LINKAGES BETWEEN MALAYSIAN HOUSING PRICES, PROPERTY COMPANIES AND STOCKS

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ABSTRACT

Although the relationships between house prices, property companies and stocks have received considerable attention in developed markets, little study has been undertaken in emerging markets. Therefore this study aims to investigate the linkages between the Malaysian housing market, property companies and stocks by using a vector-autoregressive model (VAR) over the study period 1999-2009. The results reveal a uni-directional relationship between housing prices, property companies and stocks. Specifically, property companies and general stocks Granger cause the housing market, whereas there is no evidence to support that property companies and stocks will incorporate the information spillover from the housing market. These findings offered some insights into the dynamic behaviour of housing prices, particularly in a developing country context.

Keywords: Housing prices, property companies, stocks, VAR and Malaysia.

INTRODUCTION

There is an extensive literature on price discovery between direct property and indirect property in developed markets such as the United States (US), United Kingdom (UK) and Australia. However, few studies have examined the linkages between these assets in developing markets that have different institutional and market structures. Thus, this study aims to examine the causality linkages between Malaysian house prices, listed property companies and stocks.

Malaysia is one of the leading developing economies. Despite the global financial crisis, the Malaysian economy has contracted moderately by 1.7% in 2009, as the recovery strengthened in the second half of the year. In 2009, however, many developed economies had experienced the sharpest contraction since the Second

World War, such as the US (-2.4%) and the UK (-5%) (CBM, 2010). Hence, the Malaysian economy did perform better than these markets during the global financial crisis. In addition, the Malaysian property market is categorised as one of the transparent markets in the world (JLL, 2010). This property market is considered as an emergent property market that is improving towards a mature level (Chin and Dent, 2005). Therefore, Malaysia provides an interesting arena for examination.

In Malaysia, residential property has been recognised as an important component of a household's overall wealth; particularly where 85% of Malaysian households own a house (GPG, 2010). The rate is considerably higher than many developed markets such as Australia (69%) and the US (67%) (GPG, 2010; US Census Bureau, 2010). The high home ownership rate has attracted many property companies to be involved in housing developments (Ting, 2002). There are currently 88 property companies listed on Bursa Malaysia. Among the large capitalised listed property companies (or known as property shares) are UEM Land Berhad, SP Setia Berhad, KLCC Property Holding Berhad, IGB Corporation Berhad, IJM Land Berhad etc. Panel A of Table 1 shows the market capitalisation of the top 5 Malaysian listed property companies.

Table 1: Major property companies and their township development projects

Panel A: Top 5 listed property companies: September 2010

Property companies	Market price (RM)	Market capitalisation (RM million)	PE Ratio	Dividend Yield (%)
UEM Land Bhd	1.81	6,592	46.6	0.0
SP Setia Bhd	4.24	4,311	25.2	3.3
KLCC Property Bhd	3.25	3,036	4.7	3.4
IGB Corporation Bhd	1.85	2,757	17.1	1.4
IJM Land Bhd	2.28	2,526	23.1	0.9

Panel B: Listed property companies and their township projects

Property companies	Township projects
Dijaya Corporation Bhd.	Tropicana Golf & Country Resort (625 acres)
E&O Property Bhd.	Seri Tanjung Pinang (1,000 acres)
IJM Land Berhad	Seremban 2 (2,300 acres), Shah Alam 2 (1,163 acres)
SP Setia Bhd	Setia Alam (2,300 acres), Bukit Indah (1,509 acres), Setia Indah (888 acres), Setia Eco Park (791 acres), Setia Tropika (740 acres)
Asia Pacific Land Bhd	Bandar Tasik Puteri (2,670 acres)
UEM Land Bhd.	Bandar Seri Alam (3,700 acres), Bandar Seri Putra (898 acres), Seri Austin (500 acres)
Equine Capital Bhd.	Equine Park, Putra Permai, Permai Park and Pusat Bandar Putra Permai (900 acres)
Paramount Corporation Bhd.	Kemuning Utama (525 acres), Bandar Laguna Merbok (493 acres)
Glomac Berhad	Bandar Saujana Utama (1,000 acres), Sri Saujana (450 acres)

Sources: Miscellaneous annual reports and Starbiz(2010).Note: A$1=RM2.98 (September 2010)

The majority of these companies are property development companies which are heavily involved in property developments of residential townships. Township developments are defined as those housing developments involving land size of 500 acres or more and/or a development period of ten years or more. Panel B of Table 1 exhibits the list of several major listed property companies and their current township developments. Importantly, Bursa Malaysia has a listing requirement for all property shares in which the companies should have a land bank of a minimum at 1,000 acres (or 405 hectares) and sufficient projected earnings and aggregate after tax profit of more than RM30 million for the first five years from their listing (KLSE, 2001).

Another important feature of Malaysian listed property companies is that many of these companies are subsidiaries of plantation companies. This feature has ensured a continuous supply of agricultural land from their parent companies that could be converted to residential townships. Importantly, listed property companies also account for 5% of the total market capitalisation of Bursa Malaysia. Several listed property companies are also on the list of 100 largest companies of the Kuala Lumpur Composite Index (KLCI) (The Star, 2010).

