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An Empirical Study of the Relationship between Economic Growth, Real Estate Prices and Real Estate Investments in Hong Kong

LHT Chui and KW Chau[1]

ABSTRACT

This study examines the lead-lag relationships between real estate prices, real estate investments, and economic growth. The results suggest that there is no relationship between GDP and real estate investment. This contradicts the results of similar previous studies in other economies. We propose that the lack of relationship is due to the significant variation in the project's duration in Hong Kong. The variation in project duration implies that the observed volume of real estate investment in any period represents the realization of investment decisions made at different points in time in the past.

The lack of a relationship between real estate investment and economic growth does not mean that changes in demand for real estate have no effect on economic performance. Since Hong Kong's real estate market is very efficient, changes in demand conditions in the real estate sector are reflected more accurately and quickly in real estate prices. Our empirical results show that real estate prices, especially office and residential prices, lead economic growth

The findings in this study have a number of implications. First, real estate prices, office and residential prices in particular, were found to lead GDP growth. Therefore, movements in real estate prices can be used to forecast GDP growth. Second, since real estate prices lead GDP, policies that stabilize residential prices are also likely to stabilize economic growth. Third, any policy that suppresses or deters the real estate sector, especially the residential sector, is likely to negatively affect economic performance. Similarly, any policy that stimulates real estate prices will also stimulate the economy.

In Hong Kong, the SAR Government has far more ability to influence real estate prices than aggregate demand, since the government is the only supplier of new developable land. For example, real estate prices will go up if land supply is restricted by the cessation of land sales, as investors would anticipate a lower supply of real estate units.

KEYWORDS

economic growth, leading indicators, real estate investment, real estate cycle

[1]*Department of Real Estate and Construction, The University of Hong Kong, Pokfulam Road, Hong Kong.*

Fax No: (852) 2559 9457, E-mail: hrrbckw@hku.hk

INTRODUCTION

Hong Kong is a densely populated city. Because of the limited land supply here, the real estate sector has played an important role in Hong Kong's economy. This is evidenced by the fact that the real estate sector and construction industry contribute to more than 20 percent of Hong Kong's GDP. In addition, more than 45 percent of the local listed companies are either real estate developers or investors, or are heavily involved in real estate development and investment. More than one-third of total government income is derived from real estate. Given the importance of the real estate sector in Hong Kong's economy, it is interesting to know how real estate demand and economic performance are related. There are two ways to measure real estate demand : by real estate investments or real estate prices. When demand for real estate increases, prices will rise and investors will increase their investments in it to meet demand. Therefore, real estate prices and real estate investments are directly proportional to real estate demand.

In the United States, real estate investment is a good measure of expected demand for real estate. However, this may not be the case in Hong Kong. On the other hand, economic performance is reflected in the Gross Domestic Product (GDP). If there is a leading relationship between GDP, real estate investments, and real estate prices, the real estate sector will be a leading sector of economic performance. Therefore, real estate investments and prices are good measures for reflecting expected real estate demand, and serve as good predictors of economic performance. However, there has been little empirical study on the relationship between GDP, real estate prices, and real estate investments in Hong Kong. Moreover, the restricted land supply and various planning and development controls in Hong Kong complicate the investigation of this relationship. The need to use time series data in the investigation also makes an empirical study problematic.

LITERATURE REVIEW

Since estate investment is a major form of investment expenditure, it is expected that it will be closely related changes in GDP. Green (1997) uses the Granger Causality test to examine the effect of these two kinds of investment on GDP. They found that residential investment Granger causes (leads) GDP, while investments in equipment and machinery do not. Podenza (1988) also found that downturns in housing starts occur before general downturns. Both of them share the view that residential investment, like stock prices and interest rates, is a good predictor of GDP. This is because real estate is durable asset that take a long time to produce and thus investing in real estate is a forward looking exercise. For example, if participants in the housing market anticipate a future downturn in activity, housing activity may decrease first in anticipation of this. Households will not increase their expenditures on housing unless they expect the housing market to prosper in the future. The empirical observation that housing activity "leads" downturns and upturns may thus be simply a reflection of this anticipatory behaviour in the housing market.

