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Abstract of a thesis submitted in partial fulfilment of the requirements for the Degree of PhD in Finance.

AN EMPIRICAL ANALYSIS OF MALAYSIAN HOUSING MARKET: SWITCHING AND NON-SWITCHING MODELS

by

Zaemah Zainuddin

Increasing inflows of foreign investment particularly in the real estate sector in the early 1990s, has contributed to the building up of “bubble” in the economies of several Asian countries. In 2004, house prices increased rapidly in several countries such as South Korea, Hong Kong and Singapore (World Report, 2004). The rapid increase in prices has led economists to believe that a ‘bubble’ has form in the housing market. A housing market bubble occurs when house price increases are not justified by macroeconomic fundamentals and other underlying factors (Xia and Tan 2006). The effect of housing bubble bursts is seen in the loss of value to owners of capital, increase unemployment, slowing down of the economy particularly in housing-related sector.

This study empirically test whether a bubble exist in the Malaysian Housing Market for the period 1990 to 2004. Using a general to specific approach from a simple multivariate liner regression model (OLS) to more sophisticated models such as Vector Error Correction Model (VECM), Vector AutoRegression (VAR), regime-switching (Markov-Switching),GARCH model and MS-GARCH, our result suggests that a semi-rational bubble does exist in the Malaysian housing market in 1997:Q1 to 1998:Q2. The deviations or fluctuations of the Malaysian House Price Index cannot be explained by the macroeconomic fundamental variables such as income, interest rate and inflation. Furthermore, the result also implies that Malaysian housing market is inefficient market due to the slow adjustment process towards its long run equilibrium price. The mean and variance of the MHPI is significantly different in the two states (boom and burst) which suggest that the Malaysian housing market had experienced a boom and bust of house price bubble prior to the occurrence of the 1997 Asian financial crisis. The results of switching model approach support the changing behaviour of MHPI in different economic states, implying possible existence of bubbles in the Malaysian housing market.

Keywords: house price bubbles, regimes switching, GARCH, VECM
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Chapter 1
Overview of the study

“The world wide rise in the house price is the biggest bubble in history. Prepare for the economic pain when it pops.”

(Economist 2005)

1.0 Introduction

Since the early 1990s, the nominal house prices in several countries such as Australia, Spain, Sweden, Ireland and Britain are reported to have increased by more than 100% (Todd, 2008). The US nominal house prices have also increased by 95% between 1997 and 2006, the largest increase in the US housing market history (Todd, 2008).

The impact of increasing house prices on the economy drew the attention of economists (see Ball et al., 1996; Malpezzi & Wachter, 2005; Pollin, 2005). The long-run growth of house prices in the US and UK housing markets in 1980s, the “booming” of the Japanese housing market in 1989 (Kapur, 2006) and the 1997 Asian financial crisis (Meen, 1998) contributed to the increase in house price volatility. As a consequence, many researchers believe that the significant increase of house prices in most of the housing markets is an indication of house price bubbles (see Kapur, 2006, Meen 1998, Quigley, 1999).

The discussion about house price bubbles has escalated with the current collapse of the US housing market and its sub sectors such as insurance and mortgage companies, due to the failure of subprime mortgage. For example, the unanticipated failure of Fannie-Mae, Freddie-Mac (mortgage corporations) and the American Insurance Group (AIG) marked the beginning of the US subprime crisis. The boom in the US housing market gathered momentum between 1996 and 2006 with triple house prices recorded by the S&P-Case-Shiller House Price Index and the Federal Housing Enterprise Oversight (OFHEO) Index. According to Sander (2008), an increase of 93% to 137% in the US national average house price was recorded between 1996 and 2006. In late 2000, US house price inflation (measured by OFHEO) was 7%, an increase of 5% from the US house price inflation recorded in 1995. By 2003, the US
house price inflation had increased significantly with a more than 10% increase in nominal and real house price inflation (Leahey, 2005).

