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THE DYNAMICS OF HOUSE PRICE VOLATILITY IN MALAYSIA

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Abstract

The purpose of this study is to examine the house price volatility in three urban areas in Malaysia. This empirical study covers a sample period of 9 years from 2005 Q1 to 2013 Q4. The volatility of the Malaysian housing market and its determinants were investigated. The determinants for house price volatility were found through content analysis and ARCH model. An Autoregressive Conditional Heteroscedasticity (ARCH) model was employed in this study to examine the volatility of house prices of three Malaysian main urban areas. The Engle LM test was also utilized to analyze the volatility clustering effects in these provinces. This study found that there are evidence of volatility clustering in more than half of the housing in Malaysia. The significant determinants for the house price volatility in Malaysia are BLR, GDP, housing stock and inflation rate. This study has implications for policy and decision makers as they have to take into consideration house price volatility when drawing up policies and making investment decisions. Besides, the changes in house price volatility determinants will also affect the housing market. Therefore, the determinants are important in the formulation of housing policy. The limitations for this study are time constraint and the quality of the data. This paper is probably one of the few studies undertaken to examine house price volatility in Malaysia.

Keywords: *House, price, volatility, Malaysia*

1.0 Introduction

According to Banks et al. (2010), housing is the biggest marketable asset in a household portfolio for most people. For example, in the United States, equity in housing is a major component of the household wealth. Homeowners generated household wealth through capital gains over house prices. Most of the households in the United States, anticipate using their equity in housing to finance the second half of their life. However, Mankiw and Weil (1989), Hoynes and McFadden (1994) urged that the substantial decline in house prices in the coming decades will result in capital losses for the homeowners. Therefore, the changes in house prices will influence the household wealth. In the long run, house prices have sustained growth in the housing market and its recurrent fluctuation along the growth path has been a normal phenomenon globally. According to Mankiw and Weil (1989), the changes in demography will lead to predictable changes in the demand for housing which will have a substantial impact on the price of housing. However, an econometric analysis suggests that real income, relative prices and real interest rates are also important factors which will determine demand. From this analysis, it can be viewed that house prices have a backward and forward linkage with the housing market.

House price volatility has drawn the attention of policy makers and investors in the recent market. Volatility is significantly related to lagged information or "news". When investors are uninformed and oblivious to the state of the market, their decision making will be via their gut feeling or speculation which imminently results in price fluctuation. Lagged error happened when bad news occurred. Risk to house price may be a consequence of excess volatility. Whenever there is any new information in the market, house price will be volatile. As a result of public demand on properties, the price movement of

housing relative to other goods and services is larger. House prices are much more volatile than goods prices, and real house prices are much more volatile than real incomes. House price has the linkage with the macroeconomic fundamental factors such as, population, real income, unemployment rate, inflation rate and change in house price itself. It is important to determine the factors of house price in order to predict the movement of house price. Therefore, this study is an attempt to clarify the house price volatility and its determinants in Malaysia. However, the main reason in conducting this study is due to the lack of knowledge on house prices volatility in Malaysia. In order to measure the volatility of house prices in Malaysia, a time-series data on house price trend has to be identified. The determinants of house prices volatility is an important study in order to examine the significance of house prices volatility in Malaysia. The research was done based on the following two questions which were derived from the justifications given above:

i. What is the significance of house price volatility in Malaysia?
ii. What are the determinants of house price volatility in Malaysia

Previous studies carried out in developed countries have shown the significance of house price volatility to the housing market. Generally, this study will solely examine the significance of house price volatility in Malaysia. By implication, this study will benefit investors and policy makers; investors would be able to estimate the condition of the housing market in respect to the house price volatility before they make an investment decision. Besides, policy makers should also take into account the importance of house price volatility in formulating the house policy. The housing market in Malaysia has been performing well since its independence from the British. The performance of housing market in Malaysia is mainly based on the residential property market. Since residential property is the strong backbone in the Malaysian property market, any change in house prices will greatly impact the property market and hence the Malaysian economy. A few researches on the volatility in house prices had been done in the more advanced countries such as, the United States and the United Kingdom. Comparatively, there is limited literature on house price volatility in Malaysia except for the literature by Zainuddin (1994) which touched on house price volatility in Malaysia. As Malaysia experience dynamic movements in the property market, particularly in the residential property sector, the various determinants has also evolved. Thus, the aim of this study is to identify the house price volatility and its determinants in Malaysia.

2.0 Literature Review

The significance of house price volatility has been studied by several researchers in other countries particularly in developed countries, however there are few evidence of the study ever being done in developing countries which includes Malaysia. For instance, the house volatility of eight capital cities in Australia and its determinants were investigated by Lee (2009). He found that volatility-clustering effects were found in these cities. Furthermore, the result from the EGARCH model shows that the determinants of house volatility vary from city to city. Zhu et al. (2011), models the correlated shocks across regional housing markets and found that the extra volatility could be caused by shocks in other regions. The study of house price behavior, Björk (2013), suggests that research about house price conditional variance should be concentrated on the volatility of several fundamental variables. Furthermore, Chen & Patel (1998) investigated on house price volatility and granger causality relationship between house price and its determinants in Taipei. The result has revealed several determinants such as, construction cost, interest rate, total household permanent income, house completion and stock price index; this exhibited a long-run equilibrium relationship with the house price. Researchers also found various types of volatility in the housing market. One of the studies from Tsai & Chen (2009) on house prices, used the UK nationwide house price data over the period of Q4 1955 to Q4 2005. The study had identified the asymmetry of volatility. On the other hand, Miller & Peng (2004) also demonstrated that 17 % of the metropolitan

statistical areas in the US has volatility clustering effect. In addition according to Abate and Anelin (2016) house price volatility also creates risk of unsustainability house price for lenders. They added, an increase in house price volatility increases the probability of negative home equity, and mortgage foreclosure losses become worse. Volatility in house price is very important to assess, as it will bring residential property market become unstable. This has been proving from the earlier study by Case et al. (2003). Their study revealed that the related issue of housing market volatility and risk become one of increasing prominence following problems in the US sub-prime mortgage market. House price volatility can have detrimental effects on the economy, including negative equity nad mortgage foreclosures losses, the safety and integrity of housing investment and associated mortgage lending is an area of generally growing concern given the worldwide repercussion of sub-prime mortgage problems (Morley and Thomas, 2016). The impact from GFC which started from sub-prime mortgage crisis has alert global real estate market on the house price volatility.

Over the years, the movement of house prices has been a huge concern within the housing market and had been widely researched according to the literatures. Movement of house prices is significantly related to the supply and demand of housing stocks in the market. According to Mankiw & Weil (1989), the fluctuations in demand have a substantial impact on the price of house. They suggest that the demand of house is affected by the demographic changes. However, Swan (1995) argues that Mankiw-Weil predictions of house prices are misinterpreted. According to Swan (1995), the prediction of future movements in house prices should also take into consideration, information on the supply factors in addition to relevant demand variables. House prices are usually described by fluctuations around a function of fundamental variables in the economy (Björk, 2013). It has been a normal phenomenon that house prices fluctuates recurrently in a time-series. However, large fluctuations of house prices are likely to cause problems in the property market. Declines in house prices will result in capital losses for the homeowners (Feinstein & Mcfadden, 1989; Mankiw & Weil, 1989). However, if households are able to anticipate house price changes, potential losses may be mitigated.

