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Studying the dynamic relationships between residential property prices, stock prices, and GDP in Hong Kong

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Abstract

This paper studies the dynamic relationships between GDP, residential property prices, and stock prices in the economy of Hong Kong. Studying the housing and stock markets sheds light on the economy as a whole because most people put their wealth into these two markets. In the study, we find that there are long-run feedback effects between the two asset markets, providing evidence of wealth and credit-price effects in Hong Kong. There are also long-run, bi-directional causal links between real GDP and real asset prices. Hence, real asset prices can drive long-run economic growth and vice versa.

JEL: C51, G11, R30

Keywords: Cointegration, Causality, GDP, Housing prices, Stock prices.

1. Introduction

This paper studies the dynamic relationships between GDP, residential property prices, and stock prices in Hong Kong. The goals of this analysis are twofold. First, Hong Kong's economy suffered considerably from the Asian financial crisis of 1997, so there is a general awareness that the economy must be restructured to avoid that kind of crisis in the future. We can learn a number of lessons from that crisis. Chief among them is that policymakers should have the ability to prevent excessive deviation of housing prices from their economic fundamentals.

The volatility of Hong Kong property prices is world famous. Before the Asian financial crisis, the Hong Kong property market rose continuously for nearly a decade. But when the crisis hit and the government mishandled its reaction, property prices sunk precipitously until 2003, losing 50% of their peak 1997 values. Equally astonishing, the subsequent comeback — though interrupted by the US financial crisis in 2008 — was so powerful that residential property prices rose 45% from 2008 to 2010 alone (Lau, 2010). Consequently, housing prices in Hong Kong are now the most expensive in the world (Liu and Leung, 2011).

Although the market has recovered, these large boom-bust cycles in asset prices significantly hurt many parts of the economy. Therefore, it would be interesting to investigate whether or not housing prices have been running ahead of the economy and whether the rises in housing prices are caused by GDP.

Another goal of this study is to understand the dynamic relationships between stock prices and housing prices. Recently, people are more and more seeing real estate as an investment and a consumption good. People mainly do this to diversify their investments and balance investment portfolios (Williams, 1996, De and Dirk, 1997, Kleiman, et. al. 2002 and Oikarinen and Asposalo, 2004). However, long-term diversification benefits offered by holding both stocks and residential properties in the same portfolio will be limited if their prices move together in the long run, i.e. cointegrated. Since current economic theory does not say that there must be a certain type of relationship between residential property markets and stock markets, it is vitally important for investors to understand the dynamic relationships between these two markets if they are to ever diversify and balance their portfolios.

To do that, we examine the dynamic relationships between housing prices and stock prices. Knowing the direction of causality will enable investors to predict how an asset price will change based on the movement of the other market price.

We use Hong Kong as a case study because its property market is one of the deepest and most liquid markets in the world (Chau et al., 2001). The short runs of lease (1 to 2 years), low agent fees, zero capital gains tax, and low tax rates on personal and business income have all contributed to the unparalleled liquidity of the market. Because of these special characteristics, studies of other economies may not be generalizable to Hong Kong. To understand the interaction between the economy and the two asset markets, we use Johansen's (1991) multivariate cointegration methodology to carry out the analysis. Since GDP and asset markets usually interact via other macroeconomic variables, we add the real interest rate and real effective exchange rate into the model. We then use tests of causality, impulse response functions (IRFs), and variance decompositions (VDs) to examine the causal relationship between the variables.

The rest of the paper is organized as follows: The next section reviews the theoretical background. Section 3 explains the methodology, and Section 4 describes the data. Section 5 presents the empirical results, and Section 6 gives concluding remarks.

2. Theoretical background

Before conducting the empirical analysis, it is important to understand the theoretical relationships between GDP, housing prices, and stock prices. For GDP and housing prices, it is reasonable to expect a two-way link. Strong economic growth tends to stimulate demand for houses, which in turn propels property prices. However, as Zhu (2003) points out, a number of factors other than GDP can drive real estate prices, including policy, institutional factors, elasticity of supply, the housing finance system, subsidy/tax policies and relevant laws.

From time to time, housing prices may deviate from their fundamental values. This may occur because the turnover rate of properties is low. Also, price information is limited and often inaccurate. Therefore, it is usually difficult (if not impossible) for market participants to predict future property prices. Another reason is that the supply response in the property market is much slower than with other goods because the housing production cycles—from urban planning to market sales—normally take several years to complete. When market demand is strong, new construction starts, but it normally takes several years before new real estate is ready for market sale. By the time construction is complete, market demand may have fallen off. Then oversupply can drive rent and prices below their fundamental values. Against this background, it is unclear whether or not GDP will show a definitively positive or causal relationship with housing prices.