Factors which have contributed to the emergence of the US house price bubbles include low interest rates, poor lending standards and a mania for purchasing houses (Krinsman, 2007). The action by the Federal Reserves Bank of US (Fed) to lower interest rates is believed to be the main contributing factor triggering the expansion (boom) in the US real estate (Unterman, 2006). For example, a one-year adjustable rate mortgage (1/1 ARM) fell from 7% to 4% in June 2006 (Crouhy et al., 2008). The lowering of US interest rates resulted in a higher demand for houses as mortgage financing become cheaper (Crouhy et al., 2008).

The OFHEO reported that the increase in US house prices started to slow down due to the increase in interest rates by the Fed for a record seventeen times between 2004 to 2006 (from 1% to 5.25%). In addition, the Fed fund rates, which were at 1% in June 2003 increased to 5.25% by June 2006 (Crouhy et al., 2008). This increase in the Fed fund rate caused a 1.2 % decreased in US house prices (annual rate of 4.7%) in the second quarter of 2006 (Krinsman, 2007).

The slowing down of housing demand in the US affected the subprime lenders the most (Krinsman, 2007). The subprime mortgage schemes gave loans to borrowers who did not qualify for market interest rates loans because of their poor credit history or their inability to prove that they had enough income to support the monthly payments on the loans (Krinsman, 2007). Hence, the use of housing loans such as subprime mortgages- ARM to finance house purchase, have raised concern about the ability of borrowers to repay the loans if interest rates rise (Krinsman, 2007).

In March 2007, the Mortgage Bankers Associations declared that 13% of subprime borrowers were defaulting on their payments by 60 days or more (Krinsman, 2007). The collapse of the subprime mortgage industry was due to the higher than expected home foreclosure rates with 25 subprime lenders declaring bankruptcy. For example as of April 2007, the New Century Financial, which was the largest subprime lender in the US had liabilities exceeding $100 million (Krinsman, 2007). The US housing
market bubble reached its peak between 2005 and 2006 and finally burst in July 2007, leaving the US housing market with a subprime loan crisis (Smith & Smith, 2006).

The contagion of the subprime lending crisis spread from the US market to other countries, such as Australia, Canada, China, France, India, Ireland, Italy, Korea, Russia, Spain and the UK (Schiller, 2007). For example, MacQuire Bank in Australia declared losses of 25% in their two bonds, which were invested into senior loans and apply leverage. Similarly in Taiwan, the Taiwan Life Insurance Company also announced a loss on securities which were backed by subprime mortgages. Shin Kong Financial Holding Company, which owns the third largest life insurer in Taiwan, also reported to have invested as much as US$356 million in collateralized debt obligations in subprime mortgages in the US. In China, the Bank of China also reported a significant loss of $9 billion on US subprime securities, which claimed the two hedge funds of the Bear Stearns Company (Lim, 2008).

The real estate market is described as inefficient and imperfect compared with other financial markets due to the characteristics of real estate properties such as fewer transactions, fewer participants, less liquidity and supply rigidities (Kang & Gardner, 1989). These characteristics are believed to contribute to the deviation of the real estate markets’ price from its fundamental values and hence to the creation of a price bubble or boom in the real estate market (Xia & Tan, 2007).

The bubbles are described by economists as events which are unstable and unpredictable (Kritayanavaj, 2008). In real estate research, the concept of bubble is defined as an unusually sharp rise (deviation) in the asset price at the extraordinary high levels from the market fundamentals (Kritayanavaj, 2008). Market fundamentals are defined as an uncodified set of variables that help to determine an asset’s price which include the current values, dividends, and expectations about that asset’s value in the future’ (Garber, 2000, p.4). The fundamental variables which often influence house prices are interest rates, income level and inflation (Shiller, 2001).

In the real estate market, the buyer of a property is prepared to pay a price which he/she thinks is similar to the ‘fundamental’ values based on two criteria; the information on rental flows and the expected changes in the future price of the property (Xia & Tan, 2007). Therefore, people’s expectation of future house prices
changes during different economic conditions such as an expansion (boom) and recession (bust).

During a boom or rising market, residential properties sell quickly at values near to or higher than the seller asking price (Genesove & Mayer, 2001). However, in a decreasing property market, the average time taken to sell a residential property is longer due to the lower asking price (Genesove & Mayer, 2001). This was evident in Perth’s property market. During the boom period in 2005, houses in Perth took 25 days to sell. However, in 2008, the average time to sell a house in Perth was 62 days due the decreasing price in Perth’s property market (www.myrp.com.au).

