of bubbles whereas the latter studies the determinants of real estate prices. This essay belongs to the latter area.

Factors affecting real estate prices may be numerous. Some studies focused on "real" economic factors like population and income. Case and Shiller (1990) analyzed the housing prices of four US cities by using both time-series and cross-sectional data from the period 1970Q1 to 1986Q3. They found that housing prices are positively correlated with the amount of adults in population and the per capita income. The study of Clapp and Ciaccotto (1994), analyzed three US cities by using the monthly data from October 1981 to September 1988. They found that macroeconomic variables like population and employment are good predictors of housing prices.

Regarding the bubble-economy of Japan during the 1980s, monetary factors as well as the role of expectation seemed to be more appropriate in influencing real estate prices than real factors. Ito and Iwaisako (1996) indicated that the significant rise in Japanese land prices during the late 1980s was first caused by the expansion of bank loans and credits, then, land price and stock price were affecting each other afterwards. Okina, Shirakawa and Shiratsuka (2000) stressed that the monetary policy of the government and Japanese's over-optimistic on future prospects had caused great fluctuations in asset prices in Japan during the 1980s.

Leung, Chow and Han (2008) explored the short-term and long-term determinants of property prices in Hong Kong. Their studies showed that per-capita GDP, real interest rate, the amount of land supply as well as a residential investment deflator are long-term determinants of Hong Kong property prices, whereas the stock price is the short-term determinant.

For fast-growing Asian economies like China, rises in housing prices had been spectacular since 1998 when a reform on housing allocation was carried out in the country. The reform abolished the previous centrally-planned allocation of housing and replaced it with the price mechanism. And since then, many researches have been done by Chinese scholars on the factors influencing China's housing prices. Many of them found that changes in China's housing prices were not so affected by fundamental factors. On the other hand, monetary factors like a loose-monetary policy, inflows of foreign capital (Han, Tu and Cao, 2007), changes in stock prices (Liu, Li and Yuan, 2008), bank credit and money supply (Zhou and Ju, 2008a and 2008b; Chen and Du, 2010; Sun 2010), excess liquidity (Liu, Li and Yuan, 2008; Chen and Du, 2010), are found to be relevant in explaining the changes.

3. Value of Residential Property and Excess Liquidity

A residential property is a durable asset. Just like all kinds of investment, investors of housing have to consider both the benefit of such investment as well as the opportunity cost of doing so. Suppose the purchase price of a property is P (all other expenses are included) and an investor can lend his capital in the financial market at an annual interest rate of i, then the interest income a year after will be iP and which represents the opportunity cost of the housing investment. If the investor can sell the property after a year at a price of P1, if there is a rental income (R) during the holding period, the total return to the investor becomes R + (P1-P). (See Tse, pp.121-122)

To a wealth-maximizing investor, the return from the housing investment must be greater than the corresponding cost, i.e.

$$iP < R + (P1-P) \quad (1)$$

Under the condition of zero-arbitrage opportunity, we have

$$iP = R + (P1-P) \quad (2)$$

Divide both sides of (2) by i, we have

$$P = R/i + (P1-P)/I \quad (3)$$

As P1 occurs only after the investment is made but investment always based on expected values, P1 in (3) can be replaced by the expected selling price, E(P1)

$$P = R/i + [E(P1)-P]/I \quad (4)$$

From (4), we can see the property price has two components, R/i and [E(P1)-P]/i, respectively. The former one, R/i, is the present value of the expected rental cash-flows obtained in the holding period and it is considered as the fundamental value of the property. [E(P1) – P]/i is the present value of the expected capital gain, and the value depends on investor's expectation. Other things held constant, property price will rise when (i) the rental income of the property rises, (ii) interest rate falls, and (iii) an expected capital gain occurs. The last one relates to "expectations".

But what factor may lead to a rise in the resultant expected capital gain? One relevant factor may be related to the amount of money supply available in the economy relative to the amount of nominal output, and we will use the term excess liquidity to represent it.