Given the significance of listed property companies in housing development, it is reasonable to expect that there is a causality link between house prices and listed property companies, since these markets could respond to a similar set of market fundamentals. However, the connection between housing prices and listed property companies has not been well evaluated, particularly in an emerging market context, although information transmission between commercial properties and REITs has been extensively investigated in developed markets (Myer and Webb, 1994; Pagliari and Webb, 1995).

There is also a large literature that has examined the price interaction between real estate and the broader stock market (Ling and Naranjo, 1999; Quan and Titman, 1999), while no attempt has been made to assess the linkages between Malaysian residential properties and stocks. It should be noted that numerous large companies in Malaysia (e.g. IOI Corp, IJM Corp, Sime Darby, YTL Corporation) have large exposure to residential development through their listed property development subsidiaries. Given the significant exposure of general stocks to housing development, stocks could be interrelated with the housing market.

This study aims to present a comprehensive investigation of the information transmission mechanism of Malaysian residential property. Specifically, the linkages between Malaysian housing prices and listed property companies are examined. In addition, the interaction between Malaysian housing prices and stocks is also investigated in this study. The contributions of this study are twofold. Firstly, the linkages between housing prices and both listed property companies and general stocks are examined for the first time in the Malaysian context. Malaysia, being an

emerging market, is not fully integrated with the world market. Thus, previous studies in developed markets would not necessarily be generalised into the emerging market. More importantly, Bursa Malaysia provides a unique dataset to examine this issue as many listed property companies are involved with large scale housing development townships. Therefore, an enhanced understanding of linkages between housing prices and both listed property companies and stocks is critical for a variety of investment and risk management decisions, particularly for Malaysian investors. Secondly, it is one of limited studies to examine the linkages between different types of residential property and indirect property. The findings of this paper are important for policy makers, particularly those from developing countries in formulating their housing policies.

The remainder of this paper is organised as follows. Section 2 reviews the related literature. The data and methodology of this study are discussed in Section 3. Section 4 reports and discusses the results. The final section concludes the paper.

LITERATURE REVIEW

The issue of information transmission between direct property and indirect property have received substantial attention in the literature. In the real estate literature, it has been widely studied and supported that indirect property leads the commercial property market. Gyourko and Keim (1992, 1993) offered the evidence that US REIT returns have strong explanatory power to direct property returns. Barkham and Geltner (1995) found that property companies and REITs lead commercial property. They also documented lags of up to one year in the UK and two years in the US by property companies and REITs over commercial property. As highlighted by Geltner *et al.* (2003), securitised real estate has a high degree of liquidity and constantly incorporates information into prices quicker than direct property. Therefore, indirect property would lead direct property. In Asia, comparable results are demonstrated by Ong (1994) and Newell and Chau (1996) in the Singapore and Hong Kong property markets respectively. More recently, Hui *et al.* (2007) found that office property is lag behind about three months by property companies in Hong Kong. Newell *et al.* (2009) examined the linkages between direct commercial property (office and retail) and indirect property markets for China and six Asian markets (i.e. Hong Kong, Singapore, Thailand, Indonesia, Malaysia and Philippines). Interestingly, they only found Granger-causality between the direct and indirect property markets in Indonesia.

In contrast, the relation between residential property and indirect property is largely ignored in the literature. There are few studies on apartment properties. He (2000) found a feedback causality relationship between unsecuritised apartment returns and apartment REIT returns. Recently, Nishigaki (2007) has offered evidence of a positive correlation between US REIT returns and house prices. The empirical results of Liang

et al. (1996) have shown that a considerable amount of the volatility of US apartment real estate can be attributed to the hedged apartment REIT index. Furthermore, their results also demonstrated diversification benefits and return enhancement of residential properties in mixed-asset portfolios.

Numerous studies have also demonstrated the causality linkages between house and stock prices. Chen and Patel (1998) found a bilateral relationship among stocks and house prices, suggesting that investors would hold both assets in their portfolios. Kapopoulos and Siokis (2005), however, examined the relationship between stocks and housing prices in Greece. The results showed that stock prices Granger caused house prices, but not in the other direction. They also attributed the finding as a wealth effect in which households would increase their housing investment holdings with the unanticipated gains in share prices. Jud and Winkler (2002) also explored this issue in the US housing context. The results also suggest that stocks impart wealth effects on the housing market. Kakes and Van Den End (2004) also found that the Dutch stock market is the determinant of Dutch house prices. Importantly, comparable results based on the data of six developed countries (the US, the UK, Canada, Australia, Ireland and the Netherlands) are identified by Sutton (2002). In contrast, Sim and Chang (2006) offered contrary results, in which they found a credit effect in which house prices Granger caused stock prices in Korea. Liow (2006) found a contemporaneous long-term relationship between the stock, residential and office property markets in Singapore.