Volatility is used to commonly refer to the amount of uncertainty or risk in a given security or market index. It is about the size of changes in a series of value. Within the financial markets, investors are increasingly concern with house price volatility. Large changes in volatility and its market returns will have a negative impact on risk averse investors. It can have important effects on capital investment, consumption, and other business cycle variables (Schwert, 1989). Volatility has been widely studied in the financial context. The rate of return in the stock markets, bond markets or foreign currency exchange market is volatile due to their high risk and liquid trading volume. According to Andersen and Bollerslev (1996), volatility is computed as the sum of high-frequency absolute returns. Besides, Cotter (2005) also says that absolute return volatility provides accurate measures of volatility. Therefore, the frequency of returns is referred to as volatility. Volatility is caused by the activities in the market. Unexpected high market activity will cause an increase in volatility and will widen the spread of volatility. Any announcement in the news on the state of the market can affect volatility. Unscheduled announcements can cause a rise in volatility depending on whether it is a public or private announcement. For scheduled announcements, speculative trades during the pre-announcement period will lead to an increase in volatility (Bauwens et al., 2005). The arrival of new information will lead the investors to trade simultaneously in the same direction which will cause the large price changes (Schwert, 1990). The volatility in stock market is generally caused by the new information in the market. Volatility is also caused by the economy health and changes in policy. According to Schwert (1989), any financial leverage increase during recessions will cause an increase in the volatility of leveraged stocks. Other than the economic condition, changes in policy also has implications for volatility. Investors will use the information of program trading to reflect new information and rebalance their portfolios. Thus, many studies have been conducted in order to understand how prices behave in a highly liquid securities market.

Despite the fact that there were extensive studies on volatility in the financial literature, in the context of house prices, very few studies were undertaken. A few researchers have studied the behavior of volatility. According to Hott (2012), fluctuations can possibly be explained by the herding behavior among house investors. Hott (2012) demonstrates that, in a stable economic environment with low interest rates, people start to believe that, that is when it is a good time to invest in housing. As a consequence of this type of behavior, house price increases much more than its fundamental price. The study suggests that the variance of growth rate of actual house prices is six times higher than the fundamental prices. It is proven that buyers and sellers' decisions could make a huge impact on changes in house prices. According to (Roche, 2001), emerging with the volatility of house prices, an increase in house prices attracts more speculative investment demand with the expectation of further price increase. Extensive literature on speculation in the housing market was carried out. Evidence of speculative behavior was found by Shiller (1990), Abraham & Hendershott (1996) and Muellbauer & Murphy (1997).

Another study that investigates the impact of volatility in house price to residential property market is done by Willcocks (2010) explored on variances in regional house prices using time series processes commonly employed in financial market research. Campbell et al. (2009) studies on housing markets and traditional financial markets by using dynamic growth model to assess rent-price ratio on housing market in US. Furthermore, house price volatility also creates of unsustainable house price for lender; negative home equity and mortgage foreclosure losses become worse (Abate and Anselin, 2016). Therefore, the study on house price volatility is important as it will give significant impact to housing market which consequently affect the country's economy growth.

According to Shiller (1990), speculation appears to be a local phenomenon due to the difference in perception towards house price across cities. This result is further discussed and supported by Abraham & Hendershott (1996) where the lagged appreciation rate in the more volatile coastal cities appeared to have larger coefficient which is twice that of the stable inland cities. Moreover, Muelbauer & Murphy (1997) also found the presence of larger numbers of speculative traders in a volatile housing. Speculation in the housing market mainly depends on the expected and current capital appreciation in housing. The misrepresentation by investors might result in excess demand and lead to excessive house price changes. In summary, any speculation in the housing market will raise uncertainty in house price increment in the future.

The effect of house price volatility was found different with findings from the financial market. Tsai & Chen (2009) found that when bad news is announced for property market, the lagged error is negative and the variance will decrease. Shocks in the market will magnify volatility (Hossain & Latif, 2009). This could be explained by the behavior of speculative. Besides, the effect of negative shock is long lasting compared to positive shocks. House price volatility is also believed to have forward and backward linkage with the determinants. Variance Decomposition technique was carried out in several studies to estimate the impulse response of the house prices to such shocks. Evidence of impulse response was found in Hossain & Latif (2009), Chen & Patel (1998) and Lan & Zhang (2014). Given the close relationship between macroeconomic factors and house price volatility, it is relatively important to identify the significance of determinants to the housing market in order to make the right decision for investment and policy. According to Banks (2010), housing is risky in some geographic markets with high levels of house price uncertainty. When the house price is volatile, there is a lower probability of moving. For those households who are looking to settle down, there is a greater influence in their mobility decision to move to a less volatile housing area. Other than mobility, Li & Yao, (2007) presented the effects of house price uncertainty on housing demand. The dimension of house price risk would affect a household's precautionary savings incentive and consumption rate. These studies proved that the volatility of house price has a direct impact on the consumption and investment of housing market.

3.0 Significant of Residential Property in Malaysia

Global House Price Index released by Knight Frank on 4th June 2014 showed the index rising by 0.6% compared to 1.2% last quarter. Although, there was a drop in the growth rate of house prices in the first quarter of 2014, the house price index still recorded an annual growth of 7.1%. For the first time since 2008, not a single country has had an annual price fall in excess of 10%. The recovery in the global property market is becoming more entrenched. The Knight Frank Global House Price Index, shown in Table 1, shows Malaysia ranked 15th, recording a price growth of 8% in the year ending March 2014. For the first three months of 2014, Malaysia had recorded a price rise of 0.3%. It shows that Malaysia's index performance was strengthening in the first quarter of 2014.