At present house price bubble crises are occurring frequently in most housing markets. However, today’s house price bubbles differ from those of the past. To better understand the current house price bubble, this study describes two historical bubbles events one in Florida, US (1929) and the other in Japan (1989).

In 1920, the prosperity of the US economy allowed people to invest in property market. Due to an outstanding marketing strategy, real estate in Miami, Florida went into a ‘boom’ phase for several years (Allen, 1931). According to Bordo (2005), the Florida land boom indicated a real ‘displacement’ stage in the Keynes-Minsky-Kindleberger model. Furthermore, the boom and burst of Florida real estate is believed to have been caused by speculative bubbles with the American middle class people saw Florida as a wonderful residential place (Galbraith, 1954).

However, in spring and summer of 1926, the boom in the Florida property market ended with the busting of the bubble caused by the sinking of a Danish warship in Miami harbour and a hurricane that destroyed the Biscayne Bay projects (Allen, 1931). Theses events directly contributed to a higher cost of living in Miami. Other factors such as the oversupply of residential housing in Florida and the changes in residential investors’s perceptions of the Florida economy caused residential prices to decreased and burst (Galbraith, 1954).
Cargill et al. (1996) describe the Japanese economy in 1986 as a ‘bubble economy’ due to higher appreciation of the Japanese yen and easy mortgage financing. After World War II, Japanese people were encouraged to save their income for the future development of their nation. The large amount of savings in Japanese banks caused the Japanese economy to ‘boom’ with development in the banking sector leading to cheaper financing costs, a trade surplus and a stronger yen. During this period, Japan experienced the most inflated property prices in the 20\textsuperscript{th} Century with asset prices doubling and then tripling within few years (Cargill et al., 1996).

The Japanese bubble peaked with a rumour about the higher cost of land beneath the Imperial Palace in Tokyo. The land was assumed to cost more than the state of California. By 1989, Tokyo’s Giza district had recorded the highest price in Tokyo’s real estate at U.S$1.5 million per square meter (Cargill et al., 1996). Asset prices in Japan finally came down in the first half of the 1990s as result of the declined in Japanese stock prices by 60% from 1990 to August 1992 and land prices by half from 1991 to 1995 (Cargill et al., 1996). This period is known as the bursting of the bubble economy in Japan (Cargill et al., 1996).

The collapse of the Japanese economy occurred gradually as many companies, particularly in sectors related to real estate, were left with large debts. For example, a total of US$ 9 trillion was lost due to decreased property prices and a 65% decreased in property prices was recorded between 1991 and 2005 (Cargill et al., 1996).

The US subprime crisis and the historical bubbles of Florida, US and Japan have shown that the asset price bubble can grow rapidly and the cost of the bubble bursting can be extremely expensive for the economy (Belke & Wiedmann, 2005). Therefore, it would be of great interest for this study to examine housing market, focusing on price bubbles to the case study of Malaysia in order to reduce the potential harm caused from booms to bursts of house price in the Malaysian economy.

1.1 Background of the Study

The real estate market has been linked to the productive sector of the economy as it offers different types of input to different sectors (O’Flaherty, 1994). For example, the property market, which is part of the real estate market has constituted 30\% of job creation in the US economy since 2001 (Economist 2005). In addition, real
Estate or property assets consist of over half of the world’s invested wealth (51.5%) (Wallace, 1990). With its increasing share in the national economy, the property sector is an important provider of economic development (Liu et al., 2004).