Green (1997) proposes another explanation for residential investment being the leading indicator of GDP. This requires the consideration of potential "exogenous forces" in residential investment that lead to economically exogenous movements. These are the income tax treatment of residential investment and regulatory treatment of housing finance institutions. Green suggests, for example, that if residential investment is given special treatment under tax law through accelerated depreciation and the generous treatment of passive losses and gains, more capital will be attracted to residential investment. Then, people who build would be given high paying jobs, and there would be a reasonably large multiplier effect over a period of several years that stimulates economic growth.

Green's (1997) causality results are strengthened by Coulson and Kim (2000). Their study confirms that GDP's response to a shock in residential investment is several times the magnitude of a response to a shock in investment in equipment and machinery. They suggest that residential shock explains far more of the variation in GDP than does a shock in equipment and machinery. Coulson and Kim extend their study of the causality to the components of GDP : consumption and government expenditure. The results show that both equipment and machinery and residential investments are caused by every component of GDP, except that the former appear to cause consumption while the latter do not.

Coulson and Kim's explanation of the relationship between residential investment and GDP is somewhat different from what Green (1997) argues in his study. Residential investment evidently Granger-causes consumption expenditure, which is the largest component of GDP in their model, so residential investment has a large effect on GDP itself (Coulson and Kim 2000). Although they gave an explanation why residential investment leads GDP, the reasons why residential investment leads consumption expenditure were not discussed. Moreover, the focus of these two studies in the United States is mainly on residential investment, and there have seldom been studies on how other real estate investments affect economic growth. The explanation suggested by these studies also does not take into account how fast real estate investments can adjust to a shakeup in the economy.

For studies on non-residential buildings and structures investment, Madsen (2002) adopted models that were based on the relative importance of demand and supply in prices and uantities. His test used a pooled cross section and time series data of 18 countries from 1950 to 1999. Madsen argues that if supply side factors have been more important for investment while demand side factors have not, then the causality direction goes from investment to economic growth, and vice versa. The results show that supply factors are not crucial to building investments, and building activity is predominantly driven by demand. Therefore, Madsen suggests that investment in non-residential buildings and structures is predominantly caused by economic growth.

In fact, there have been other studies on the relationship between real estate investment and the economy. Two of the most notable contributions arrived at virtually opposite conclusions. Aschauer (1989) argues, using a growth accounting framework for post-war U.S. data, that public infrastructure investment – virtually all of which is building investment – is a key component of growth, and that much of the post-1973 productivity slowdown can be attributed to cutbacks in public capital investment. On the other hand, DeLong and Summers (1991, 1992) and DeLong (1992), suggest that building investment has a negligible relationship with growth using purchasing power parity adjusted data. They even find a negative social return to investment in buildings. Ball and Wood (1995) report evidence of strong co-integrating relationships between productivity levels and fixed investment in both equipment and structures in the United Kingdom over the past 140 years. There is strong evidence of two-way Granger causality prior to 1938 between productivity levels and virtually all sub-categories of investment. For the postwar period, a long run error correction mechanism for productivity levels and equipment and structures investment is indicated when these are considered separately (Ball and Wood, 1995).

A similar study using the Granger Causality Test to investigate the lead-lag relationship between construction activity and the aggregate economy was conducted in Hong Kong by Ganesan and Tse (1997). The performance of the aggregate economy is proxied by GDP, while construction activity is measured using construction flow, which refers to new construction works and renovation and maintenance. The value of work put in place was measured from progress payments received during the reference period. However, the construction flow was not categorized into residential or commercial investment. Also, both GDP and construction flow are measured at

current prices (i.e., price changes were not taken into account).

The results of Ganesan and Tse's study demonstrate strongly that GDP tends to lead construction flow, but not vice versa, which is in contrast to the results of research in the U.S. and the U.K. Ganesan and Tse (1997) claim that the relationship between construction flow and GDP is analogous to the saving-income relationship. The national income identity does not imply that an increase in saving will lead to a higher GDP. It is believed that the initial impact of a change in GDP would be on the demand for construction projects and real estate rather than on the level of construction output because construction activity is very sensitive to credit conditions. If GDP rises, so will the level of construction activity needed to meet the expanded production capacity.