Table 1 : Global House Price Index

Rank	Country	12-month % change (Q1 2013-Q1 2014)	6-month % change (Q3 2013-Q1 2014)	3-month % change (Q4 2013-Q1 2014)
1	Dubai	27.70%	14.30%	3.40%
2	China[1]	17.50%	7.10%	2.00%
3	Estonia	16.20%	11.20%	5.00%
4	Turkey	13.80%	5.70%	2.90%
5	Taiwan	12.20%	3.50%	1.50%
6	Brazil[2]	12.10%	5.70%	2.10%
7	Australia	10.90%	5.60%	2.10%
8	Colombia	10.60%	3.60%	1.70%
9	United States	10.30%	-0.20%	0.20%
10	Iceland	9.70%	4.30%	1.00%
11	New Zealand	9.20%	5.00%	3.10%
12	United Kingdom	9.10%	5.60%	2.60%
13	Indonesia	9.10%	4.40%	2.60%
14	Lithuania	8.40%	1.60%	7.40%
15	Malaysia[3]	8.00%	0.80%	0.30%
16	Ireland	7.80%	1.30%	-1.30%
17	Luxembourg	7.80%	3.10%	2.70%
18	Israel	7.20%	3.50%	2.80%
19	South Africa	7.00%	6.00%	3.10%
20	Malta	6.40%	6.40%	4.30%
21	Germany	5.80%	2.20%	0.00%
22	Latvia	5.50%	3.60%	2.40%
23	Mexico	5.00%	1.80%	1.70%
24	Canada	4.60%	0.80%	0.70%
25	Sweden	4.50%	1.40%	0.50%
26	Austria	4.10%	1.30%	1.80%

27	India	3.40%	3.40%	2.40%
28	Hong Kong[3]	2.80%	-0.60%	-0.40%
29	Poland	2.70%	3.90%	-2.30%
30	Denmark	2.50%	-0.70%	-0.20%

Notes: [1] Based on Beijing & Shanghai [2] Asking prices [3] Provisional data [4] Island-wide price index for non-landed properties

(Sources: Knight Frank Residential Research, 2014)

Property markets in Malaysia are grouped as follows: residential, commercial, industrial, agriculture, resort and hotels, and plant and machinery. Among these property types, residential property market has the highest recorded transaction volume annually. Table 2, shows the volume of residential property transaction and the percentage shares of residential market, from the total property market in Malaysia from 1996 to 2012. The table also shows, that over the years, the percentage of residential property transactions in the market has been inconsistent with fluctuation. It proves that the housing market is the backbone of the property market in Malaysia.

Table 2 : Percentage of Residential Transactions from Total Property Transaction in Volume in Malaysia (1996-2012)

Year	Total Property Transaction (in volume)	Residential Property Transaction (in volume)	% of Residential from total property market
1996	270,538	170,007	62.84%
1997	274,749	175,644	63.93%
1998	186,077	122,881	66.04%
1999	225,901	157,082	69.54%
2000	240,068	170,932	71.20%
2001	242,634	176,208	72.62%
2002	231,394	162,269	70.13%
2003	243,376	164,723	67.68%
2004	293,212	195,243	66.59%
2005	276,508	181,762	65.73%
2006	283,897	182,555	64.30%
2007	309,455	199,482	64.46%
2008	340,240	216,703	63.69%
2009	338,089	211,653	62.60%
2010	376,607	226,874	60.24%
2011	430,403	269,789	62.68%
2012	427,520	272,669	63.78%

(Sources: JPPH, 1996-2012)

The real estate market in Malaysia has managed to recover from the recent Global Financial Crisis due to the government's economic policies. Since the Global Financial Crisis, Malaysia's house prices have risen impressively, especially, in the Klang Valley and Penang. The percentage of nominal

and real house price changes is shown in Figure 1. From the figure, it shows that house price fluctuates, and the disparity between nominal and real house price is inconsistent. The house price had experienced huge negative change during the crisis year. It then recovered and continue to grow after the Global Financial Crisis until it reached 7.29%, which is the highest house price index recorded at the end of 2012. In short, the Malaysian housing market had managed to recover from the impact of the Global Financial crisis. The performance of Malaysia's housing market has in fact improved as it ranked 15th in the Global House Price Index. This improvement will attract more investment in the residential property market in Malaysia, and this will subsequently contribute towards Malaysia's economic growth.

According to Malpezzi & Wachter (2005), the factor affecting house price changes are the interactions between the housing markets' and the economic sectors' cyclical changes in the property market. According to Herring (2006), macroeconomic variables are believed to influence the movement of house prices. The macroeconomic variables such as population growth, employment rate, interest rate, inflation and income are contributors to the determinants of house price volatility. A research by Case (1986) used the population growth, interest rate, income tax growth, employment growth and construction cost to determine house prices in Boston. Case et al. (2003) demonstrates that the population, real income, tax system, interest rate and the changes in house price itself have had some influence on the US house prices. A similar result was reported by Himmelberg et al. (2005), where house prices in US are in line with its macroeconomic fundamental factors. Jud and Winkler (2002) also found that population growth rates, real changes in income, construction cost and interest rate are the significant factors for the house price appreciation in the US. A more recent Australian study, by Abelson et al. (2005), had found evidence that the unemployment rate, mortgage rate, equity prices and the housing stock has a negative relationship with the Australian house prices, while income and consumer price index (CPI) has a positive relationship in the long run market.

The housing supply factors consisting of land price, construction cost and the housing stock are also factors influencing house prices (Malpezzi, 1999). Due to the lack of reliable techniques to examine supply factors, and various restrictions imposed on supply factors such as land restrictions, and type of houses, housing supply factors are seldom used by researchers (Malpezzi, 1999). The supply and demand of housing does not reach equilibrium in the real market. Due to the complexity of the housing market, many researchers prefer to use demand factors which influence house price. In the context of house price volatility, Dolde & Tirtiroglu (2002) found that volatility of house price has significant associations with economic conditions. Personal income growth, inflation and interest rates appeared to have stronger relationship with the volatility event. According to Hossain & Latif (2009), GDP growth rate, home value appreciation rate and the inflation rate happens to be the determinants of house price volatility in Canada. However, Lee (2008) found that only inflation rate appeared to be the determinant of housing volatility at the national level in Australia. Overall, most studies showed significant relationship between house price and macroeconomic fundamental variables of income, interest rate, population, inflation and construction cost. The data for construction cost is however, limited to Malaysia. Therefore, the housing stocks from the supply side will replace construction cost. In summary, while there are extensive literatures on house price determinants, little attention has been placed on the determinants of house price volatility.

4.0 Methodology

Based on the research objectives, data for house prices and the macroeconomic factors are essential for this study. Several tests and models were exploited to determine the house price volatility and its determinants in this chapter; these include the Pearson Correlation Analysis, Langrange Multiplier (LM) test and Autoregressive Conditional Heteoskedasticity (ARCH) model. This section will explain in detail the design of the research, the data and the data analysis methods used in achieving the objectives of this study. Several studies have been done to assess the level of volatility on house price. Among others is

Drake (1993) which assess on UK housing market. Later Dolde and Tirtiroglue (1997) and Miles (2008) also studied on volatility on US housing market. All of studies employed ARCH and GARCH model to test the level of volatility. Most developed countries have been very active in exploring the level of volatility in term of house price in local markets especially in UK by employed advances statistical model such as GARCH. For instance Miles (2008) assessed volatility clustering in the majority of UK regions by using GARCH effect model. While Morley and Thomas (2011) examined on house price volatility within other assets such as equities from the point of risk-return relationship and asymmetric adjustment to shocks. Based on the various previous research, therefor this research used the similar method with some modifications to suite local situations.