According to the Classical Quantity theory of money, inflation would arise if the growth rate of money supply is greater than the growth rate of real output (which determines the demand for money) in a closed economy. When inflation prevails, monetary values of goods and services in the economy will rise but the purchasing power of money fall. Just like other economic goods, the monetary value of real estate is also affected by the amount of money stock available in that economy. From the equation of exchange, we have

$$MV = PT \quad (5)$$

Where M is money supply, V is the velocity of money circulation, P is the general price level and T is the volume of transaction. (Friedman, pp.9-10) Since the equation has considered the use of money in every transaction. Apart from the exchange of goods and services, there are transfers of assets (like stocks and real estates). Hence, the equation of exchange can be re-written as

$$MV = PaQa + Py \quad (6)$$

Where Pa is the price of assets, Qa is the quantity of assets, and Py is the nominal income or nominal output. Assets can further be divided into real estate and financial assets (e.g. stocks and bonds), i.e.

$$PaQa = PhQh + PfQf \quad (7)$$

Where Ph is the price of real estate, Qh is the quantity of real estate; Pf is the price of financial assets and Qf is the quantity of financial assets. In other words, money can be used in the transactions of goods, services, as well as real estates and financial assets.

From (6), if the velocity of money circulation, V, is held constant, the increase in M will lead to either a rise in PaQa, or in Py, or in both PaQa and Py. If PaQa does not change, the effect of money growth will wholly fall on the nominal income (Py). On the other hand, if Py remains unchanged, the whole effect will fall on PaQa alone. Therefore, the rise in assets price must have the monetary dimension. In recent years, the US government has adopted the "quantitative easing" policy to stimulate the stagnant economy. However, the rise in money supply has not brought much effect on the real output or employment in the US economy. On the other hand, it leads to a rise in excess liquidity and has caused rises in prices of financial assets, precious metals and even energy.

Therefore, when we consider the change in asset prices, the change in money supply should not be ignored. In particular, when the growth rate of money supply is higher than the growth rate of nominal income, the problem of excess liquidity becomes more serious and inflation and asset price bubbles are very likely to result.

From (6),

$$PaQa = MV – Py \quad (8)$$

Hereafter, we will use the ratio of money supply to GDP to represent excess liquidity.

4. Types and Prices of Residential Housing Units in Hong Kong

According to the Hong Kong government, residential housing units in Hong Kong can be grouped into five types, according to the size of the units.

Table 1: Types of Residential Housing Units in Hong Kong

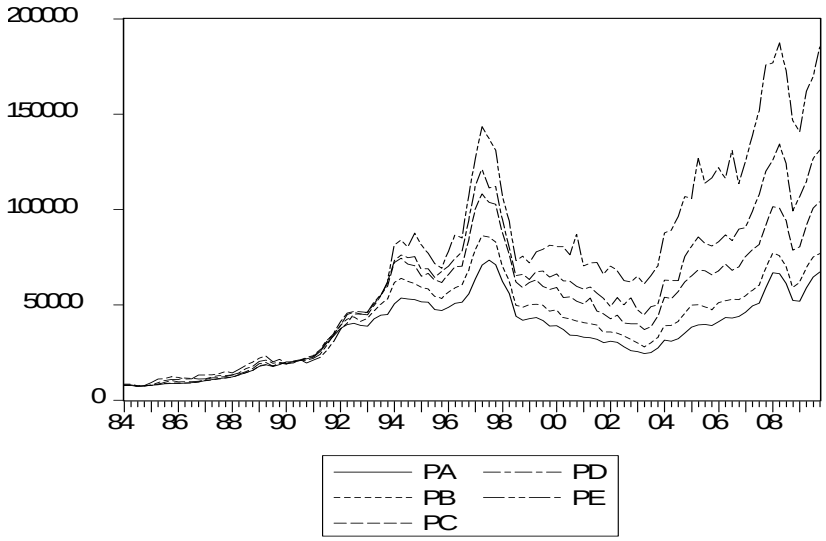
Type	Size of housing unit (m^2)
A	Below 40 m^2
B	40 to 69.9 m^2
C	70 to 99.9 m^2
D	100 to 159.9 m^2
E	160 m^2 or above

Source: Rates and Valuation Department, Hong Kong Government.