Researchers have extensively discussed the effect of housing prices on GDP. But there is no consensus on how important this effect is. On the one hand, some researchers argue that house-price fluctuations reflect changes in income expectations and has little casual effect on consumption (e.g., Attanasio and Weber, 1994;

Attanasio et al., 2005). Similarly, the Bank of England has long asserted that the housing-wealth effect is not important (Benito et. al., 2006). On the other hand, other economists believe that the housing-wealth effect cannot be ignored. For instance, Mullabuer and Murphy (2008) point out that, if the role of the credit market is taken in account, the housing-wealth effect is significant. For example, in an illiberal credit market, potential buyers need to save a large sum of money for down payments. As demonstrated by the experiences of Italy and Japan, high housing prices reduce consumer spending (Muellbauer and Murata, 2008). Therefore, housing-wealth effects depend on a number of factors, such as buyers' saving behavior, credit markets, and prevalent housing prices.

Researchers have explored in detail the theoretical basis of the link between stock prices and the macroeconomy—for example in the seminal works of Baumol (1965) and Bosworth (1975). In particular, stock prices can affect GDP by way of consumption and investment. The relationship between stock prices and consumption expenditures, for instance, can be explained by the lifecycle theory of Ando and Modigliani (1963), who argue that individuals base their consumption decisions on their expected lifetime wealth. Since people can hold part of their wealth in the form of stocks, a drop in stock prices will decrease consumption—the stock market-wealth effect (Poterba, 2000).

Similarly, the relationship between stock prices and investment spending can be explained by Tobin's (1969) q theory, where q is the ratio of total market value of firms to the replacement cost of their existing capital stock at current prices. Therefore, a booming stock market helps the economy because firms can raise capital more cheaply during periods of rising stock prices. Because borrowing costs are lower, economic activity should expand.

Regarding the influence of GDP on stock prices, it is reasonable to expect that an improvement in the performance of an economy would raise profits and hence the price performance of the listed companies. Therefore, under normal circumstances, one would expect GDP to have a positive relationship with stock prices.

For the relationship between house prices and stock prices, there are two transmission channels through which housing and stock markets can cause each other's prices to change (Kapopoulos and Siokis, 2005). First, an increase in stock values can increase consumers' future spending because increases in stock market wealth normally produce additional cash inflows to households in the form of dividends and capital gains. To the extent that property is considered both a consumption good as well as an investment (Piazzesi et al., 2007), a rising stock market may increase the amount of housing purchased through the wealth effect (Green, 2002).

Another channel is the credit-price effect. As Chen points out (2001), if an increase in bank credit supply causes a rise in real estate prices, it will improve the balance sheet positions of real estate developers. This will bestow unrealized capital gains to firms that hold real estate or land. Because real estate is often used as collateral for loans, firms can therefore borrow more for investment. Then either the expected profits from realizing capital gains or expected revenues from expanded investment will lead investors to bid up the equity value of that firm. This further enhances the balance sheet position and hence the firm's borrowing capacity. When the firms demand more real estate or land to carry out new investments, this will, in turn, spur the land or real estate market, leading to a spiraling upturn in both stock and real estate prices.

3. Methodology

To test for cointegration, we use Johansen's (1991) maximum likelihood (ML) estimation procedure, which can capture the long-run and short-run dynamics of variables. The analysis starts with a p-dimensional unrestricted vector autoregressive (VAR) model of order k:

$$Z_t = \sum_{i=1}^{k} \Pi_i Z_i + \mu + \varepsilon_t, \quad t = 1,\ldots, T, \tag{1}$$

where Z_t is a $p \times 1$ vector of stochastic variables, $Z_{-k+1},\ldots,Z_0$ are considered fixed, and ε_t $(t = 1,2,\ldots,T)$ is a sequence of independent Gaussian variables with a mean of zero. Π is a $p \times p$ matrix and μ is a p-dimensional vector, both of which need to be estimated from the model. The individual variables included in Z_t are integrated at most on the order of one or I(1). The unrestricted VAR (k) representation can be expressed as a vector error-correction model (VECM) with k-1 lags:

$$\Delta Z_t = \Pi Z_{t-1} + \sum_{i=1}^{k-1} \Pi_i \Delta Z_{t-i} + \mu + \varepsilon_t, \quad t = 1,\ldots,T, \tag{2}$$

where $\Pi = -I + \sum_{1}^{k} \Pi_i$ and $\Gamma_i = -\sum_{i+1}^{k} \Pi_j$, $i = 1, \ldots, k-1$.