Autoregressive conditional heteroscedasticity (ARCH) models have been widely used in financial time series analysis and particularly in analyzing the risk in the security or asset. The name "ARCH" conveys that time-varying variance (heteroskedasticity) that depend on (are conditional on) lagged effects (autocorrelation). ARCH model was developed by Engle (1982) in his study to estimate the variance of United Kingdom inflation. A regression model was introduced to model the time-dependent variance. This model allows the conditional variance of a series to depend on the past realizations of the error process.

For the purpose of this research, quarterly data from the year 2005 to 2013 were collected. The essential data in this study were the sales price for residential properties as dependent variables, and the determinants of house price volatility as independent variables. The data were collected from the Residential Property Stock Report published by Valuation & Property Services Department (JPPH). The sales price for nine residential properties in three states in Malaysia were collected for this study.

Table 3 : Notation and Description of Variables

Variables	Measurement	Sources
Base Lending Rate (BLR)	Percentage (%)	Central Bank of Malaysia
Gross Domestic Product (GDP)	RM/Million	Department of Statistic Malaysia
Housing stock	Completion Unit	Valuation & Property Services Department
Inflation Rate	Percentage (%)	IFO world economic survey
Population Growth	% YOY	Oxford Economics

The study targeted the states experiencing significant increase in the average residential property prices. Therefore, Wilayah Persekutuan Kuala Lumpur (WPKL), Johor and Penang were the chosen target samples. The nine housing sample in this study area are as follows: 1 – 1 ½ storey terrace house, 2 – 3 storey terrace house, 1 – 1 ½ storey semi-detached house, 2 – 3 storey semi-detached house, detached low cost house , low cost flat, flat, condominium and cluster housing. Note that the sales price for 1 – 1 ½ storey semi-detached in WPKL was not available. However, sales price for cluster was available for WPKL from the year 2005 to 2013. Therefore, the sales price for cluster was taken into consideration for WPKL. There were a total of nine residential house types for each of the states in this study.

The determinants for house prices identified from literature reviews were Base Lending Rate (BLR), Gross Domestic Product (GDP), housing stock, inflation rate and population growth. These data was obtained from the Datastream service provided by Thomson Reuters, except for housing stock, which were obtained from the Residential Property Stock Report published by JPPH. Table 3 presents the notation and description of variables to be tested in this research.

All variables will be computed into natural logarithms except BLR, inflation rate and population growth. This transformation is applied so that the data will more closely meet the statistical inference of this study

and also to improve the interpretability and appearance of graph. Volatility clustering is the condition where the variance is varies through time, with the period of tranquility (low volatility) and also high volatility. Volatility clustering is representing by time-correlated and time-varying in the property price series. Volatility clustering or ARCH effect is commonly found in asset markets (Lin & Fuerst, 2013; Miles, 2008). Thus, in order to examine the house price volatility, the existence of volatility clustering or ARCH effect must be first tested. The LM test proposed by Engle (1982) is computed as follow:

$$R_t = a_0 + a_1 R_{t-1} + \varepsilon_t$$

$$\varepsilon_t^2 = \varphi_0 + \varphi_1 \varepsilon_{t-1}^2 + \varphi_2 \varepsilon_{t-2}^2 + \cdots + \varphi_p \varepsilon_{t-p}^2$$

where ε_t^2 is the squared residuals and LM test is is presented by

$$LM = T * R^2$$

R^2 represents housing returns (difference of the natural logarithms of the housing index) and T is the sample size. The null hypothesis of LM test is that H_0: $\varphi_1 = 0$ and $\varphi_2 = 0$ and $\varphi_3 = 0$ … and $\varphi_p = 0$. If $T * R^2$ exceeds the critical value of X^2, the null hypothesis of no ARCH effects can be rejected. The series is said to exhibit volatility clustering, the periods of high volatility will be followed by higher volatility or vice versa.

Autoregressive conditional heteroscedasticity (ARCH) models have been widely used in financial time series analysis and particularly in analyzing the risk in the security or asset. The name "ARCH" conveys that time-varying variance (heteroskedasticity) that depend on (are conditional on) lagged effects (autocorrelation). ARCH model was developed by Engle (1982) in his study to estimate the variance of United Kingdom inflation. A regression model was introduced to model the time-dependent variance. This model allows the conditional variance of a series to depend on the past realizations of the error process. The ARCH model is denoted by ARCH (p) where p is the autoregressive order. Let y_t denote a stationary time series, and expressed as below:

$$y_t = c + u_t$$

Where c is the mean of y_t and u_t is independent identically distributed with mean zero.
$u_t = \sigma_t \varepsilon_t$

Where ε_t is independent identically distributed normal random variable. Therefore, the estimated conditional variance, ARCH (p) model can be specified as:

$$\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \cdots + \alpha_p u_{t-p}^2$$

After estimation of ARCH model, the presence of ARCH effects in the residuals has to be tested. Testing for ARCH effects is also testing the presence of heteroscedasticity in the time series model. Lagrange Multiplier (LM) test is proposed again to test for the ARCH effects in the residual. The test statistics is distributed as Chi-square distribution, x^2 , with p degree of freedom. When LM is greater than $x_a^2(p)$ distribution, the null hypothesis is rejected, ARCH effect is exists in the residual.

5.0 Data Analysis and Findings

The relationship between house prices and the determinants was analyzed by employing the Pearson Correlation Analysis. The independent variables are the determinants while the dependent variables are the sales prices of residential properties. The level of significance between the two variables is determined by consulting the two-tail significance. If the value of two-tailed significance is less than 0.05, then the correlation between is considered to be significant (meaning that it can be 95% confident that the relationship between that two variables is not due to chance). In this case, the null hypothesis is rejected and the alternative hypothesis is accepted. Meanwhile, the values of the Pearson Correlation range from -1 to 0 representing a negative correlation (as one variable increases, the other variable decreases), and the values ranging 0 to +1 representing a positive correlation (as one variable increases, the other also increases). The closer the value to -1 or +1, the stronger the association between the variables. The analysis was carried out according to the house prices of each state. The results of Pearson Correlation Analysis are shown in Table 4 to Table 6. Table 4 shows the correlation between house prices in Kuala Lumpur and the determinants. The result shows that only GDP, housing stock and population are the most significant determinants on the house prices in Kuala Lumpur ($p<0.05$). However, only the house price for Cluster in Kuala Lumpur was not influenced by housing stock while sharing the same determinants, namely, GDP and population growth with the rest of the properties. Moreover, only house price for Cluster was influenced by BLR at 0.05 level of significant. BLR has a significant positive relationship with the house price for Cluster in Kuala Lumpur. GDP has strong positive correlation to the house prices while housing stock and population growth has negative correlation to the house prices in Kuala Lumpur. Table 7 shows the correlation between house prices in Johor and the determinants. The result shows the correlation between house price of flat and the determinants are not significant ($p>0.05$). Therefore, the null hypothesis is accepted. There is no significant relationship between house price of flat and the determinants. On the other hand, house price for condominium has a positive correlation to GDP but a negative correlation to population. Apart from that, low cost flat only has negative relationship with the population growth at 0.05 level of significant. Similar to the correlation in Kuala Lumpur, GDP has strong positive correlation to the house prices while housing stock and population growth has negative correlation to the house prices in Johor.