According to Ibbotson et al., (1985), approximately 45% to 75% of the wealth in most developing countries was generated through the real estate market. For example in Egypt the contribution of real estate sector amounted to $75 billion of the Egypt’s’ GDP (De Soto, 1997). In East-Asian economies, the high exposure of the banking sector in real estate markets indicates that real estate generates profits to the banking sector through mortgages (see Table 1.1).

| Table 1.1 Exposure of East-Asian Banking Sector to Real Estate, 1996 |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Real estate loan in the bank    | Indonesia       | Malaysia        | Philippines     | Singapore       | Thailand        |
| 25%-30%                         | 30%-40%         | 15%-25%         | 30%-40%         | 30%-40%         | 30%-40%         |
| Average loan exposure to real   | 7%              | 58%             | 17%             | 30%             | 44%             |
| estate as % of GNP              |                 |                 |                 |                 |                 |
| NPL from the real estate sector | 18%             | 6%              | 8%              | 4.5%            | 16%             |
| (% of total loans)              |                 |                 |                 |                 |                 |
| Moody’s rating of the banking   | -               | D+              | D+              | C+              | E+              |
| sector                          |                 |                 |                 |                 |                 |


Table 1.1 shows the exposure of the banking sector to the real estate market in Indonesia, Malaysia, Philippines, Singapore and Thailand prior to the 1997 Asian financial crisis. Among the countries which were reported to have higher real estate loans in the banking sectors were Malaysia, Singapore and Thailand. The excessive bank lending in the real estate sector for these countries was due to the expectations of investors in the strong growth of the real estate market (Kallberg et al., 2002). For example, Koh et al., (2006) found that in the mid-1990s the main factor contributing to the real estate price bubble in Thailand and Malaysia was the lending sector. The over-lending in the real estate market (Allen & Gale, 2000) and the moral hazard problems (Quigley, 1999) in East-Asian financial institutions were other factors that caused price bubbles in the property market in East-Asian countries.
Quigley (2001) argued that the banking practices (which induce moral hazard) and the undeveloped market for real estate property in Asian countries are possible factors which contributed to the 1997 Asian financial crisis. In Malaysia, the use of collateral in every commercial mortgage loan induces a moral hazard problem due to the added incentive for a customer to build an appreciating market in order to borrow funds for further expansion (Quigley, 1999). Since real estate property is the only form of collateral requested by the bank, people tend to misuse it for personal gain.

The house price indexes in several Asian countries were reported to be volatile due to the impact of the 1997 Asian financial crisis (see Table 1.2 and Figure 1.1). According to Liow and Ooi (2004), the investment return from real estate in East Asia countries was affected by higher volatilities recorded in the house price indexes during the 1997 Asian financial crisis period (see Table 1.2).

Table 1.2 House Price Indexes movement during and after the Asian Financial Crisis for selected Asian Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>During crisis period</th>
<th>After crisis period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Kong</td>
<td>-61.34% (1997-2003)</td>
<td>+60.72% (2003-2005)</td>
</tr>
</tbody>
</table>

Source: Global Property Guide report (www.globalpropertyguide.com)

Table 1.2 indicates that the Hong Kong and Philippines housing markets were most affected by the Asian financial crisis. In Hong Kong, the house price index decreased by 61.34% and in Philippines by 56.20%. Higher volatility in the Hong Kong housing market was caused by the availability of residential land, the monopolization of the market by a few real estate developers and the fact that the Hong Kong public housing sector is one of the largest housing market in the world (Global Property Guide, 2009). For the Philippines, the decrease in house price index was caused by high transaction costs in buying and selling property assets (16.23%- 23.75%) and the high amount of housing stock available in the market due to less demand from professional expatriates as the global economic recession took hold (Global Property Guide, 2007).
In the post crisis period, the Hong Kong property market, which was reported to have had the highest decrease in the house price index, had a fast recovery with a 60.72% increase in the house price index recorded between 2003 and 2005 (Global Property Guide, 2007). This was followed by Thailand with increase in house price indexes of 29.34% between 1999 and 2006. Although the Malaysian house price index decreased by 18.78% during the Asian financial crisis (1999 to 2006), the recovery process has been slow as the house price index only increased by 10.20% between 1999 and 2005 (Global Property Guide, 2007).

Figure 1.1 illustrates the house price indexes for selected Asian countries with 1995 as the base year. The period covers 1995 to 2007 with a gradual movement of house price indexes in Malaysia, Thailand and Indonesia during the post-crisis period (1999 onwards). The house price index moves differently during different economic conditions such as expansion/boom, during crisis period and recession/burst (post crisis period).