The hypothesis of cointegration is formulated as a reduced rank of the long-run impact matrix Π. In particular, if Π has a reduced rank r, where $r \leq p - 1$, then there exist (i) two $p \times r$ matrices α and β such that $\Pi = \alpha\beta$, and (ii) r co-integrating vectors. The non-zero matrix $\beta' Z_{t-1}$ represents r lagged error-correction runs or equilibrium errors. The likelihood ratio (LR) test of at most r cointegrating vectors is given by the following trace test statistic:

$$\text{Trace} = -T \sum_{i=r+1}^{p} \log(1 - \lambda_i), \quad r = 0,1,2,\ldots, p-1. \tag{3}$$

where λ_i refers to the i^{th} eigenvalue. The cointegration results can be further evaluated by testing the null hypothesis of zero restrictions on β using the LR test statistic below:

$$LR = T\sum_{i=1}^{r}\log\{(1-\lambda_i^*)/(1-\lambda_i)\}, \qquad (4)$$

where λ_i^* refers to the i^{th} eigenvalue of the restricted model.

If there is cointegration among the variables, a VECM representation can capture the dynamic relationship between them. One distinct feature of the VECM is that it allows for two sources of causality to be examined (Granger, 1988). The first source is through the lagged error-correction term in α whose coefficients contain information about the direction and average adjustment speed of the dependent variables that each has to make in order to adjust the system back to its long-run equilibrium. The causal impact that the lagged error correction term impinges on the long-run relationship of the cointegrated process is considered the long-run form of Granger causality (Masih and Masih, 1996). Therefore, the statistical significance of the adjustment coefficients in α — which is tested by estimating the LR statistics under zero row restrictions on α using the formula given by (4) — can be considered evidence of long-run causality.

The second source of Granger causality can be revealed through the impacts of the sum of the lags of each explanatory variable on the dependent variables, which are short-run and do not have any influence on the long-run relationship. Such short-run causal impacts can be detected using the standard Wald test. Finally, IRFs describe the direction, magnitude, and persistence of the responses of variables to shocks in other variables over time. VD measures the proportion of a variable's forecast error variance explained by its own shocks and shocks to other variables in the system. Therefore, VD allows us to determine the relative strengths of various shocks in accounting for the variations of a variable of interest. Altogether, IRFs and VD can give more detailed analyses of dynamic relationship among variables in a cointegrated system.

4. Data

We use quarterly data of the private domestic premises price index (PDP), Hang Seng Index (HSI), GDP, 3-month interbank offer rates (INT), and real effective exchange rate index of Hong Kong dollars (REER). PDP represents the average price of private residential premises based on an analysis of transactions scrutinized by the Department of Rating and Valuation for the purposes of stamp duty collection. HSI measures the performance of the largest and most liquid companies listed in the Hong Kong Stock Exchange. GDP figures are measured at current market prices. Also, the figures for REER are in real terms at the source, and other series are converted into real values by deflating the nominal values with the composite consumer price index. We denote the real housing price index as RPDP, real stock price index as RHSI, real GDP as RGDP, and real interest rate as RINT.

The data series are collected from different sources. The private domestic premises price index is from various issues of the *Hong Kong Property Review*. The real effective exchange rate index is from the Bank of International Settlements. All other data series are from *Datastream*. The sample period runs from 1987.Q1 to 2009.Q1, with 89 observations in total. All variables are transformed to natural logarithms and are seasonally adjusted using the X11 procedure.

5. Empirical Results

We start by examining the time series property of the variables to be used in the model. The first step is to test for the presence of a unit root in each variable in the system. Four standard unit root tests with a constant and a linear time trend in the test regression and one stationarity test have been employed. The unit root tests are: (1) the Augmented Dickey-Fuller (ADF) test, (2) the Phillips-Perron (PP) test, (3) the Elliott-Rothenberg-Stock (ERS) Dickey-Fuller with GLS de-trending (DF-GLS) method, and (4) the ERS point optimal (PO) test. Also, the stationarity test adopted is the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test which examines the null hypothesis of trend stationarity against the alternative of unit root process. The details of these unit root and stationarity tests were documented in Phillips and Xiao (1998). Table 1 shows all test results. The test statistics uniformly suggest that all the series in level are I(1), while their first differences are I(0).