The correlation between house prices in Penang and the determinants are shown in Table 6. The table shows that GDP, housing stock and population growth are the determinants for the whole housing market in Penang. GDP have strong positive correlation to the house prices where the Pearson Correlation r-value is more than 0.5 and near to 1.0. Both housing stocks and population growth has negative relationship with the house prices in Penang. However, the relationship between housing stocks and house prices are weaker than the relationship of population growth and house prices.

Specifically, these analysis shows that there are three common determinants which has significant relationship with the house prices in Malaysia. The determinants are GDP, housing stocks and population growth. The relationship between the determinants and house prices are strong. From the *r* value, GDP has positive correlation with the house prices while housing stocks and population growth have negative correlation with the house prices. Based on the result, house price will increase when GDP increases or vice versa. This is supported by Holly & Jones (1997) that income is the driving force behind the house prices. As income is increases, the purchasing power will also increase. The demand for housing is increasing significantly line with income increment. House price change is also driven by the supply of housing stocks. The result shows that there is a negative relationship between house prices and housing stocks. This is in line with the theory of supply and demand. When the supply is limited, and the demand is increasing, the house price is forced to increase. The behavior of the housing market is dependent on the buyer and seller. This study shows that population growth has a negative relationship with the house prices. Increases in population growth will result in decreases of house prices or vice versa. This phenomenon may be caused by an overestimation of supply in the market when the population expands. The demand for housing is difficult to determine when the population expands and when it stops growing.

Table 4 : Correlation between House Prices in Kuala Lumpur and the Determinants

		LBLR	LGDP	LHS	LINF	POP
LWPST1	Pearson Correlation	0.231	.897**	-.778**	-0.011	-.946**
	Sig. (2-tailed)	0.175	0.000	0.000	0.949	0.000
LWPST2	Pearson Correlation	0.235	.935**	-.810**	-0.006	-.966**
	Sig. (2-tailed)	0.167	0.000	0.000	0.974	0.000
LWPSD2	Pearson Correlation	0.196	.920**	-.768**	-0.023	-.891**
	Sig. (2-tailed)	0.253	0.000	0.000	0.895	0.000
LWPD	Pearson Correlation	0.241	.689**	-.470**	-0.074	-.655**
	Sig. (2-tailed)	0.156	0.000	0.004	0.667	0.000
LWPC	Pearson Correlation	.362*	.446**	-0.21	-0.085	-.343*
	Sig. (2-tailed)	0.030	0.006	0.219	0.621	0.040
LWPLCH	Pearson Correlation	0.241	.816**	-.736**	0.081	-.880**
	Sig. (2-tailed)	0.157	0.000	0.000	0.637	0.000
LWPF	Pearson Correlation	0.117	.838**	-.791**	-0.046	-.911**
	Sig. (2-tailed)	0.498	0.000	0.000	0.791	0.000
LWPCON	Pearson Correlation	0.08	.872**	-.779**	-0.038	-.917**
	Sig. (2-tailed)	0.641	0.000	0.000	0.825	0.000
LWPLCF	Pearson Correlation	0.017	.724**	-.660**	-0.058	-.799**
	Sig. (2-tailed)	0.924	0.000	0.000	0.738	0.000

*Notes: ** indicates significant at the 0.01 level, * indicates significant at the 0.05 level*

Table 5 : Correlation between House Prices in Johor and the Determinants

		LBLR	LGDP	LHS	LINF	POP
LJST1	Pearson Correlation	0.211	.819**	-.740**	0.000	-.886**
	Sig. (2-tailed)	0.217	0.000	0.000	0.996	0.000
LJST2	Pearson Correlation	0.167	.872**	-.756**	-0.067	-.930**
	Sig. (2-tailed)	0.331	0.000	0.000	0.699	0.000
LJSD1	Pearson Correlation	0.173	.819**	-.731**	-0.031	-.882**
	Sig. (2-tailed)	0.313	0.000	0.000	0.856	0.000
LJSD2	Pearson Correlation	0.137	.853**	-.763**	-0.015	-.911**
	Sig. (2-tailed)	0.426	0.000	0.000	0.933	0.000
LJD	Pearson Correlation	0.263	.638**	-.629**	0.113	-.687**
	Sig. (2-tailed)	0.121	0.000	0.000	0.510	0.000
LJLCH	Pearson Correlation	0.113	.537**	-.516**	0.003	-.613**
	Sig. (2-tailed)	0.513	0.001	0.001	0.986	0.000
LJF	Pearson Correlation	0.005	0.257	-0.182	-0.100	-0.29
	Sig. (2-tailed)	0.975	0.130	0.289	0.560	0.086
LJCON	Pearson Correlation	0.183	.368*	-0.273	0.221	-.443**
	Sig. (2-tailed)	0.286	0.027	0.107	0.196	0.007
LJLCF	Pearson Correlation	0.119	0.315	-0.292	0.008	-.418*
	Sig. (2-tailed)	0.490	0.062	0.084	0.965	0.011

*Notes: ** indicates significant at the 0.01 level, * indicates significant at the 0.05 level*

Table 6 : Correlation between House Prices in Penang and the Determinants

		LBLR	LGDP	LHS	LINF	POP
LPST1	Pearson Correlation	0.143	.917**	-.777**	-0.062	-.927**
	Sig. (2-tailed)	0.404	0.000	0.000	0.719	0.000
LPST2	Pearson Correlation	0.02	.910**	-.797**	-0.102	-.950**
	Sig. (2-tailed)	0.908	0.000	0.000	0.555	0.000
LPSD1	Pearson Correlation	-0.11	.690**	-.614**	-0.243	-.762**
	Sig. (2-tailed)	0.525	0.000	0.000	0.153	0.000
LPSD2	Pearson Correlation	0.063	.845**	-.732**	-0.077	-.907**
	Sig. (2-tailed)	0.716	0.000	0.000	0.654	0.000
LPD	Pearson Correlation	0.035	.674**	-.621**	0.033	-.713**
	Sig. (2-tailed)	0.838	0.000	0.000	0.849	0.000
LPLCH	Pearson Correlation	0.039	.633**	-.610**	-0.086	-.698**
	Sig. (2-tailed)	0.820	0.000	0.000	0.618	0.000
LPF	Pearson Correlation	0.126	.913**	-.802**	-0.061	-.956**
	Sig. (2-tailed)	0.466	0.000	0.000	0.725	0.000
LPCON	Pearson Correlation	0.122	.898**	-.815**	-0.106	-.956**
	Sig. (2-tailed)	0.479	0.000	0.000	0.537	0.000
LPLCF	Pearson Correlation	-0.169	.722**	-.793**	0.056	-.815**
	Sig. (2-tailed)	0.323	0.000	0.000	0.746	0.000

*Notes: ** indicates significant at the 0.01 level, * indicates significant at the 0.05 level*

5.1 ADF Unit Root Test

Unit root test is important to perform for examining the stationary of time series data. This study adopted Augmented Dickey-Fuller (ADF) unit roots test to test the integration of all variables including the independent variables. Table 7 reviews the ADF unit root test results. The table shows that only few variables are not stationary at level. Thus, null hypothesis indicate that the variables contain a unit root cannot be rejected completely. However, after the first differencing on each of the variable, all the variables are stationary at 1 per cent level of significant. Thus, the null hypothesis can be rejected and accept the alternative hypothesis. This means that all the variables are stationary of order 1, which is I (1). The only exception is the house price of condominium in Kuala Lumpur which it is statistically significant at 5 per cent level. In short, the shocks to the series are temporary and the effects will disappear and revert to its long run.