In summary, although few studies have examined the price discovery between residential real estate and REITs in the real estate literature, little attempt has been devoted to examine the linkage between listed property companies and house prices. This is due to, in part, the limited dataset. It should be noted that REITs are the most common types of securitised real estate in many developed markets such as the US and Australia. However, Malaysian REITs have little exposure to residential properties (Newell *et al.*, 2002; Lee and Ting, 2009). Furthermore, previous studies on wealth effects have focused mainly on developed markets, whereas little study has been undertaken in an emerging market such as Malaysia. In addition, the information transmission mechanisms between different residential sectors and share prices are rarely evaluated in previous studies.

DATA AND METHODOLOGY

Data

To assess the causality relationship between housing and both property shares and stocks, the study utilised the quarterly returns of housing, listed property companies and stocks over the study period from 1999:Q1 to 2009:Q2. The data were obtained

from the Malaysian National Property Information Centre (NAPIC) and DataStream for the following:

- Housing – Malaysian Housing Price Index (MHP)
- Property shares – Bursa Malaysia Properties Index (BM Prop)
- Stocks – FTSE Bursa Malaysia KLCI Index (KLCI)

It should be noted that the Malaysian Housing Price Index is a transaction-based housing index. Therefore, the issue of smoothing that is commonly found in valuation-based real estate indices is irrelevant in this case.

Methodology

Augmented Dickey-Fuller and Phillips-Person tests were performed in order to examine the stationarity of all series. The results indicate that all return series are stationary at the 5% significance level. In other words, no evidence of a unit root is presented in these series.[1] Therefore, a standard Vector Autoregressive Model (VAR) was employed to examine the causality linkages among housing, property shares and stocks. Each pair of the Malaysian Housing Price and Bursa Malaysia Properties indices is examined by the following VAR models:

$$MHP_t = a_1 + \sum_{i=1}^{n} \beta_i BM\ \mathrm{Prop}_{t-i} + \sum_{j=1}^{m} \gamma_j MHP_{t-j} + \varepsilon_{1,t} \quad (1)$$

$$BM\ \mathrm{Prop}_t = a_2 + \sum_{i=1}^{n} \theta_i BM\ \mathrm{Prop}_{t-i} + \sum_{j=1}^{m} \delta_j MHP_{t-j} + \varepsilon_{2,t} \quad (2)$$

where MHP is quarterly growth rate of housing index, $BM\ \mathrm{Prop}$ is quarterly return series of listed property companies.

In contrast, the relationship between housing prices and stocks is investigated as follows:

$$MHP_t = a_1 + \sum_{i=1}^{n} \vartheta_i KLCI_{t-i} + \sum_{j=1}^{m} \lambda_j MHP_{t-j} + \varepsilon_{1,t} \quad (3)$$

$$KLCI_t = a_2 + \sum_{i=1}^{n} \alpha_i KLCI_{t-i} + \sum_{j=1}^{m} \chi_j MHP_{t-j} + \varepsilon_{2,t} \quad (4)$$

where $KLCI$ is quarterly return series of stocks.

An appropriate lag selection was performed for each VAR model. Akaike Information criterion and Schwarz Bayesian criterion were employed to select the appropriate lag

[1] The results are available from the authors.

length[2]. To shed more light on the VAR results, we also conducted Granger causality tests to examine the possible causality among these assets. Specifically, the tests determine whether (1) the MHP index leads the BM Prop Index (KLCI Index) or (2) the BM Prop Index (KLCI Index) Granger causes the MHP Index or (3) there is a strong bi-directional linkage between both assets.

Thereafter, a variance decomposition analysis was also performed to test the sources of variability. The analysis gives the proportion of the movements in the dependent variable that is due to its "own" shocks and shocks to the other variables. In other words, it breaks down the variance for each variable into components that can be attributed to each of the endogenous variables. Summary statistics for these series are tabulated in Table 2.

Table 2: Descriptive statistics

Variable	Mean (%)	Standard deviation (%)	Maximum (%)	Minimum (%)	Skewness	Kurtosis
Houses	3.255	2.059	13.080	-7.320	0.273	3.555
Property shares	1.049	34.673	267.752	-100.951	1.455	6.544
Stocks	7.274	26.608	233.338	-74.339	1.766	9.107

Notes: The first two moments (mean and standard deviations) are expressed in percentage form and are annualised figures. The skewness and kurtosis statistics have a value of 0 for a normal distribution and these statistics give a preliminary indication of the normality of these series.

As depicted in Table 2, the average return of housing prices over this study period was around 3.3%, compared to stocks (7.3%) and property shares (1.1%). The standard deviation statistics have further shown the defensive characteristics of Malaysian houses in which housing was the sector with the lowest risk level (2.1%), compared to stocks (26.6%) and listed property companies (34.7%). Skewness and kurtosis statistics also show that these series are positively skewed and reveal excess kurtosis, although these features are less pronounced for the housing market. These suggest that the distributions of these series are not normally distributed[3].

[2] The results were not reported for brevity.

[3] LM tests were also performed to examine the presence of volatility clustering effect in the series. However, little evidence of volatility clustering effect was found in the series, indicating that volatility modelling of housing prices by a GARCH model could be a vain exercise. Thus, the GARCH analysis was not undertaken in this study. The importance of the volatility clustering effect in GARCH modelling has been discussed by Miles (2008).