Ganesan and Tse (1997) also compare the volatility of construction flow and that of GDP. They show that construction flow is more volatile than GDP. Ball and Morrison (1995) argue that all types of fixed investment are considerably more volatile than national income. It is expected that short term growth rates of construction can easily fluctuate a lot due to changes in capacity utilization. Akintoye and Skitmore (1994) suggest that construction is a derived demand that is growth dependent. If markets are interdependent, disturbances in one market will be transmitted to other markets (Ganesan and Tse, 1997).

From these studies, there are two contrasting views on the lead-lag relationship between construction investments and GDP. Some hold the view that construction investments, especially residential investments, stimulate consumption and economic growth, and therefore residential investments lead GDP. On the other hand, some believe that construction activity is a derived demand that depends on economic performance, and thus they conclude that GDP leads real estate investments. However, most of the studies have focused on residential investments or real estate investments as a collective term without looking at how GDP affects each type of real estate investment separately.

GDP and Real Estate Prices

Englund and Ioannides (1997) compare the dynamics of housing prices in 15 countries, and discover that lagged GDP growth exhibits significant predictive power over housing prices. Hui and Yiu's (2003) study, which uses the Granger Causality Test to empirically test the market fundamental dynamics of private residential real estate prices in Hong Kong, confirms this result. It has been shown that residential prices leads GDP from 1984:Q1 to 2000:Q4, but not the opposite. The following reason is suggested by Hui and Yiu : GDP represents an overall change the economy, and is regarded as one of the market fundamentals that affect demand for private residential real estate. Also, GDP is affected by some market fundamentals. Since both price and GDP are expectation driven, they lag behind the release of information for market fundamentals.

At the same time, GDP is affected by residential prices (Hui and Yiu 2003). Another study done by Chau and Lam (2001) on speculation and property prices in Hong Kong reveals that nominal GDP is a leading indicator of housing price. The model which Chau and Lam used included the real interest rate, the percentage change in the lagged housing price, the marriage rate, the stock market index, housing supply, transaction volume, and an error correction term in order to control for other factors affecting housing prices. Nominal GDP is used in the model to capture the effects of inflation and economic growth, while housing price is the official residential index compiled by the Rating and Valuation Department (RVD). Chau (2001) suggest that due to the high land price policy and importance of the property sector in Hong Kong, its economic performance has been dependent on the performance of the property market, which means that property price leads economic growth and drives inflation.

Iacoviello (2003), in his study of consumption, housing prices, and collateral constraints, find a direct effect from housing prices to consumption

using the Euler equation for consumption. Then, according to Coulson and Kim (2000), as consumption forms a large part of GDP, it is reasonable to expect that housing prices will have a leading relationship to GDP.

Although the above mentioned studies have shown that GDP leads housing price, the main focus of these studies is not to investigate the relationship between GDP and housing price. Moreover, in Hui and Yiu's (2003) paper, the housing price used is in nominal terms rather than in real terms. This nominal housing price is used to investigate its relationship to constant GDP. In Chau's (2001) study, nominal GDP is used to investigate its relationship to the residential price index. There has been no study that has researched the relationship between real GDP and real estate prices. In most studies, only residential price has been investigated. There has also been no research done on the relationship between GDP and other property prices.

DiPasquale and Wheaton (1992) have shown that stock adjustment is much slower then price adjustment in real estate market when there is an external shock. Their results suggested that the stock coefficient in their model, which represents the speed in which the stock adjusts through new construction, was two percent, while that of the price coefficient was much higher, meaning that the price adjusts much faster than the stock. Therefore, it is not surprising that any external shock to the economy will be reflected in price first.

Ganesan et. al. (1999) supports the idea that housing price is a leading indicator of housing supply. They observed that housing demand in Hong Kong dropped instantly after the Tiananmen Square incident in 1989 and the Gulf War in 1991, but housing supply was only adjusted in the years following these incidents. They therefore suggested that there is a lag effect on the adjustments of housing supply. The short run supply of housing is also fairly inelastic because housing supply is based on current completions that will continue, and cannot be changed within a short period of time. Unlike housing supply, it is possible for housing demand to change suddenly due to external changes. Ganesan et. al. agrees that fluctuations in demand should manifest themselves primarily in changes in the price of housing and much less so in the supply of housing.

RESEARCH ISSUES

Does Real Estate Investment Lead GDP?