Table 7 : ADF Unit Root Test Result

	Level		**First Difference**	
Variables	**Intercept**	**Trend and Intercept**	**Intercept**	**Trend and Intercept**
LWPST1	1.303819	-2.275352	-8.414975***	-9.021171***
LWPST2	0.024263	-2.675686	-7.738157***	-7.752171***
LWPSD2	-1.757082	-5.449413***	-6.676313***	-6.694451***
LWPD	-3.542440**	-5.342860***	-5.607083***	-5.503600***
LWPC	-2.461237	-2.607074	-12.73833***	-12.55945***
LWPLCH	0.127597	-1.860973	-7.914379***	-8.493177***

LWPF	0.223202	-3.103876	-8.187807***	-8.349370***
LWPCON	0.405225	-3.594514**	-3.515604**	-3.445759
LWPLCF	0.662211	-2.826711	-5.936228***	-6.691947***
LJST1	0.924349	-1.261696	-6.786791***	-6.509313***
LJST2	1.165003	-2.183288	-5.855865***	-6.702260***
LJSD1	-0.538974	-2.705069	-5.538035***	-6.015375***
LJSD2	-0.160185	-5.599498	-11.43724***	-11.36198***
LJD	-3.365013**	-4.214304**	-7.025145***	-7.631943***
LJLCH	-3.345832**	-2.996735	-4.029235***	-4.002673**
LJF	-4.293266***	-4.289435***	-8.321760***	-8.170505***
LJCON	-2.810158	-3.086199	-6.589135***	-6.522250***
LJLCF	-3.167540**	-3.080468	-6.495064***	-6.894230***
LPST1	-0.918416	-4.169395**	-8.533984***	-8.511940***
LPST2	0.682182	-3.691386**	-6.686555***	-6.824776***
LPSD1	-2.085646	-4.366833***	-6.985112***	-7.020241***
LPSD2	-17.57615***	-6.567832***	-14.21871***	-15.50568***
LPD	-1.010753	-2.865922	-8.045420***	-8.269893***
LPLCH	-3.255665**	-4.810104***	-8.224502***	-8.279828***
LPF	2.517959	-1.833268	-7.118066***	-7.347534***
LPCON	2.735593	-1.663438	-1.568434	-5.290832***
LPLCF	-1.894698	-3.281922	-7.104359***	-7.014561***
POP	-4.450722***	-2.661871	-5.967976***	-0.613541
BLR	-2.367410	-2.318995	-4.049227***	-3.995619**
GDP	-1.144068	-3.563841**	-3.928903***	-3.964912**
INF	-3.925527***	-3.675319**	-5.471203***	-5.473875***
HS	-1.557843	-4.297406***	-7.232541***	-7.106363***

*Notes: * indicates at the 10 per cent level of significance, ** indicates at the 5 per cent level of significance and *** indicates at the 1 per cent level of significance*

5.2 Volatility clustering

ARCH LM test by Engle (1982) was undertaken to investigate the existence of volatility clustering in the house price series prior to employing an ARCH model. The results of LM tests for 9 residential properties prices in three states are depicted in Table 8. The results shows that house prices in Kuala Lumpur has positive LM values at 1 per cent of significance. The exemptions are Detached and Cluster house price which are not significant at p-value (P>0.10). Therefore, the house prices in Kuala Lumpur which have volatility clustering are Terraced, Semi-Detached, Low Cost House, Low Cost Flat, Flat and Condominium. On the other hand, Terraced, Semi-Detached, Detached and Condominium in Johor are also has positive significant LM values. This suggests the result rejecting the null hypothesis of homoscedasticity and proved that there is volatility clustering in the series. However, no similar result was found in Low Cost House, Low Cost Flat and Flat.

In Penang, there are Terraced houses, 2-3 Storey Semi-Detached, Flat and Condominium which shows positive LM value at 1 per cent of significance. Low Cost Flat and 1- 1 ½ Storey Semi-Detached shows positive LM value at 5 per cent and 1 per cent of significance respectively. Detached house and

Low Cost House in Penang do not show significant volatility clustering. However, the result of ARCH LM test is inconsistent with assessed house price trend in line graph. In the first objective, it is revealed that Detached, Semi-detached and condominium has volatile house price trend. Result of ARCH LM test shows that detached house has weak evidence in volatility clustering. This explains that house price for detached house are not fulfilling condition of volatility clustering, which is low volatility is followed by low volatility and vice versa. Overall, over half of the sample properties in the three states have volatility clustering. This result is consistent from the findings by Miles (2008), whereby the ARCH effects was found in over half of all U.S. states. The strong evidence of volatility clustering denotes that ARCH model is appropriate to carry out in order to analyze the volatility in these housing markets. The ARCH effects also showed that there are potential of underestimation of actual risk in the conditional variance.

Table 8 : ARCH LM tests for Volatility Clustering

Housing Types	LM (*p-value)*		
	Kuala Lumpur	Johor	Penang
1- 1 1/2 Storey Terraced	22.67372 (0.0000)***	23.79993 (0.0000)***	15.16804 (0.0001)***
2- 3 Storey Terraced	26.99294 (0.0000)***	28.01913 (0.0000)***	13.15332 (0.0003)***
1- 1 1/2 Storey Semi-Detached		23.79993 (0.0000)***	3.056047 (0.0804)*
2- 3 Storey Semi-Detached	8.82198 (0.0030)***	15.5732 (0.0001)***	11.32194 (0.0008)***
Detached	0.724113 (0.3948)	3.180985 (0.0745)*	1.740779 (0.1870)
Low Cost House	24.67099 (0.0000)***	0.008716 (0.9256)	1.115163 (0.2910)
Low Cost Flat	19.24576 (0.0000)***	0.007775 (0.9297)	6.288122 (0.0122)**
Flat	11.55313 (0.0007)***	0.043378 (0.8350)	24.18275 (0.0000)***
Condominium	18.87245 (0.0000)***	6.650956 (0.0099)***	24.21993 (0.0000)***
Cluster	0.091032 (0.7629)		

*Notes: *indicates at the 10 per cent level of significance, ** indicates at the 5 per cent level of significance and ***indicates at the 1 per cent of significance*

5.3 The ARCH Model

Once the house price series are determined to have volatility clustering, ARCH model is conducted together with the determinants to examine the volatility of the series. From the result of ARCH LM test, there are 7 types of properties in Kuala Lumpur and 6 types of properties in Johor that were to be estimated using the ARCH model. The results for each market are shown in Table 9 to 11. In analyzing the result, the significance of the variables (*p*-value) was determined from the Z score. Z score is a measure of standard deviation. In the end, two-tailed *p*-value ($|Z|>1$) was adopted in this study. The null hypothesis suggests that the volatility of dependent variables (house price) is affected by independent variables (determinants). In Kuala Lumpur, the most significant determinant to the house price volatility is the Base Lending Rate (BLR). BLR is 5 per cent significant to the house price of terraced, low cost house and flat in Kuala Lumpur. Gross Domestic Product (GDP) is also at 1 per cent level of significant to the house price of 2-3 storey semi-detached. Furthermore, low cost houses are affected by the changes

in the inflation rate at the 10 per cent level of significant. The determinants to house price volatility in Kuala Lumpur are BLR, GDP and inflation rate.