Table 1: Results of unit root and stationarity tests

Variables	**ADF**	**PP**	**DF-GLS**	**PO**	**KPSS**
RPDP	-2.487	-2.152	-1.775	33.318	0.181**
RHSI	-2.618	-2.784	-2.782	7.148	0.614*
RGDP	-3.354	-3.379	-1.192	12.385	0.149**
RINT	-2.658	-2.232	-2.741	10.139	0.160**
REER	-0.953	-0.893	-0.931	49.370	0.288*
△RPDP	-4.658*	-4.799*	-4.672*	3.104*	0.106
△RHSI	-5.176*	-8.234*	-5.325*	3.122*	0.048
△RGDP	-7.384*	-7.495*	-4.089*	3.355*	0.090
△RINT	-4.256*	-8.792*	-3.287**	2.816*	0.053
△REER	-6.459*	-6.623*	-5.123*	2.955*	0.108

Note: The 5% and 1% critical values for ADF and PP are 3.461 and -4.064; for DF-GLS are -3.065 and -3.621; for PO are 5.657 and 4.251; and for KPSS are 0.146 and 0.216.
** and * denote significance at the 5% and 1% levels, respectively.

The next step of the analysis is to identify the number of cointegrated or long-run relations in the 5-variable VAR model.[1] Table 2 reports the cointegration test results, which show that there is at most one long-run equilibrium relationship among the five variables in the system. Hence, the real values of GDP, housing prices, stock prices, interest rates, and effective exchange rates move together in the long run. Results of restriction tests on β's (shown in Table 3) suggest that all the variables in the cointegrating vector should not be excluded in the VAR model because their LR statistics are significant. Hence, Hong Kong's housing and stock markets are cointegrated. Investors in both of these markets cannot obtain much long-term diversification benefits as the prices of these two markets tend to move together over time.

Table 2: Cointegration test results

Null hypothesis	Eigenvalues	Trace statistics	p-value
$r = 0$	0.423	93.094**	0.044
$r \leq 1$	0.224	46.371	0.405
$r \leq 2$	0.137	24.840	0.478
$r \leq 3$	0.087	12.329	0.329
$r \leq 4$	0.052	4.580	0.064

Note: The number of lag lengths chosen is 4 for the VAR model (with an unrestricted constant) using the Schwarz Criterion. The p-values are calculated based on the finite-sample adjustment of the asymptotic critical values of the trace statistics (Johansen and Juselius, 1990), using the scaling factor T/(T-pk) proposed by Cheung and Lai (1993).
** denotes significance at the 5% level.

[1] The empirical results of cointegration tests were obtained using CATS in RATS, Version 2 by Dennis, Hansen, Johansen, and Juselius (2005).

Table 3: Results of the restriction test on β

Variables	LR(β)[a]	LR(β)[b]	LR(β)[c]
RGDP	18.717*	11.692*	14.973*
RHSI	20.826*	13.010*	16.660*
RPDP	12.605*	7.875*	10.084*
RINT	7.480*	4.673**	5.984**
REER	5.636**	3.521***	4.508**

Notes: [a]The LR statistics for the zero restrictions on β, denoted by LR(β), were calculated using formula (4) without finite-sample adjustment. [b]The LR(β) statistics were adjusted by the Bartlett small-sample correction (Johansen, 2000). [c]The LR(β) statistics were adjusted by the small-sample modification method from Psaradakis (1994). All LR statistics are distributed as χ^2 with 1 degree of freedom.
***, **, and * denote significance at the 10%, 5%, and 1% levels, respectively.

We now examine the directions of causal relationships among the variables in the system with Granger causality tests and the results are presented in Table 4. To check the causality we focus on the significance of the coefficients of the lagged disequilibrium. As shown in Table 4, the adjustment coefficients in α are only significant for the equations of RPDP, RHSI, and RGDP. These results imply that any deviations from long-run equilibrium will feed back into the changes in RPDP, RHSI, and RGDP in order to force the system towards the long-run equilibrium. In other words, when disequilibrium occurred in the last period, all of these three variables must re-adjust in the current period in order to bring the system back to equilibrium. This information can be used to determine long-run causal relationships. Take the case between housing and stock markets as an example. Since the adjustment coefficients in α of both equations of RPDP and RHSI are statistically significant, the real housing prices are being Granger-caused by the real stock prices through the lagged error-correction term, while real stock prices are also Granger-caused by real housing prices. Hence, there is a long-run, bi-directional causal relationship between housing and stock markets. Therefore, an increase in stock market wealth can help increase the purchase of housing property, while an upsurge in the housing sector could signify stronger balance sheet positions of real estate companies, which in turn lead equity investors to bid up their share prices. These results provide evidence of both wealth and credit-price effects in Hong Kong.[2] Likewise, current changes in RGDP are Granger-caused by previous values of either RPDP or RHSI, and vice versa. Therefore, it is also possible to conclude that real GDP has long-run two-way causal relationships with both the stock and housing markets.