RESULTS AND DISCUSSION

Correlation analysis

Correlation analysis was first performed to examine the inter-asset linkages between houses, property shares and stocks. The results are expected to provide some preliminary insights into the connections between these asset classes. The correlation coefficients among these assets are exhibited in Table 3.

Table 3: Correlation analysis

	Houses	Property shares	Stocks
Houses	1.000		
Property shares	0.309*	1.000	
Stocks	0.246	0.886*	1.000

Note: * denotes significance at the 5% level

A significant correlation coefficient is evident between housing prices and property shares. However, no similar evidence is found between stocks and housing assets, suggesting that there is some diversification benefit for including residential properties in a stock portfolio. In addition, property shares and stocks are heavily correlated (r=0.89), indicating that the movements in both assets are strongly associated and little diversification benefit of property shares is available for stock investors. In summary, property shares are strongly correlated with housing prices, implying that the movement of property shares has a strong influence on housing prices.

Vector autoregressive analysis

Although the above section has provided some preliminary results on the linkages among these assets, the causality directions between housing prices and property shares, as well as stocks should also be addressed. Therefore, the causality relations among these assets were examined by performing a vector autoregressive analysis (VAR). The empirical results of housing prices and property shares are reported in Table 4.

Table 4: VAR and Granger causality tests: house prices and property shares

Panel A: Granger causality test

Test	Chi-square	Probability
Property Shares cause House Prices	6.347	0.042
House Prices cause Property Shares	0.278	0.870

Panel B: VAR model

	Houses	Property shares
Intercept	0.011	0.003
	(3.949)***	(0.092)
Houses $_{t-1}$	-0.310	-1.077
	(-1.795)*	(-0.453)
Houses $_{t-2}$	-0.066	-0.868
	(-0.391)	(-0.372)
Property shares $_{t-1}$	0.020	0.192
	(2.007)*	(1.428)
Property shares $_{t-2}$	0.015	0.176
	(1.518)	(1.264)
R^2	0.296	0.442

Notes: A VAR model with 2-lag was performed. The specification was selected based on the results of AIC and SIC. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Panel A of Table 4 reveals the results of the Granger causality test based on the VAR analysis. The chi-square statistic of the first test is 6.347 with a probability value of 0.042, suggesting that property shares Granger cause residential property. Nonetheless, no similar evidence is found to support the statement of housing prices Granger causing property shares. In other words, there is a uni-directional relationship between property shares and housing prices. These results are intuitively appealing in which listed property companies are more updated and efficient in terms of handling current market information. It is, therefore, not surprising that the information of property shares would be transmitted to the housing market, but not vice versa.

The estimated results of the VAR analysis are displayed in Panel B of Table 4. The coefficient estimate of property shares $_{t-1}$ is statistically significant at the 10% level, indicating that housing prices were positively related to the past realisation of property shares. This result suggests that property shares do convey the information about house prices. More importantly, the pricing of the housing market will incorporate the information from listed property companies. The result has some important practical implications to property analysts, which they should monitor and incorporate the

information from listed property companies in their analyses in the light of property shares are more efficient than the housing market. On the other hand, the BM Prop Index is insignificant, related with the past realisation of housing prices and its own past returns. The results are consistent with the results of the Granger causality test and support the informational efficiency hypothesis for indirect property. The results also provide some indirect support for the finding of Li *et al.* (2009) in the US commercial property market.

Table 5: VAR and Granger causality tests: house prices and stocks

Panel A: Granger causality test		
Test	**Chi-square**	**Probability**
Stocks cause House Prices	10.824	0.005
House Prices cause Stocks	0.241	0.887
Panel B: VAR model		
	Houses	**Stocks**
Intercept	0.010	0.008
	(3.985)***	(0.287)
$Houses_{t-1}$	-0.366	-0.770
	(-2.178)**	(-0.431)
$Houses_{t-2}$	-0.051	0.200
	(-0.321)	(0.119)
$Stocks_{t-1}$	0.036	-0.016
	(2.991)***	(-0.121)
$Stocks_{t-2}$	0.027	0.165
	(2.074)**	(1.191)
R^2	0.259	0.053

Notes: A VAR model with 2-lag was performed. The specification was selected based on the results of AIC and SIC. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Table 5 displays the VAR results of housing prices and general stocks. Panel A shows a uni-directional relationship between stocks and housing prices. Specifically, a strong chi-square coefficient is evident to reject the hypothesis of stocks do not Granger cause housing prices, whereas no comparable evidence is available for the second statement. The wealth effect could be the plausible explanation. As discussed by Sim and Chang (2006), unexpected gains in the stock market will encourage household investors to rebalance their portfolios by investing in the housing market. Numerous studies have also offered the empirical evidence of wealth effects in the U.S. and European housing markets (Jud and Winkler, 2002; Kakes and Van Den End, 2004; Kapopoulos and Siokis, 2005).