The five types of housing units are distributed in four areas: (i) Hong Kong Island, (ii) Kowloon, (iii) New Kowloon, and (iv) New Territories. Amongst these four areas, the price of housing units on Hong Kong Island is the highest.

Figure 1 shows the per square-meter price (in HK$) of the five types of residential housing units (on Hong Kong Island) during the period 1982Q1 to 2009Q4. PA, PB, PC, PD and PE represent the prices of Type A, Type B, Type C, Type D and Type E housing units. Trends of the price of the five housing types are very similar. The most spectacular point is at the end of 2007 when prices of Type D and Type E housing units had surpassed their former peaks in 1997. However, if we group the five types together, their average price at the end of 2009 had not reached its peak at 1997 (but has surpassed the peak in 2011).

Figure 1: Prices of Five Types of Residential Housing Unit (on Hong Kong Island) 1984Q1-2009Q4 (unit: per square-meter price in HK$)



Source: Rates and Valuation Department, Hong Kong

5. Regression Model

Based on equation (4), the price of a property is determined by the property's fundamental value, as well as the expected capital gain of the property. A multiple regression model explaining Hong Kong residential housing prices can be established as:

$$H = \alpha + \beta 1\ RENT + \beta 2\ LIQ + \beta 3\ HSI + \beta 4\ INT + \mu \quad (9)$$

Where H is the average price of the residential hosuing units; RENT is the average annual rental of the corresponding housing unit, calculated by multiplying the average monthly rental by 12; LIQ is excess liquidity and is caluclated by dividing money supply M3 with GDP; HSI is Hang Seng Stock Index which represents the performance of the Hong Kong stock market; HSI is considered here because stocks investment is the main form of financial investment in Hong Kong (as the bond market is not well-developed) and changes in the index should affect investors' expectation. INT is real

interest rate, it is found by deducting inflation rate from the best-lending rate. μ is the error term. Except INT, all explanatory variables are in logarithmic values. The expected value of β1 is positive, the higher the level of rental, the higher will be the housing price. The expected value of β2 is positive, when more liquidity is available in the economy, more can be channelled to the purchase of assets, include housing units. The expected value of β3 is positive. The higher the HSI, the greater will be the wealth effect on consumption and demand for mortgage, as well as a brighter expectation on future. The expected value of β4 is negative, the higher the real interest rate, the lower will be the present value of housing investment.

The period of estimation is from 1984Q1 to 2009Q4. Housing prices and rentals are obtained from Rate and Valuation Department; HSI data comes from Datastream Co.; data on money supply, interest rate, inflation rate and GDP are obtained from Hong Kong Census and Statistics Department.

5.1. Unit Root Test

Since H, RENT, LIQ, HSI and INT are all time-series data, the Augmented Dickey-Fuller (ADF) Test has been used to test for the existence of unit root. In case unit root is found in any of the series, then the series of data is non-stationary and ordinary regression analysis may give spurious results.

Table 2: Unit Root Test on the level values and their first-difference of variables in the regression model