Based on these results, our analysis concludes that price booms in the housing and stock markets drive long-term growth in the Hong Kong economy, while real GDP also influences the long-run stochastic path of the real housing and stock prices. We can infer from this result that the housing prices in Hong Kong were supported by economic fundamentals. Hence, one can argue that the government should increase its land supply if it believes the prices of the housing market are too high.

Table 4: Results of long-run and short-run Granger causality tests

Dependent variables	**Wald statistics of sum of lagged first differenced terms**					**α**	**LR(α)**
	△RPDP	△RHSI	△RGDP	△RINT	△REER		
△RPDP		0.503	0.073	0.349	3.311***	-0.210	(3.655)*** [2.924]***
△RHSI	4.107**		2.207	0.078	1.483	0.512	(4.145)** [3.316]***
△RGDP	0.043	5.907**		0.776	2.657	-0.124	(9.452)* [7.561]*
△RINT	6.491**	1.696	0.445		0.019	-0.029	(1.793) [1.434]
△REER	4.529**	0.818	0.0002	0.276		-0.027	(0.196) [0.156]

Note: The LR statistics for the zero restriction on α (LR(α)) shown in parentheses were calculated using formula (4) without finite-sample adjustment. The figures in squared brackets are LR(α) with small-sample adjustment (Psaradakis, 1994). All LR statistics are distributed as χ^2 with 1 degree of freedom.
***, **, and * denote significance at the 10%, 5%, and 1% levels, respectively.

From Table 4 we also find that the values of adjustment coefficients in α of the

[2] Our evidence of stock market wealth effects are consistent with those of Green (2002), Kapopoulos and Siokis (2005), and Sim and Chang (2006). However, their results were produced from traditional Granger causality tests only, not based on error-correction mechanism.

real housing and stock prices are 0.210 and 0.512, respectively. These results suggest that about 21% and 50% of the disequilibrium are eliminated per quarter in the housing and stock markets, respectively, in the process of returning the system back to long-run equilibrium. Therefore, as disequilibrium occurs, real stock prices adjust faster than real housing prices. This is not surprising because the stock market is more liquid than the housing market. The adjustment coefficient (0.124) of RGDP reveals that real GDP adjusts at a slower speed towards long-run equilibrium than those of the stock and housing markets. This may reflect the fact that adjustments in good markets—due to sticky wages and long-run contracts — are more sluggish than those of asset markets. Furthermore, the insignificant coefficients of their lagged error-correction terms suggest that real interest rates and real effective exchange rates do not make adjustments towards equilibrium when disequilibrium occurs. Hence, these two macroeconomic variables have limited roles in equilibrating the system and are weakly exogenous to the system (Johansen, 1992).

To examine short-run causality, we have to rely on Wald statistics, which provide evidence of short-run causality running from the housing market to the stock market and from the stock market to real GDP. Therefore, temporary capital gains from the housing market could cause investors to re-balance their short-run stock portfolio, which in turn leads to temporary fluctuations in stock prices.