Comparable evidence is also demonstrated in Panel B in which housing prices are sensitive to the past realisation of the general stock market, while stocks are not influenced by housing prices. As discussed earlier, the wealth effect could cause households to increase their housing investments. Therefore, the reported results here can also be explained in the similar fashion. Moreover, the results also reveal that stocks have greater influence on housing prices. This can be attributed to general equities being more liquid and informational efficient than property shares. It should be noted that the KLCI index comprises the 100 largest companies in Malaysia with larger trading volumes in comparison to listed property companies. Hence, the finding of stocks having greater influence on housing prices is sensible since the KLCI index is more efficient than property shares, thereby having a stronger influence on housing prices.

Another important point emerging from Tables 4 and 5 is the first lag of housing prices are significant at 5%, suggesting that the past movement in housing prices will affect the fluctuation of housing prices in the subsequent period. The results are consistent with the results of Case and Shiller (1989) and Chen and Patel (1998). Overall, property shares and stocks are more informational efficient in comparison to housing prices. Thus, changes in response to the arrival of news will be incorporated in listed property companies and stocks, thereafter the information will be transmitted to housing prices.

Variance decomposition analysis

The preceding section demonstrated a uni-directional causality relationship between housing prices and stocks, as well as property shares. As a further analysis, this study examines the relative importance of stocks and property shares shocks in explaining variations in house prices by performing a variance decomposition analysis. The results are exhibited in Tables 6 and 7.

Table 6: Variance decomposition of house prices and property shares

Period	Houses	Property shares
Panel A: Variance decomposition of house prices		
2	93.867	6.133
4	91.357	8.643
6	91.271	8.729
Panel B: Variance decomposition of property shares		
2	4.258	95.742
4	4.130	95.870
6	4.129	95.872

Note: Variance decompositions are expressed in percentage form.

Table 7: Variance decomposition of house prices and stocks

Period	Houses	Stocks
Panel A: Variance decomposition of house prices		
2	88.270	11.730
4	86.983	13.017
6	86.889	13.111
Panel B: Variance decomposition of stocks		
2	4.965	95.036
4	5.460	94.540
6	5.480	94.520

Note: Variance decompositions are expressed in percentage form.

In general, the variance decomposition analyses yield comparable results for Tables 4 and 5. At the 6-quarter horizon, almost 9% of the variance of house prices can be attributed to property shares, whereas shocks from house prices only contribute around 4% of the variance of listed property companies. It appears that property shares help in explaining variations in the housing sector, whereas the housing variable has an insignificant effect on the property sector. It is possible to state further that the BM Prop index Granger-causes the housing series.

Turning our attention to the stock market, stocks explain around 13% of house price forecast error variance, while only as little as 5.5% of the variance of the general equity market is attributed to house prices. The results confirm the uni-directional link between stocks and home prices that are found by the preceding Granger-causality tests. In short, the variance decomposition analysis found comparable results for the VAR analysis in which there are only unidirectional linkages between residential properties and stocks, as well as listed property companies.

Macroeconomic variables

A related issue concerns the role of macroeconomic variables in housing price modelling is also addressed. As highlighted by Green (1997) and Kim (2004), strong linkages are found between residential investments and macroeconomic variables. Therefore, the baseline results were controlled for macroeconomic variables. In the light of the small sample size in this study, we only include one macroeconomic variable in our VAR models[4]. In this study, the robustness of baseline results was examined by controlling for the GDP growth rate. Tables 8A and 8B present the VAR

[4] Three macroeconomic variables (GDP, base lending rate and unemployment rate) were considered. An OLS regression model was performed in order to identify the most influential macroeconomic variable. The regression results show that the GDP growth rate is the most important variable in explaining Malaysian house prices. Hence, this variable was used in this study. The results are available from the authors.

results by controlling for the economic variable and the results of variance decomposition are reported in Tables 9A and 9B[6].

Table 8A: VAR and Granger causality tests: house prices and property shares: controlled for macroeconomic variable

Panel A: Granger causality test		
Test	**Chi-square**	**Probability**
Property Shares cause House Prices	2.488	0.115
House Prices cause Property Shares	0.109	0.741
Panel B: VAR model		
	Houses	**Property shares**
Intercept	0.010	0.007
	(4.711)***	(0.188)
Houses $_{t-1}$	-0.321	-0.991
	(-1.958)*	(-0.330)
Property shares $_{t-1}$	0.015	0.071
	(1.577)	(0.405)
GDP $_{t-1}$	0.067	0.470
	(1.931)*	(0.739)
R^2	0.191	0.023

Note: A VAR model with 1-lag was performed. The specification was selected based on the result of AIC and SIC. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Table 8B: VAR and Granger causality tests: house prices and stocks: controlled for macroeconomic variable

Panel A: Granger causality Test		
Test	**Chi-square**	**Probability**
Stocks cause House Prices	5.128	0.024
House Prices cause Stocks	0.182	0.670
Panel B: VAR Model		
	Houses	**Stocks**
Intercept	0.010	0.023
	(4.764)***	(0.830)
Houses $_{t-1}$	-0.332	0.9591
	(-2.112)**	(-0.427)
Stocks $_{t-1}$	0.026	-0.161
	(2.265)**	(-0.966)
GDP $_{t-1}$	0.071	0.504
	(2.123)**	(1.060)
R^2	0.243	0.054

Note: A VAR model with 1-lag was performed. The specification was selected based on the result of AIC and SIC. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

[6] VAR models with 2 and 3 lags yield comparable results.