Green (1997) and Coulson and Kim (2000) have shown that residential investment is a leading indicator of GDP in the United States. Their result suggest that the residential sub-sector is a leading sector of the economy, and that changes in housing demand are ahead of changes in aggregate demand. Green (1997) proposes that this trend is due to forward looking behaviour (the forward looking effect) and the potential "exogenous forces" in residential investment that lead to the economically exogenous movements (the external shock effect). These forces are the income tax treatment of residential investment and regulatory treatment of housing finance institutions. If residential investment is given favourable tax treatment, more capital will be attracted and people will be given high-paying jobs. When people become wealthier, they will spend more and stimulate economic growth (the wealth effect). Therefore, an increase in residential investment will lead to economic growth (this is in contrast to the "income effect," which suggests that people's demand for housing increases when their incomes increases). This explanation is confirmed by Coulson and Kim (2000). They find that residential investment actually Granger causes private consumption, which is the largest component of GDP. Therefore, it can be said that any external shock will be reflected in the demand for real estate first, which will be reflected in residential investments in the U.S. Given that the changes in real estate investment reflects changes in demand for real estate, the "wealth effect" implies that residential investment leads GDP, while the "external shock effect" and "forward looking effect" imply that the non-residential sector investment, (i.e., office,

retail, and industrial buildings) will also lead GDP.

Unlike the US, real estate investment in Hong Kong is unlikely to be a good predictor of GDP. This is mainly because of the differences in the land development processes between the two places. Unlike the U.S., Hong Kong is a densely populated city with a limited supply of land. The government is the sole owner of all land in Hong Kong. It has a monopoly over the release of new and previously undeveloped land through the leasehold land tenure system. Thus, land development is not at the sole discretion of developers in Hong Kong. Rather, it is subject to numerous supply and development controls. Developers have to bid for land in land sales, apply for planning applications or lease modifications for redevelopment, or purchase land with multiple owners. Therefore, there is a significant time lag between the decision to invest (triggered by an increased demand) and the actual realization of the investment. More importantly, the time lag varies significantly depending on the scale of development, type of real estate, location, and other characteristics.

The land development period in Hong Kong is much longer than that in the U.S. A decision to develop may be made a few years before actual construction takes place because in Hong Kong, real estate investments in one time period are actually a mix of development decisions made during different time periods that present different demands. The level of real estate investments in one time period cannot reflect a just-in-time demand for real estate. This is in contrast to the situation in the U.S., where single house developments are common and developers are subject to fewer planning and development controls. The time lag between the decision to invest in residential real estate and the actual realization of such an investment is relatively uniform and not too long in the U.S.

The major part of real estate investment expenditure is construction cost. However, construction cost only constitutes about 30% of a typical development (due to high land prices in Hong Kong). This means that once a project has started, it is more economical to finish it even if demand for it has declined significantly.

Do Real Estate Prices Lead GDP?

Previous studies suggested that real estate prices (in particular residential prices) are leading indicators of GDP (e.g. Chau, 2001). This is the case in Hong Kong, since real estate prices reflect changes in demand for real estate more quickly. In addition, a high land price policy and the significance of real estate in Hong Kong make its economy dependent on the performance of the property market. The major form of wealth for most Hong Kong people is their homes. On average, the value of a residential unit is worth more than 20 years of an average homeowner's real household income. This means that the "wealth effect" is likely to be more important in Hong Kong.

Previous studies also suggested that Hong Kong's real estate market (especially the residential market) is very efficient. If the real estate market is efficient, it is reasonable to expect that any external shock will be reflected in real estate prices faster than in the GDP.

Moreover, investors / developments' forward looking behavior will also be reflected in changes in real estate prices. If an investor foresees an increase in demand, his / her decision to invest in real estate will drive prices up, and such changes in real estate prices will lead economic growth.

Amongst all the real estate sub-sectors : residential, office, retail, and industrial, residential price is expected to show the strongest leading relationship to GDP due to its considerably larger volume of transactions than the other sub-sectors. Residential properties constitute more than 80% of all property transactions in Hong Kong.

Do Real Estate Prices Lead Real Estate Investments?