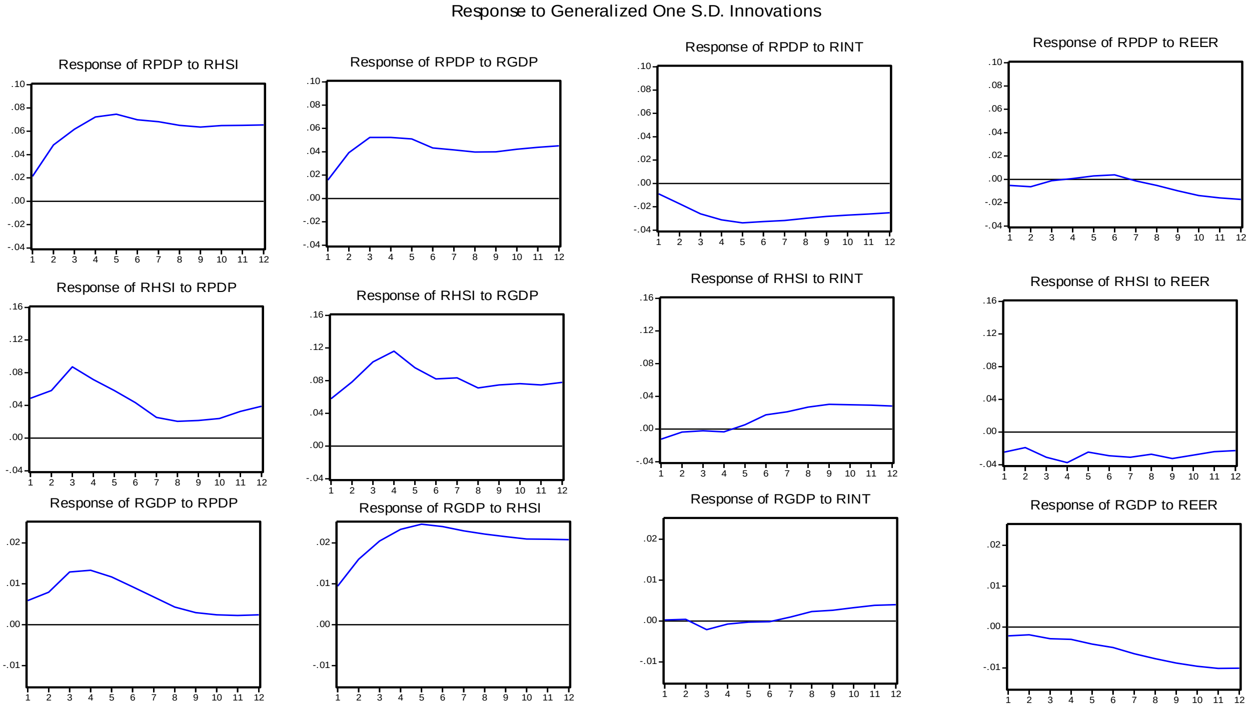
The absence of short-run causality from the stock market onto the housing market implies that decisions to buy residential flats may be driven more by economic fundamentals than by the short-run exuberance of the stock market. Furthermore, although short-run stock market fluctuations (arising from, for instance, inflows or outflows of hot monies) cannot influence the housing market, it can drive the short-term growth of real GDP in the economy. This implies that fluctuations in stock prices can create temporary instability in real GDP. In summary, these short-run causal linkages are transitory and their appearance may be caused by such factors as speculative activities, irrational expectations, and waves of pessimistic and optimistic views that are unrelated to the long-run relations.

In order to understand how real GDP and the two real asset prices interact over time, we analyzed the IRFs and VDs based on VECM. As far as our research focus is concerned, we are interested in the responses of RHSI, RPDP, and RGDP to shocks arising from other variables in the system. To avoid the causal ordering issue, we use generalized IRFs developed by Pesaran and Shin (1998). We find that the evidence of the wealth effect and credit-price effect can be reaffirmed in the stock and housing markets by the positive and persistent responses of one market to shocks in another one (as seen in Figure 1). Similarly, we can see the positive feedback effects between real asset prices and real GDP.

The positive effects of real stock and housing prices on real GDP mean that the asset markets generate wealth effects on the real economy. By comparison, the stock market wealth effects on the real economy are more pronounced and persistent than those of the housing wealth effect. Also, real interest rates have the expected negative impact on the housing market. Rises in real interest rates have a negative effect on the stock market in the short run, but their long-run impact is positive. This is probably because a rise in real interest rates may reflect the strong fundamentals of the economy, which leads to upsurge in stock prices in the long run.

Real GDP has a similar response to real interest rates. However, rises in real effective exchange rates consistently bring down real GDP, stock, and housing markets. This is probably because of the rising exchange rate lowers the external competitiveness of the Hong Kong economy.

Figure 1. Analysis of generalized impulse responses



To assess the relative importance of shocks in different sectors, we estimated VD (Table 5). We found that forecast error variances in housing prices and stock prices are dominated by their own innovations, which fade off gradually over time. Besides their own movements, most of the variation in RPDP can be explained by innovations of RHSI and vice versa. By comparison, the influence of other macroeconomic variables on the housing and stock markets is less important. These results indicate that the dynamic relationship between RHSI and RPDP gains prominence as time progresses. This supports our previous evidence of long-run feedback effects between the housing and stock markets.

RGDP is largely explained by RHSI innovation, with the proportion rising from 23% initially to over 67% at the end of 12 quarters. RPDP still plays a role in determining the variation in RGDP, but its impact on RGDP is much less important (around 10% at horizon 12) than the stock market. This is consistent with the earlier finding from IRFs that the impact of the stock market on the real economy is stronger and more persistent than that of the housing market.