The VAR results of Tables 8A reveal that property shares have little explanatory power for house prices. In addition, home prices have little influence on listed property companies. The Granger-causality results further reinforce this point. The results are inconsistent with the baseline results and suggest that both assets were independent assets once the GDP growth rate was controlled. The contradictory results can be explained by the significant influence of the GDP variable on the housing market. A separate VAR test between house prices and GDP was performed. Importantly, evidence of GDP Granger-causing the performance of the Malaysian housing market is evident.[7] Hence, the inclusion of GDP has diminished the importance of property shares in our model, implying that both listed property companies and residential properties are affected by some common economic fundamentals.

Table 8B depicts the GDP controlled results for stocks. After the macroeconomic variable is included into our models, strong evidence of a uni-directional relationship between stocks and home prices is still observed in which stocks would lead house prices, but not in the other direction. In other words, housing is not a driver of stocks, but a follower of the stock market. The results also indicate that housing investors should keep a close eye on the movements of the stock market which conveys important information on housing prices.

Table 9A: Variance decomposition of house prices and property shares: controlled for macroeconomic variables

Period	House prices	Property shares	GDP
Panel A: Variance decomposition of houses			
2	84.372	9.074	6.554
4	84.265	9.062	6.674
6	84.262	9.059	6.679
Panel B: Variance decomposition of property shares			
2	7.318	91.535	1.146
4	7.430	91.414	1.156
6	7.432	91.412	1.156

Note: Variance decompositions are expressed in percentage form.

[7] The results were not reported for brevity.

Table 9B: Variance decomposition of house prices and stocks: controlled for macroeconomic variables

Period	House prices	Stocks	GDP
Panel A: Variance decomposition of houses			
2	78.401	14.405	7.192
4	78.133	14.712	7.156
6	78.124	14.722	7.155
Panel B: Variance decomposition of stocks			
2	7.582	90.172	2.246
4	7.939	89.705	2.356
6	7.948	89.692	2.360

Note: Variance decompositions are expressed in percentage form.

Table 9A presents the variance decomposition results with control for the GDP growth rate. Compared to the results of the benchmark model in Table 6, no significant alteration is found, in which property shares explain around 9% of the variance of housing prices, while weaker explanation power of home prices to listed property companies is also evident. Table 9B also illustrates that stocks capture substantial variance of housing prices, whereas little evidence is found for house prices. The results are consistent with the baseline results from Table 7. In general, the information transmission mechanism of housing prices is robust to the macroeconomic variable.

Different types of residential property

To shed more light on the information transmission mechanisms among these assets, the effect of different residential property types were also investigated. As demonstrated by Wheaton (1999), different types of property have quite divergent cyclic behaviours. Thus, the baseline results were also scrutinized with different types of residential property (high rise, terrace, detached and semi-detached) in order to disentangle the potential effect of types of residential property in the models. The results are depicted in Tables 10A-10D.

A uni-directional relationship between terrace houses, property shares and stocks was observed from Table 10A based on the results of Granger causality and VAR tests. More specifically, property shares and stocks provide useful information on terrace house prices in the next quarter, whereas no evidence is available to support that home price appreciation rates will affect stocks and listed property companies. The results are consistent with the baseline results on all types of residential property. Comparable results are also identified for semi-detached houses in Table 10B, which property shares and stocks Granger cause semi-detached houses. Panel B of Table 10B also reveals similar results in which semi-detached housing prices are significantly related to the past realisation of both common stocks and property

companies. The findings suggest that property companies and stocks contain some important information of terrace and semi-detached houses.

Table 10A: Robustness check by different types of property: terrace houses

Panel A: Granger causality test		
Test	**Chi-square**	**Probability**
Property shares cause terrace houses	8.615	0.035
Terrace houses cause property shares	0.626	0.891
Stocks cause terrace houses	3.523	0.061
Terrace houses cause stocks	0.005	0.944

Panel B: VAR model				
	Terrace houses	**Property shares**	**Terrace houses**	**Stocks**
Intercept	0.014 (3.854)***	-0.014 (-0.358)	0.010 (4.271)***	0.023 (0.894)
Terrace houses $_{t-1}$	-0.435 (-2.564)**	-0.153 (-0.082)	-0.327 (-2.057)**	0.120 (0.070)
Terrace houses $_{t-2}$	-0.245 (-1.400)	-1.457 (-0.759)		
Terrace houses $_{t-3}$	-0.215 (-1.236)	-0.678 (-0.355)		
Property shares $_{t-1}$	-0.000 (-0.019)	0.384 (2.238)**		
Property shares $_{t-2}$	0.027 (2.137)**	0.106 (0.774)		
Property shares $_{t-3}$	0.025 (1.978)*	-0.007 (-0.048)		
Stocks $_{t-1}$			0.029 (1.877)*	-0.155 (-0.929)
R^2	0.277	0.190	0.142	0.024

Note: A VAR model with 3-lag was performed for terrace houses and property shares, while a VAR model with 1-lag was performed for stocks and terrace houses. The specifications were selected based on the results of AIC and SIC. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Table 10B: Robustness check by different types of property: semi-detached houses