Since the level of real estate investments cannot be increased or decreased overnight in Hong Kong, neither can it adjust itself immediately after an external shock. Housing demand in

Hong Kong dropped instantly after the 4 June 1989 incident and the Gulf War in 1991, but housing supply only adjusted in the years following these incidents (Ganesan, et. al., 1999). Thus, it is reasonable to expect that real estate price movements are ahead of real estate investments. However, since the lead times for different projects vary significantly, there may not be any observable lead-lag relationship between real estate prices and real estate investments.

DATA

The data series for testing the lead-lag relationships between economic growth, real estate investment, and estate prices of different sub-sectors were obtained from the RVD and the Census and Statistics Department of the Hong Kong SAR Government. Economic growth was measured by growth in de-seasonalized GDP in real terms. The real estate sub-sectors investigated were the residential, office, retail, and industrial sub-sectors.

The RVD price indices were compiled based on transaction evidence. The reliability of a transaction based index depends on the trading volume and the method of controlling for those attributes that influence price. In Hong Kong, the volume of real estate transactions in relation to the size of the total stock of real estate is relatively high compared to most other cities. The high trading volume is attributable to the dynamic nature of Hong Kong's economy and simple taxation system. There is no capital gains tax, and transaction costs are relatively low (Brown and Chau, 1997). The small size of Hong Kong and the relatively short economic life of buildings tend to reduce any error in the price index from arising due to possible bias caused by adjusting average transaction prices for differences in those factors that affect price. Moreover, the mortgage policy adopted by most banks in Hong Kong discriminates against older buildings (Chau and Ma, 1996). More favourable terms will normally be given to buildings not more than ten years old. The result of this policy is that most properties transacted in the market are less than ten years old. These factors tend to make the market more homogeneous (Brown and Chau, 1997).

Real estate investments are divided into two 0categories (i.e., residential and non-residential investments). These investments are further divided into public and private investments. Real estate price indices for the residential, office, retail, and industrial sub-sectors are available and used in this study. All data is quarterly time series data. These variables and their symbols are listed in Table 1. The summary statistics of the variables presented in Table 2.

Table 1 Symbols of the Time Series Variables

Variable	Symbol
GDP in Real Terms	**GDP_R**
Residential Price	**RP**
Office Price	**OFFP**
Retail Price	**RETP**
Industrial Price	**INDP**
Private Residential Investment	**RIPR**
Public Residential Investment	**RIPU**
Private Non-residential Investment	**NIPR**
Public Non-residential Investment	**NIPU**

Table 2 Summary of Statistics of the Variables in Level Terms

Variable	Minimum	Maximum	Mean	Std Dev
GDP_R	18.30	109.70	58.69	27.70
RP	15.20	433.00	138.94	111.72
OFFP	24.00	230.00	95.78	58.68
RETP	35.00	413.00	154.11	100.66
INDP	36.00	192.00	91.81	47.09
RIPR	19.54	103.43	53.45	23.84
RIPU	3.43	102.22	37.80	21.38
NIPR	41.18	311.95	154.76	61.32
NIPU	5.47	160.35	61.12	35.48

Real estate price indices were obtained from the RVD. The indices are the composite quarterly index for a certain type of premises. Types of private sector premises include residential, office, retail, and industrial. The composite quarterly index is compiled by calculating a weighted average of the component indices (the indices for a property class or grade) that have been derived from an analysis of all transactions effective in a given quarter. The premises are categorized according to the use for which the occupation perm it was originally issued. The indices measure value changes by reference to the factor of price divided by the rateable value of the subject properties such that allowance is not only for made for floor area, but also other qualitative differences between properties.

The real estate investments were obtained from the expenditure GDP series. They are major components of investment expenditure, and classified into private and public sectors. Under each sector, the real estate investments were further categorized into residential and non-residential buildings. Real estate investment includes payment to contractors and other expenses directly related to property developments, architectural design, and technical consultancy services.

The data series are tested for seasonality and stationarity. Granger causality test are then performed to test for lead-lag relationship.

EMPIRICAL RESULTS

The Augmented Dickey-Fuller (ADF) Test showed that the deseasonalized trend was I(1). Table 3 shows the ADF test statistics. The optimal lag is 4 for all series.