Real interest rates and real effective exchange rates show strong relative exogeneity, as shown by their respective VDs. This supports the idea that real GDP and the two asset prices have virtually no influence over these two macroeconomic variables. This is consistent with the earlier findings of their weak exogeneity.

Table 5: Analysis of variance decomposition

Variance decomposition of RPDP, explained by innovations in:					
Period	RPDP	RHSI	RGDP	RINT	REER
1	100.000	0.000	0.000	0.000	0.000
4	90.596	4.920	0.798	4.739	2.944
8	84.006	9.487	0.459	1.635	4.410
12	79.770	14.438	0.360	2.051	3.378
Variance decomposition of RHSI, explained by innovations in:					
Period	RPDP	RHSI	RGDP	RINT	REER
1	26.540	73.459	0.000	0.000	0.000
4	31.848	62.176	5.239	0.635	0.100
8	23.357	67.325	6.294	2.670	0.351
12	19.781	66.274	8.080	5.110	0.753
Variance decomposition of RGDP, explained by innovations in:					
Period	RPDP	RHSI	RGDP	RINT	REER
1	14.655	23.544	61.800	0.000	0.000
4	24.796	49.121	24.945	0.167	0.968
8	19.935	63.518	19.616	0.282	0.646
12	10.130	67.574	19.867	0.629	1.797
Variance decomposition of RINT, explained by innovations in:					
Period	RPDP	RHSI	RGDP	RINT	REER
1	4.739	0.051	2.041	93.167	0.000
4	4.488	1.931	0.676	92.637	0.266
8	3.587	1.457	0.488	94.193	0.272
12	3.341	2.724	0.619	92.750	0.564

Variance decomposition of REER, explained by innovations in:					
Period	RPDP	RHSI	RGDP	RINT	REER
1	1.595	5.185	0.045	2.787	90.386
4	0.5578	4.970	0.032	3.655	90.784
8	3.778	3.384	0.039	2.828	89.942
12	5.293	3.149	0.136	2.100	90.320

VI. Conclusion

This paper studies the dynamic relationships between real home prices, stock prices, and GDP in Hong Kong. Our estimation results indicate that the three variables have long-run, bi-directional casual relationships and perform an error-correcting role in the system. In particular, growth in real GDP causes long-run rises in the real prices of houses and stocks, as shown by the causality test and IRFs. In other words, rises in the real prices of the housing and stock markets have been consistent with long-run economic fundamentals. Therefore, if the government believes that housing prices in recent years have gone too high, one proper solution is to increase the supply of land. On the other hand, because real housing prices can also cause long-run growth in real GDP, this would imply that the government should be careful in its urban development strategy. Any mistakes made in the supply of land may have repercussions on the economy through housing prices.

Another conclusion is that real housing and stock prices have positive and two-way causal impacts on each other — evidence of wealth and credit-price effects. Since rises in the stock market lead to rises in the housing market, the wealth effect of the stock market on the real economy is greater and longer lasting than that generated by the housing market, as seen from the results of the IRFs and VDs. This is because stock-wealth effects may be further generated through the housing markets. Moreover, including housing and stock assets in a portfolio does not give investors much risk diversification benefits because they move together in the long run with other macroeconomic variables.

Finally, IFRs show how real interest rates and real effective exchange rates influence the long-run stochastic paths of other variables in the system. However, as indicated by causality tests and VDs analysis, real interest rates and real effective exchange rates are weakly exogenous to the system.

Reference:

Attanasio, O., and G. Weber. 1994. The UK Consumption Boom of the Late 1980s: Aggregate Implications of Microeconomic Evidence. *The Economic Journal* 104(427): 269-302.

Attanasio, O., L. Blow, R. Hamilton, and A. Leicester. 2005. Booms and Busts: Consumption, House Prices and Expectations. Working Paper 05/24. Institute for Fiscal Studies, London.

Baumol W. 1965. *Stock Market and Economic Efficiency*. New York: Fordham University Press.

Benito, A., J. Thompson, M. Waldron, and R. Wood. 2006. House Prices and Consumer Spending. *Bank of England Quarterly Bulletin* Summer: 142-154.

Bosworth B. 1975. The Stock Market and the Economy. *Brookings Papers on Economic Activity* 2:257-300.

Chau, K.W., B. D. Macgregor, and G. M. Schwann. 2001. Price Discovery in the Hong Kong Real Estate Market. *Journal of Property Research* 18(3):1-30.