Panel A: Granger causality test				
Test	**Chi-square**		**Probability**	
Property shares cause semi-detached houses	6.736		0.001	
Semi-detached houses cause property shares	0.014		0.906	
Stocks cause semi-detached houses	3.601		0.057	
Semi-detached houses cause stocks	0.048		0.827	
Panel B: VAR model				
	Semi-detached houses	**Property shares**	**Semi-detached houses**	**Stocks**
Intercept	0.014 (4.356)***	0.008 (0.265)	0.013 (3.831)***	0.021 (0.904)
Semi-detached houses $_{t-1}$	-0.458 (-3.307)***	-0.154 (-0.119)	-0.406 (-2.855)***	0.213 (0.218)
Property shares $_{t-1}$	0.045 (2.595)**	0.087 (0.534)		
Stocks $_{t-1}$			0.044 (1.898)*	-0.152 (-0.947)
R^2	0.295	0.008	0.241	0.025

Note: A VAR model with 1-lag was performed for semi-detached houses and both property shares and stocks. The specifications were selected based on the results of AIC and SIC. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Table 10C shows the linkages between detached houses and both property shares and stocks. Surprisingly, the results show that detached houses and listed property companies are two independent markets, with no significant causality link in either direction. Similar results are also obtained between detached houses and stocks. High-rise property units also demonstrated equivalent results in Table 10D. There is little causality runs in both directions between high-rise properties and property shares, as well as stocks based on the VAR and Granger causality tests, suggesting that the past realisation of stocks and property companies are not important for high-rise properties. Importantly, these results reflect that different types of property have different information transmission mechanisms. The lack of a transmission effect could be attributed to the nature of these properties, with reference to these properties are considered as high end properties such as condominium units and luxury bungalows.

Interestingly, the results of high-rise properties are not consistent with previous results in U.S. apartment units (He, 2000). The discrepancy between He (2000) and this study could be attributed to different markets, reflecting the significant difference between mature and developing markets. In fact, these also highlight that international evidence on the information transmission mechanism of housing should be provided.

Table 10C: Robustness check by different types of property: detached houses

Panel A: Granger causality test				
Test	**Chi-square**		**Probability**	
Property shares cause detached houses	1.388		0.239	
Detached houses cause property shares	0.959		0.328	
Stocks cause detached houses	2.772		0.096	
Detached houses cause stocks	0.755		0.385	
Panel B: VAR model				
	Detached houses	**Property shares**	**Detached houses**	**Stocks**
Intercept	0.015 (3.610)***	0.019 (0.631)	0.015 (3.525)***	0.031 (1.346)
Detached houses $_{t-1}$	-0.380 (-2.370)**	-1.122 (-0.979)	-0.387 (-2.498)**	-0.749 (-0.869)
Property shares $_{t-1}$	0.028 (1.178)	0.135 (0.806)		
Stocks $_{t-1}$			0.049 (1.665)	-0.116 (-0.705)
R^2	0.136	0.032	0.166	0.043

Note: A VAR model with 1-lag was performed for detached houses and both property shares and stocks. The specifications were selected based on the results of AIC and SIC. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Table 10D: Robustness check by different types of property: high-rise property units

Panel A: Granger causality test				
Test	**Chi-square**		**Probability**	
Property shares cause high-rise property units	0.774		0.379	
High-rise property units cause property shares	0.025		0.875	
Stocks cause high-rise property units	2.113		0.348	
High-rise property units cause stocks	0.320		0.852	
Panel B: VAR model				
	High-rise property units	**Property shares**	**High-rise property units**	**Stocks**
Intercept	0.006 (1.086)	0.008 (0.262)	0.006 (1.076)	0.004 (0.199)
High-rise property units $_{t-1}$	-0.193 (-1.187)	-0.135 (-0.158)	-0.246 (-1.521)	-0.165 (-0.329)
High-rise property units $_{t-2}$			-0.286 (-1.764)*	0.195 (0.389)
Property shares $_{t-1}$	0.027 (0.880)	0.084 (0.519)		
Stocks $_{t-1}$			0.013 (0.322)	-0.034 (-0.274)
Stocks $_{t-2}$			0.059 (1.451)	0.153 (1.226)
R^2	0.056	0.008	0.2175	0.055

Note: A VAR model with 2-lag was performed for high-rise property units and property shares, while a VAR model with 1-lag was performed for high-rise property units and stocks. *, **, *** denote significance at the 10%, 5% and 1% level respectively.

Table 11A: Variance decomposition of different types of houses

Panel A: Housing prices and property shares		
Period	**Housing prices**	**Property shares**
	Model I: Terrace houses	
2	99.999	0.001
4	89.156	10.844
6	89.257	10.743
	Model II: Semi-detached houses	
2	86.800	13.200
4	85.370	14.630
6	85.314	14.686
	Model III: Detached houses	
2	96.848	3.152
4	96.677	3.323
6	96.676	3.324
	Model IV: High-rise property units	
2	98.093	1.908
4	98.071	1.929
6	98.071	1.929
Panel B: Housing prices and stocks		
Period	**Housing prices**	**Stocks**
	Model I: Terrace houses	
2	92.303	7.697
4	90.475	9.525
6	90.442	9.558
	Model II: Semi-detached houses	
2	92.554	7.446
4	90.266	9.734
6	90.174	9.826
	Model III: Detached houses	
2	94.031	5.969
4	92.512	7.488
6	92.500	7.500
	Model IV: High-rise property units	
2	99.857	0.143
4	97.314	2.687
6	97.300	2.700

Note: Variance decompositions are expressed in percentage form.