Table 3 Results of the Unit Root Test on growth rates

Variable	1 Lag	2 Lag	3 Lag	4 Lag
GDP_N	**-6.04***	**-5.14***	**-7.46***	**-7.92***
GDP_R	**-9.81***	**-5.82***	**-4.40***	**-4.65***
RP	**-5.16***	**-5.91***	**-8.36***	**-5.90***
OFFP	**-4.77***	**-4.40***	**-6.30***	**-4.71***
RETP	**-5.00***	**-5.18***	**-7.31***	**-4.64***
INDP	**-5.09***	**-3.10**	**-5.21***	**-8.05***
RIPR	**-8.55***	**-5.61***	**-7.06***	**-7.48***
RIPU	**-8.02***	**-5.89***	**-7.22***	**-6.84***
NIPR	**-6.66***	**-5.70***	**-8.27***	**-5.87***
NIPU	**-8.41***	**-5.82***	**-8.05***	**-8.05***

* MacKinnon critical values for the rejection of the hypothesis of a unit root at 1%

** MacKinnon critical values for the rejection of the hypothesis of a unit root at 5%

*** MacKinnon critical values for the rejection of the hypothesis of a unit root at 10%

The Granger Causality Test

The Granger Causality Test was first performed with six lags, according to the experimental results in Guilkey and Salami (1982). The test was then performed with four lags and five lags to confirm the robustness of the results. Table 4 shows the results of the Granger Causality Tests on real GDP and Real Estate Investments

The p-values of the Granger Causality Test on each pair of variables were higher than 0.1, except on GDP_R and NIPR. This meant that most of the null hypotheses could not be rejected, except for the null hypothesis "GDP_R does not Granger cause NIPR". Hence, there was no evidence that real estate investment leads GDP. The result was quite robust and not sensitive to the choice of lags around the optimal lag. The results were different from those in the U.S., but were within expectations. The results confirmed that real estate investments are not good leading indicators of economic performance.

Table 4 Results of the Granger Causality Test on GDP_R and Real Estate Investments

	4 Lag	5 Lag	6 Lag
	Probability	Probability	Probability
GDP_R does not Granger RIPR	0.93514	0.92038	0.95474
RIPR does not Granger cause GDP_R	0.23183	0.15155	0.20874
GDP_R does not Granger cause RIPU	0.39756	0.39569	0.21699
RIPU does not Granger cause GDP_R	0.71888	0.63397	0.53636
GDP_R does not Granger cause NIPR	0.01546*	0.01053*	0.01998*
NIPR does not Granger cause GDP_R	0.12168	0.24060	0.64147
GDP_R does not Granger cause NIPU	0.72259	0.87575	0.90557
NIPU does not Granger cause GDP_R	0.98664	0.97099	0.96844

* Rejection of the null hypothesis

Table 5 shows the result of the Granger Causality Test between real estate prices and GDP. The result shows that GDP_R was Granger caused by RP and OFFP, but not vice versa. No lead-lag relationship was found between RETP and GDP_R. These results were within expectations. Residential price and office price are both leading indicators of economic growth.

Table 5 Results of the Granger Causality Test on GDP_R and Real Estate Prices

	4 Lag	5 Lag	6 Lag
	Probability	Probability	Probability
RP does not Granger cause GDP_R	0.05366*	0.02881*	0.02703*
GDP_R does not Granger cause RP	0.74581	0.51182	0.16580
OFFP does not Granger cause GDP_R	0.01057*	0.00051*	0.01286*
GDP_R does not Granger cause OFFP	0.34834	0.45330	0.51047
RETP does not Granger cause GDP_R	0.39362	0.48037	0.59321
GDP_N does not Granger cause RETP	0.30130	0.27993	0.41169
INDP does not Granger cause GDP_R	0.09771*	0.07661*	0.13992
GDP_R does not Granger cause INDP	0.16211	0.15080	0.21575

* Rejection of the null hypothesis

Table 6 shows the results of the Granger Causality Test on Real Estate Prices and Real Estate Investments. Most p-values obtained from the Granger Causality Test were greater than 0.1, indicating that most null hypotheses could not be rejected at all lags. There were some exceptions to the results. Both RETP and INDP led NIPR, and the feedback relationship did not exist. The results were again within expectations due to variations in the lead time for different project types.