Variable	ADF Test Statistic	MacKinnon 1% Critical value
Ha	-1.829099 (C, T, 2)	-4.0512
ΔHa	-5.117568 (0, 0, 1)*	-2.5862
Hb	-1.750985 (C, T, 1)	-4.0503
ΔHb	-4.660333 (0, 0, 1)*	-2.5862
Hc	-1.976145 (C, T, 2)	-4.0512
ΔHc	-4.753696 (0, 0, 1)*	-2.5862
Hd	-2.185353 (C, T, 2)	-4.0512
ΔHd	-4.445808 (0, 0, 1)*	-2.5862
He	-1.687097 (C, T, 4)	-4.0530
ΔHe	-4.765860 (0, 0, 1)*	-2.5862
Ra	-1.778264 (C, T, 5)	-4.0540
ΔRa	-6.053102 (0, 0, 1)*	-2.5862
Rb	-1.714145 (C, T, 3)	-4.0521
ΔRb	-5.452640 (0, 0, 1)*	-2.5862
Rc	-1.798779 (C, T, 1)	-4.0503
ΔRc	-5.081128 (0, 0, 1)*	-2.5862
Rd	-1.880213 (C, T, 1)	-4.0503
ΔRd	-4.740738 (0, 0, 1)*	-2.5862
Re	-1.853888 (C, T, 1)	-4.0503
ΔRe	-5.936659 (0, 0, 1)*	-2.5862
LIQ	0.273396 (C, 0, 6)	-3.4986
ΔLIQ	-3.960994 (0, 0, 5)*	-2.5871
HSI	-2.643194 (C, T, 1)	-4.0503
ΔHSI	-4.977793 (0, 0, 3)*	-2.5866
INT	-1.921805 (C, T, 5)	-4.0540
ΔINT	-5.264273 (0, 0, 3)*	-2.5868

Note: *indicates that unit root is rejected at 1% significance level. Terms inside parenthesis represent the existence of an intercept (C), a trend (T) and lags. 0 indicates no intercept or trend. Ha, Hb, … He are average prices of the five types of housing units; Ra, Rb, …Re are the average annual rentals of the five types of housing units.

In Table 2, we can find the level value of all variables are non-stationary, however, their first-differences are stationary, i.e. they are I (1) variables. It means there may be linear relationship among the variables and they may be co-integrated.

5.2. Cointegration Analysis

The Johansen Cointegration Test has been used to test for the cointegration of the variables (H, RENT, LIQ, HSI and INT) and the correspondingly results (for the five types of housing units) are listed in Table 3 to Table 7.

Table 3: Results of Johansen Cointegration Test (Type A Housing Units)

Eigenvalue	Likelihood Ratio	5% Critical Value	1% Critical Value	Hypothesized No. of Cointegrating Equation
0.338507	85.84867	68.52	76.07	None **
0.190778	45.34958	47.21	54.46	At most 1
0.134021	24.60477	29.68	35.65	At most 2
0.101013	10.50310	15.41	20.04	At most 3
0.000688	0.067442	3.76	6.65	At most 4

Table 4: Results of Johansen Cointegration Test (Type B Housing Units)

Eigenvalue	Likelihood Ratio	5% Critical Value	1% Critical Value	Hypothesized No. of Cointegrating Equation
0.296030	75.17427	68.52	76.07	None *
0.181092	40.77435	47.21	54.46	At most 1
0.108403	21.19555	29.68	35.65	At most 2
0.096063	9.950943	15.41	20.04	At most 3
0.000544	0.053374	3.76	6.65	At most 4

Table 5: Results of Johansen Cointegration Test (Type C Housing Units)

Eigenvalue	Likelihood Ratio	5% Critical Value	1% Critical Value	Hypothesized No. of Cointegrating Equation
0.298368	75.76316	68.52	76.07	None *
0.165918	41.03716	47.21	54.46	At most 1
0.123571	23.25768	29.68	35.65	At most 2
0.096979	10.33153	15.41	20.04	At most 3
0.003409	0.334604	3.76	6.65	At most 4

Table 6: Results of Johansen Cointegration Test (Type D Housing Units)

Eigenvalue	Likelihood Ratio	5% Critical Value	1% Critical Value	Hypothesized No. of Cointegrating Equation
0.238015	74.40937	68.52	76.07	None *
0.203577	47.77018	47.21	54.46	At most 1 *
0.137272	25.46300	29.68	35.65	At most 2
0.104538	10.99279	15.41	20.04	At most 3
0.001754	0.172080	3.76	6.65	At most 4

Table 7: Results of Johansen Cointegration Test (Type E Housing Units)

Eigenvalue	Likelihood Ratio	5% Critical Value	1% Critical Value	Hypothesized No. of Cointegrating Equation
0.268724	77.87310	68.52	76.07	None **
0.189435	47.20264	47.21	54.46	At most 1
0.143761	26.62036	29.68	35.65	At most 2
0.107985	11.41021	15.41	20.04	At most 3
0.002156	0.211564	3.76	6.65	At most 4

Since all variables can be cointegrated, irrespective of the types of housing units, and therefore, they have long-run equilibrium relationship.