Table 12, signifies that the housing stock is the most significant determinants of the housing market in Johor. It is at the 1 per cent level of significant for the 1-1 ½ storey terraced, 1-1 ½ storey semi-detached and at 10 per cent level of significant for condominium. At the same time, BLR and inflation rate also have a significant effect on the house price volatility for 2-3 storey terraced dwellings. It is noted that house price of condominium in Johor is volatile by three determinants; these are the BLR, housing stock and the inflation rate.

The housing market in Penang is less influenced by these determinants. At a 1 per cent level of significant, there were no significant determinants of house price volatility in Penang. However, GDP had a 5 per cent level of significant for the 1-1 ½ storey terraced while housing stock had a 10 per cent level of significant for the 2-3 storey terraced. Furthermore, inflation rate was at 5 per cent of significant for the low cost flat. The determinants of house price volatility in Penang are: GDP, housing stock and inflation rate.

In summary, the most significant determinants of house price volatility from the three housing markets were found to be: the BLR, GDP, housing stocks and inflation rate.

Table 9 : ARCH model for Kuala Lumpur

Housing types	1- 1 1/2 Storey Terraced	2- 3 Storey Terraced	2- 3 Storey Semi-Detached	Low Cost House	Low Cost Flat	Flat	Condominium
Mean equation							
Constant	23.7624	19.4217	-1.1030	28.5279	16.1815	17.7180	16.1376
	(5.9025)***	(7.1281)	(-0.1777)	(1423.1010)	(5.3757)***	(4.8579)***	(2.8191)***
Base Lending Rate	0.1283	0.0903	-0.0250	0.1662	-0.0006	0.0855	-0.0165
	(2.2444)**	(2.4141)**	(-0.3461)	(3.1671)**	(-0.0179)	(2.3418)**	(-0.2623)
Gross Domestic Product	-0.6210	-0.2492	1.3043	-1.0391	-0.2916	-0.2539	-0.0494
	(-2.3070)	(-1.2300)	(3.0203)***	(-25.1585)	(-1.3931)	(-0.9553)	(-0.1302)
Housing Stock	0.0926	0.0761	0.0397	0.1105	0.0056	-0.0498	0.0850
	(1.0517)	(1.6105)	(0.1954)	(1.4027)	(0.0894)	(-0.7310)	(0.5441)
Inflation Rate	0.0140	0.0149	0.0066	0.0318	0.0047	-0.0106	0.0160
	(0.8030)	(1.2972)	(0.2052)	(1.9554)*	(0.3879)	(-0.8881)	(0.7962)
Population	-3.2732	-2.8372	-0.4276	-3.8371	-0.9438	-1.7896	-2.0833
	(-9.1132)	(-7.6635)	(-0.5111)	(-14.0926)	(-2.5914)	(-3.8872)	(-3.4018)
Variance equation							
Constant	0.0053	0.0035	0.0150	0.0147	0.0016	0.0029	0.0102
	(2.9539)***	(1.9969)**	(3.0520)***	(1.9430)*	(2.9980)**	(1.7779)*	(2.0099)**
ARCH(1)	-0.2362	-0.1591	0.0094	-0.4616	0.4744	0.4760	-0.1439
	(-1.1964)	(-0.3495)	(0.0430)	(-0.9292)	(1.1231)	(1.4360)	(-0.3387)

Table 10 : Result of ARCH model for Johor

Housing types	1- 1 1/2 Storey Terraced	2- 3 Storey Terraced	1- 1 1/2 Storey Semi-Detached	2- 3 Storey Semi-Detached	Detached	Condominium
Mean equation						
Constant	15.8267	13.3210	15.8267	22.2155	32.4461	18.4097
	(325.0028)	(5.2223)***	(325.0028)	(6.7403)	(3.1078)***	(4.3398)***
Base Lending Rate	0.0201	0.0417	0.0201	0.0570	0.1300	0.1488
	(1.4549)	(1.7568)*	(1.4549)	(1.2280)	(1.0555)	(3.0050)***
Gross Domestic Product	-0.1975	0.0441	-0.1975	-0.5128	-1.3501	-0.4950
	(-27.3430)	(0.2511)	(-27.3430)	(-2.1118)	(-1.7744)	(-1.6481)
Housing Stock	0.0485	0.0299	0.0485	0.0084	0.1731	0.1504
	(3.3703)***	(0.4472)	(3.3703)***	(0.1484)	(0.7210)	(1.9072)*
Inflation Rate	0.0004	0.0017	0.0004	0.0108	0.0639	0.0419
	(0.0847)	(0.1873)	(0.0847)	(0.9211)	(1.5752)	(2.6651)***
Population	-1.1075	-1.3515	-1.1075	-2.1928	-3.8949	-1.7507
	(-14.8406)	(-4.1121)	(-14.8406)	(-5.5338)	(-2.7725)	(-3.2628)
Variance equation						
Constant	0.0003	0.0009	0.0003	0.0038	0.0216	0.0052
	(0.8228)	(1.7550)*	(0.8228)	(2.7743)***	(4.8067)***	(1.1226)
ARCH(1)	1.4980	0.9180	1.4980	-0.0608	0.0562	0.5464
	(2.1474)**	(1.5720)	(2.1474)**	(-0.1631)	(0.2358)	(1.0666)

*Note: *indicates at the 10 per cent level of significance, **indicates at the 5 per cent level of significance and ***indicates at the 1 per cent level of significance*