Chen, N. K. 2001. Asset price fluctuations in Taiwan: Evidence from stock and real estate prices 1973 to 1992. *Journal of Asian Economics* 12: 215–232.

Cheung, Y. W. and K. S. Lai. 1993. Finite-sample Sizes of Johansen's Likelihood Ratio Tests for Cointegration. *Oxford Bulletin of Economics and Statistics* 55, 313-328.

De, W. and P. M. Dirk. 1997. Real Estate Diversification Benefits. *Journal of Real Estate Research* 14. 117-135.

Granger, C. W. J. 1988. Some Recent Development in a Concept of Causality. *Journal of Econometrics* 39: 199-211.

Green, R. K. 2002. Stock Prices and House Prices in California: New Evidence of a Wealth Effect? *Regional Science and Urban Economics* 32:775-783

Dennis J. G., H. Hansen, S. Johansen, K. Juselius. 2005. CATS in RATS, Version 2, Estima.

Johansen, S. 1991. Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica* 59: 1551–1580.

Johansen, S., 1992. Testing Weak Exogeneity and the Order of Cointegration in UK Money Demand Data. *Journal of Policy Modeling* 14: 313-334.

Johansen, S. 2000. A Small Sample Correction for the Test of Cointegration Rank in the Vector Autoregressive Model. *Econometrica* 70: 1929-1961.

Johansen, S., and K. Juselius. 1990. Maximum Likelihood Estimation and Inference on Cointegration – with applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics* 52:169-210.

Kapopoulos, P. and F. Siokis. 2005. Stock and Real Estate Prices in Greece: Wealth versus Credit-Price Effect. *Applied Economics Letter,* 12: 125-128.

Kleiman, R. T., J. E. Payne and A. P. Sahu. 2002. Random Walks and Market Efficiency: Evidence from International Real Estate Markets. *Journal of Real Estate Research* 24, 280-297.

Lau J. 2010. Investors from Mainland snap up HK Property. *Financial Times* 14 October: 4.

Liu, P. and P. Leung. 2011. Even the rich must pay twice as much. *South China Morning Post* January 29, 2011.

Masih, A. M. M. and R. Masih. 1996. Modelling the Dynamics of Macroeconomic Activity: New Evidence from a Developing Economy. *Journal of Quantitative Economics* 12:85-105.

Muellbauer, J. and K. Murata. 2008. Consumption, Land Prices and the Monetary Transmission Mechanism in Japan. Paper presented at WSRI and the Center on Japanese Economy and Business (CJEB) at Columbia Business School, workshop on 'Japan's Bubble, Deflation and Long-term Stagnation', Columbia University, 21 March.

Muellbauer, J. and A. Murphy. 2008. Housing Markets and the Economy: the Assessment. *Oxford Review of Economic Policy* 24: 1-33.

Oikarinen, E. and H. Asposalo. 2004. Housing Portfolio Diversification Potentials in the Helsinki Metropolitan Area in the Short and Long Horizon. Series Discussion and Working Papers 11: 2004, Turku School of Economics and Business and Administration.

Pesaran, H., and Y. Shin. 1998. Generalized Impulse Response Analysis in Linear Multivariate Models. *Economics Letters* 58:17-29.

Phillips, P.C.B., and Z. Xiao. 1998. A Premier on Unit Root Testing. *Journal of Economic Surveys* 12:423-469.

Piazzesi M, M. Schneider and S. Tuzel. 2007. Housing, Consumption and Asset Pricing. *Journal of Financial Economics* 83:531-569.

Poterba, J. M. 2000. Stock Market Wealth and Consumption. *Journal of Economic Perspectives* 14(2):99-118.

Psaradakis, Z. 1994. A Comparison of Tests of Linear Hypotheses in Cointegrated Vector Autoregressive Model. *Economics Letters* 45: 137-144.

Sim, S. H. and B. K. Chang. 2006. Stock and Real Estate Markets in Korea: Wealth or Credit Price Effect. *Journal of Economic Research* 11: 105-126.

Tobin J., 1969. A General Equilibrium Approach to Monetary Theory. *Journal of Money, Credit and Banking* 1(1): 15–29.

Williams, J. E. 1996. Real Estate Portfolio Diversification and Performance of the Twenty Largest SMSAs. *Journal of Real Estate Portfolio Management* 2, 19-30.

Zhu H. 2003. The Importance of Property Markets for Monetary Policy and Financial Stability. Bank of International Settlement Papers, No.21.

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Important Note

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