Table 6 Results of the Granger Causality Test on Real Estate Prices and Real Estate Investments

	4 Lag	5 Lag	6 Lag
	Probability	Probability	Probability
RP does not Granger cause RIPR	**0.44152**	**0.44152**	**0.58055**
RIPR does not Granger cause RP	**0.55571**	**0.55571**	**0.63249**
RP does not Granger cause RIPU	**0.79040**	**0.84357**	**0.68586**
RIPU does not Granger cause RP	**0.39196**	**0.44160**	**0.43098**
OFFP does not Granger cause NIPR	**0.34358**	**0.30734**	**0.40619**
NIPR does not Granger cause OFFP	**0.91944**	**0.87196**	**0.93372**
OFFP does not Granger cause NIPU	**0.12151**	**0.22224**	**0.29134**
NIPU does not Granger cause OFFP	**0.96964**	**0.95933**	**0.95859**
RETP does not Granger cause NIIPR	**0.09951***	**0.06236***	**0.10413**
NIPR does not Granger cause RETP	**0.95010**	**0.96498**	**0.96629**
RETP does not Granger cause NIPU	**0.83151**	**0.87904**	**0.84446**
NIPU does not Granger cause RETP	**0.62168**	**0.66169**	**0.63908**
INDP does not Granger cause NIPR	**0.13279**	**0.03451***	**0.04634***
NIPR does not Granger cause INDP	**0.77895**	**0.70503**	**0.52675**
INDP does not Granger cause NIPU	**0.18812**	**0.31207**	**0.40611**
NIPU does not Granger cause INDP	**0.97459**	**0.94748**	**0.78960**

* Rejection of the null hypothesis

CONCLUSION

This study examined the lead-lag relationships between real estate prices, real estate investments, and GDP. The results suggested that during the period 1973:Q1 to 2003:Q2, there was no relationship between GDP and real estate investments. This contradicted the findings by Green (1997) and Coulson and Kim (2000), which used data from the United States. This was, however, consistent with our expectations. Due to the time lag between the decision to invest in real estate and the realization of the investment that varies significantly across development projects in Hong Kong, the observed real estate investment during any period represents a realization of a mix of investment decisions made at different points in time with significant variations in demand conditions. This makes real estate investments inappropriate measures of expected demand for real estate, and thus are poor predictors of GDP.

This result was further supported by the Granger Causality Test on the relationship between real estate prices and real estate investments, which showed no lead-lag relationship between prices and the volume of investment of different types of real estate. This provides further evidence that real estate investments are not good measures of a market's expected demand for real estate at any point in time. This however, does not mean that real estate demand has no effect on economic performance. Since Hong Kong's real estate market is very efficient, changes in demand are reflected more accurately and quickly in real estate prices. The Granger Causality Test results show that real estate prices, especially residential price, exhibit a strong leading relationship with GDP.

The findings in this study have important policy implications. Real estate prices, residential prices in particular, were found to lead GDP. Therefore, movements in residential prices can be used to forecast GDP growth. Second, since residential prices lead GDP, policies that stabilize residential prices will also stabilize economic growth. Third, any policy that suppresses or deters the real estate sector, especially the residential sector, is likely to negatively affect economic performance. Similarly, any policy that stimulates real estate prices will also stimulate the economy.

In Hong Kong, the SAR government has far more influence on residential prices than on aggregate demand through its land supply and housing policies. For example, residential prices will go up if land supply is restricted by the cessation of land sales, as investors anticipate a lower supply of residences in the future. Also, the cessation of public housing construction will increase demand for private housing because of the substitution effect, which will, in turn, increase residential prices. However, the government has less power to influence aggregate demand through monetary policy due to the current board system. Moreover, according to Article 107 of the Basic Law, the SAR is required to maintain a balanced budget. Thus, it is also difficult for the government to influence aggregate demand through fiscal policy. In order to minimize the effects of external shocks and maintain sustainable stable economic growth in the long run, the government should aim to stabilize real estate prices.

Due to insufficient observations after 1997, it is not possible to test the presence of structural breaks in this study. This is a potential area for further study in the future when more observations are accumulated. A structural break test can be performed to investigate if there has been any structural break. In addition, the RVD indices can be replaced by transaction-based indices that are constructed using the repeat sales or hedonic pricing models. A further area for research is the investigation of leading indicators of real estate prices.

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