Table 11B: Variance decomposition of property shares and stocks

Panel A: Property shares and house prices		
Period	**House prices**	**Property shares**
	Model I: Terrace houses	
2	4.984	95.016
4	5.156	94.844
6	5.154	94.846
	Model II: Semi-detached houses	
2	1.251	98.749
4	1.255	98.745
6	1.255	98.745
	Model III: Detached houses	
2	9.196	90.804
4	9.311	90.689
6	9.313	90.688
	Model IV: High-rise property units	
2	0.215	99.785
4	0.216	99.784
6	0.216	99.784
Panel B: House prices and stocks		
Period	**House Prices**	**Stocks**
	Model I: Terrace houses	
2	11.015	88.985
4	11.008	88.992
6	11.008	88.992
	Model II: Semi-detached houses	
2	0.254	99.746
4	0.284	99.716
6	0.285	99.715
	Model III: Detached houses	
2	9.398	90.602
4	9.743	90.257
6	9.744	90.257
	Model IV: High-rise property units	
2	4.459	95.541
4	4.575	95.425
6	4.594	95.406

Note: Variance decompositions are expressed in percentage form.

The variance decomposition results are exhibited in Tables 11A and 11B. Interestingly, the results are quite consistent with the results from Tables 10A-10D in which there is evidence of uni-directional relationships among terrace houses, semi-detached, property shares and stocks. Neither property shares nor general equities have significant explanatory power in explaining the variance of detached and high-rise residential properties. Moreover, high rise units do not capture the volatilities of property shares and stocks, although detached residential properties exhibit some explanatory power. Again, this can be explained by different transmission mechanisms for different types of property. Importantly, the results have provided some indirect support to the finding of Wheaton (1999).

Overall, the results also show that different types of residential property have different information transmission mechanisms. As a result, property developers and policy makers should be aware this sectoral difference and take it into consideration in their analyses and decision making processes. Specifically, property developers should consider the outlook of the share market for a housing project of terrace and semi-detached houses. However, the outlook is not crucial for a development of high end properties such as bangalows and condominium units.

Robustness checks

To reinforce the previous findings, the baseline results for VAR were further evaluated by different lags. Our VAR models were further performed by 1-lag and 3-lags, since VAR model could be sensitive to the lag length selection. The results are very similar to those reported in Tables 4 and 5, reflecting that listed property companies and stocks lead the housing market. In other words, the baseline results are robust to different lag specifications, confirming that residential property is a follower rather than a driver of stocks and listed property companies.

The baseline results were also further adjusted for real terms. Even though the inflation rate in Malaysia was low and stable over this study period, a robustness check by utilising the real returns of housing, listed property companies and stocks was also performed. Obviously, no significant variation is found by comparing the results with the baseline results. Specifically, there is evidence of uni-direction linkages between house prices and both listed property companies and equities. In other words, the conclusions were not altered by using real returns.

In brief, there is clear evidence to support the view that stocks and listed property companies are more liquid assets and contain some important information that would be impounded into the housing market.

CONCLUSIONS AND PROPERTY INVESTMENT IMPLICATIONS

Although the issue of price discovery between REITs and unsecuritised real estate has been widely investigated, the linkages between listed property companies and housing prices have received little attention, particularly in an emerging market context. Therefore, this study aims to examine the causality relationships between Malaysian housing prices and listed property companies, as well as the stock market.

Several important findings have been found in this study. Firstly, there is evidence of uni-directional linkages between housing prices and both stocks and property shares. More specifically, listed property companies and stocks Granger caused housing prices, whereas there was no evidence to show the other direction, indicating that the housing market is a follower rather than a leader. In other words, the information of stocks and listed property companies will be transmitted to housing prices. Secondly, the influence of stocks appears to be greater than listed property companies. This suggests that stocks are more informationally efficient in comparison to property companies. Thirdly, high rise residential units and detached houses have little connection with listed property companies and stocks, suggesting that different types of residential property have different information transmission mechanisms. All of these findings provide additional insights into the information transmission mechanism of housing in Malaysia.

These findings have some important practical property investment implications for real estate analysts, policy makers and investors. First, the finding of causality linkages between house prices and both property shares and stocks are important. This suggests that housing investors and real estate analysts should incorporate the information of listed property companies and stocks in their analyses and asset allocations. Besides, the findings also suggest that any policy decision regarding stocks and listed property companies are likely to affect the housing market. As a result, it is essential for policy makers to assess the potential impact of their policies, which could have a severe impact on the housing market. Furthermore, housing investors should also be aware with the different information transmission mechanisms for different types of residential property in making their investment decisions.

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