Table 11: Result of ARCH model for Penang

Housing types	1- 1 1/2 Storey Terraced	2- 3 Storey Terraced	1- 1 1/2 Storey Semi-Detached	2- 3 Storey Semi-Detached	Low Cost Flat	Flat	Condominium
Mean equation							
Constant	8.397172	10.59936	15.49774	19.94888	19.07836	15.12843	22.06399
	(2.8839)***	(2.4758)**	(1.5295)	(4.1474)***	(10.0023)	(4.5586)***	(6.2624)
Base Lending Rate	-0.015942	-0.093304	-0.092606	-0.025113	-0.044145	-0.003466	0.067608
	(-0.5574)	(-2.2771)	(-1.0494)	(-0.4697)	(-2.4180)	(-0.2134)	(1.62)
Gross Domestic Product	0.405905	0.363634	-0.03393	-0.293284	-0.403345	-0.081704	-0.401678
	(1.9895)**	(1.2031)	(-0.0485)	(-0.8682)	(-3.0542)	(-0.3668)	(-1.5901)
Housing Stock	0.075183	0.127723	0.110023	0.18703	-0.057097	0.105207	-0.017674
	(0.9336)	(1.6876)*	(0.6065)	(1.5239)	(-1.2361)	(1.6015)	(-0.2513)
Inflation Rate	0.003225	0.00934	-0.023166	0.012757	0.017218	0.006956	-0.012993
	(0.2593)	(0.7252)	(-0.8712)	(0.6257)	(2.2208)**	(0.7381)	(-1.1115)
Population	-1.160545	-1.819277	-1.702428	-2.952756	-1.429065	-2.020994	-2.805709
	(-2.9125)	(-3.1955)	(-1.6235)	(-4.0882)	(-5.0974)	(-5.2803)	(-7.1669)
Variance equation							
Constant	0.005119	0.005701	0.021981	0.008471	0.000852	0.004049	0.00263
	(3.7802)***	(3.0647)***	(3.0727)***	(5.6401)***	(1.0145)	(3.4631)***	(1.5412)
ARCH(1)	-0.143474	-0.175252	-0.196799	-0.16544	1.362792	-0.452104	0.604366
	(-4.1986)	(-0.8240)	(-1.6760)	(-3.2550)	(1.9851)**	(-0.8924)	(1.0705)

*Note: *indicates at the 10 per cent level of significance, **indicates at the 5 per cent level of significance and ***indicates at the 1 per cent level of significance*

6.0 Property Implications

Based on the results in the previous chapter, the difference between significant determinants of house price and volatility were identified. From Table 12, it can be noticed, that there are three significant determinants of house price while there are 4 for house price volatility. The significant determinants for house price are GDP, housing stocks and population growth. In the case of house price volatility, population growth is not a determinant; however, BLR and inflation rate are determinants for house price volatility. This means that shocks in BLR, GDP, housing stocks and inflation rate will produce dynamic responses in the Malaysian housing market.

This paper provides an insight to the house price volatility in Malaysia based on the sample of house prices within the states that showed significant growth in the housing market. The findings of this study proved that volatility clustering exists in more than half of the house price in Malaysia. There are 7 housing types in Kuala Lumpur and Penang and 6 housing types in Johor which exhibited volatility clustering in their house price series. This implies that the housing market is exposed to an amount of underestimated level of risks. This information will raise investors' and policy makers' awareness of the significance of house price volatility in the Malaysia housing market. This study found that the house price trends of Kuala Lumpur exhibited higher volatility as compared to the house price trends of other states. As a result, the price of 2-3 storey semi-detached properties in Kuala Lumpur has increased by 240% from the lowest price of RM 807,875 (Q3 2005) to the highest price of RM 2,745,969 in Q4, 2013. Another significant increase also occurred in the 2-3 storey terraced property house prices in Kuala Lumpur, where it has increased by 150% from 2005 to 2013.

In recent years, people are panicking over the exceptional boom in the housing market. There is speculation that the housing bubble will burst in the housing market which will affect the high end overpriced property market. However, this issue can be resolved if the volatility clustering pattern in the house price trend is determined. Volatility clustering can be tracked by using ARCH LM test. This approach will enable investors to analyze the potential underlying risk in the house price trend, and make an extended forecast to predict the future house price trend. This study also showed that volatile house price trend does not have volatility clustering. Volatility clustering refers to the period of low volatility, followed by low volatility or vice versa. Therefore, volatility clustering cannot be explicitly identified from the house price trend. The ARCH LM tests were used to test the volatility clustering in the house price time series. This will allow investors and policy makers to assess the volatility clustering in the house price time series. Consequently, this will expose the underlying risk in the housing market and will assist investors to properly manage their portfolios. Furthermore, this result will also benefit those who develop housing market pricing derivatives. Furthermore, the result from ARCH model showed that there are 4 determinants which have impacts to the housing market in Malaysia. This study provides the information on the level of significance of determinants with the house types. This will enhance decision-making process for house investors. Investors can take into consideration the specific determinants which will impact specific housing type before making their investment decision, hence minimizing the risk and prevent loss of profits. Consequently, the housing market in Malaysia will grow further and help generate economic growth. Apart from that, policy makers can also take these determinants into consideration when making housing policies. Appropriate housing policy can be applied to the housing sector and attract the demand for homeownership and housing investment.

ARCH model allows the conditional variance to change over time and the main purpose of ARCH model is to predict the future conditional variance. The ARCH LM tests diagnosed that there were no ARCH effects in the remaining residual. Thus, ARCH model is a sufficient representation to analyze house price volatility. The investors should estimate the conditional variance by using the ARCH model as the measure for underestimate of the actual risk. Recent global financial crisis had drawn the attention

of policy makers and investors to the importance of house price volatility. The ability to capture and track volatility clustering in the Malaysian house price in a time series is going to make a big impact to the Malaysia economy. Therefore, the volatility risk can be estimated to prevent loss of profit. This will curtail speculation and herd behavior since investors will be knowledgeable about the condition of the housing market in Malaysia.

Table 12 : Comparison of determinants for house price and house price volatility

Most significant determinants	
House Price	House Price Volatility
1. GDP	1. BLR
2. Housing Stocks	2. GDP
3. Population Growth	3. Housing Stocks
	4. Inflation rate

7.0 Summary

This study has investigated the house price volatility in the Malaysian housing market by using quarterly time series data from 2005 to 2013. A volatile trend was observed in detached, semi-detached and condominium time series. The study on the volatility of house price in Malaysia is very limited. As such, the findings of this research contribute in various ways.

Firstly, this study has identified the determinants of house price volatility from the macroeconomics factors. Factors such as Base Lending Rate (BLR), Gross Domestic Product (GDP), housing stock, inflation rate and population growth have been determined as factors that had contributed to the price volatility in Malaysia's residential sector.

Secondly, the factors were tested by employing several econometrics technique to measure the level of volatility of house price. From the findings, the stakeholders of Malaysia's residential industry were able to identify which factors need to be responsive in order to control the price from booming. Furthermore, the analyses also differentiate the factors determination between house price and house price volatility. Therefore, property industry players will be able to know which factors will affect the residential industry in Malaysia and in particular affect the house pricing.

More importantly, the findings from this research will contribute towards understanding the relationship between macroeconomics factors and house price determination in Malaysia. It is important to study the house price issues because there are limited literature and analyses done on the subject matter and the fact that recently, residential has become a sensitive issue in Malaysia. With Malaysia potentially becoming a developed country in the near future, this delicate issue needs to be explored and research extensively, especially since the cost of living is escalating.

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