6. Results

As the variables are cointegrated, ordinary regression analysis can apply. Table 8 reports the regression result. Ha to He are prices of Type A to Type E housing units.

Table 8: Regression Results of the Five Types of Residential Housing Units

	Ha	**Hb**	**Hc**	**Hd**	**He**
α	-0.2690 (1.12921)	-0.8671 (-3.5968)	-0.5913 (-2.3490)	-0.9070 (-3.0849)	-1.4851 (-3.7376)
RENT	1.1468 (18.3231)	1.1642 (18.8345)	0.9783 (13.9783)	0.9679 (12.9065)	0.8592 (8.0827)
LIQ	-0.2525 (-3.7914)			0.21125 (2.0548)	0.3503 (3.2912)
HSI	0.2786 (6.9479)	0.2777 (8.4661)	0.4028 (9.6712)	0.3900 (6.6132)	0.5281 (7.4015)
INT	-1.1596 (-3.5801)	-0.7733 (-2.2112)	-0.9489 (-2.3797)		-1.0011 (-2.2131)
Adj R^2 D-W Stat F-stat	0.9765 0.8428 1059.083	0.9772 0.5298 1457.958	0.9744 0.5013 1295.118	0.9719 0.3974 1158.524	0.9703 0.6128 833.1892

Note: Numbers in parenthesis are t-values.

Except the real interest rate (INT), all variables are of logarithmic values. Therefore, we can treat this analysis as an elasticity analysis. The regression model basically fits the data well (Adj-R^2 = 0.97). 97% of the variations in housing price can be explained by the explanatory variables. Using Type E housing units as an example, a one percent rise in rental will lead to a 0.86 percent rise in housing price; a one percent rise in excess liquidity will raise the housing price by 0.35 percent; a one percent rise in Hang Seng Index will raise the housing price by 0.53 percent. Nevertheless, a one percent rise in interest rate will reduce housing price by one percent.

Since the explanatory power of liquidity on prices of Types B and C housing units and interest rate on Type D housing units are insignificant, they were deleted afterwards. Blank boxes in the Table 8 showed LIQ has not been included in later estimations for Type B and C housing units, whereas interest rate has been deleted in the estimation of Type D housing units. For Type A housing units, the rise in excess liquidity does not lead to a rise in housing price, but instead, lead to a fall in housing price. This result contradicts the expected “positive” relationship between excess liquidity and housing price. One possible explanation may be because those who buy Type A housing units are those with lower income, the rise in excess liquidity may not lead to a corresponding rise in their income, or the increased liquidity has been invested in the stock market instead. Anyway, further investigations into the phenomenon are necessary. Besides, as Hong Kong is operating under the “Linked exchange rate system” (the currency board system) in which Hong Kong dollar is pegged to US dollar, the change in Hong Kong money supply, and hence excess liquidity, is affected by US monetary policy as well as Hong Kong’s balance-of-payments situations. Further explorations in the relationship between the exchange rate system and excess liquidity are necessary.

7. Conclusion

Based on the above regression model, we found that housing rental, excess liquidity, stock price and real interest rate are the key determinants of the residential property price in Hong Kong. The result is consistent with those simple asset-pricing models, given perfect knowledge and zero transaction costs,

wherein the price of an income-generating asset (e.g. a housing unit) is determined by the discounted cash-flow (e.g. the housing rental) brought by that asset. However, as we do not have perfect foresight in reality, we have to make use of the relevant information in making judgment. The Classical Quantity Theory of money throws light on the role of money supply, and in our study the excess liquidity, in determining housing prices.

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