Figure 1.1 Real House Price Indexes for Asian Countries (1995=100)

All house price indexes showed volatile movement during the 1997 Asian financial crisis. Hong Kong, Indonesia and the Philippines recorded the most decreased value in house price indexes. In the post crisis period, most of the house price indexes moved along the range of less than 100 basis points index, except for Thailand. The recovery of Indonesia house price index is far behind other countries. This is due to
the failure of the IMF stimulation packages, designed to restore the Indonesian economy after the Asian financial crisis (Koh et al., 2005).

According to Renaud et al., (1998) financial crises can also be associated with business cycle downturns as the countries which are most affected by the financial crises go through a series of ‘unfavorable events’ in their financial markets. This includes a collapse in property prices, a weakening of the banking systems, volatility in the exchange rates and the bursting of business cycles (Herring & Wachter, 1999). These events took place in most of the East-Asian countries during the financial crisis from 1997 to 1999.

The real estate market was believed to be the main factor, which triggered the Asian financial crisis in the Thailand, Philippines, Indonesian and Malaysian economies (Liow, 1998). Furthermore, the collapse of land prices in Indonesia and Thailand also contributed to the 1997 Asian financial crisis (Mera & Renaud, 2000).

The impact of the Asian financial crisis on the Malaysian housing market was less damaging than in other Asian countries (see Figure 1.1). Figure 1.2 shows the movement of the nominal and real house price index (MHPI) in Malaysia. The MHPI, which consists of 70 sub-indices, measured the long-run trend in Malaysian house prices and evaluated the condition of Malaysian housing market (Valuation and Property Service Department of Malaysia). The 1997 Asian financial crisis depressed the Malaysian property sector as the market was significantly affected by the substantial devaluation of the Malaysia Ringgit (RM), the outflows of foreign capital, the emergence of financial and moral hazard problems in banking and financial institutions and the weakening in employment (Hwa and Keng, 2004).

In the first half of the 1990s, the Malaysian economy encountered strong economic growth and high asset inflation (Hwa and Keng, 2004). Malaysian real estate debt, as a percentage of GNP, was about 58% in 1996 (Renaud et al., 1998) and the growth in bank credits to the private sector, mainly in residential mortgage relative to the GDP growth, was about 40% prior to the crisis (Barth et al., 1998). Furthermore, the substantial inflows of foreign direct investments into Malaysia increased the demand

A report from the Malaysian Valuation and Property Services Department, (Malaysia Ministry of Finance 2002 and 2003) showed that at the peak of the property market in 1997, the total volume of transactions was almost 40% of the GNP but this dropped to 22% in 1998 during the Asian financial crisis. Furthermore, prior to the 1997 Asian financial crisis, the real estate market and other related sectors accounted for 20% to 30% of the Malaysian GDP growth (Jomo, 2001). The yields in the prime properties in Malaysia were low in the peak period, compared with other East-Asian countries, since many people were expecting higher returns on their investments by buying and selling real estate properties in a short period of time. This short-selling of real estate properties for capital gain purposes caused the Malaysian real estate market to become more volatile (Hwa and Keng, 2004).

**Figure 1.2 Malaysian House Price Index, MHPI (1990=100)**

![](source: Global Property Guide (www.globalpropertyguide.com)

According to Talib (2000), a market analysis warned about the oversupply of condominium in the Malaysian urban areas in the early 1990s. However, due to the higher expectation of capital gains from buying and selling properties during the peak of Malaysia housing market (1990 to 1996), developers and investors seemed to ignore the warning. For example, prior to the 1997 Asian financial crisis, house prices in Damansara (Kuala Lumpur) were valued between RM1.5 million to RM2.5 million (Talib, 2000).
By 1997, the Malaysian property market was brought to a halt due to the currency and economic crises caused by the Asian financial crisis (Talib, 2000). The luxury property prices in Kuala Lumpur fell by 39% between 1997 and 1999 (Global Property Guide, 2007) and the MHPI plunged by 9.4% at the end of 1998. Further decline in MHPI is reported in 1999 by 2.3% (Rating Agency of Malaysia, 2007) (see Table 1.3).

The impact of the post Asian financial crisis includes the decrease in Malaysia’s GDP by 7.5%, a decrease in real estate transactions by 32% and the overall decline in real estate value by 48% (Jomo, 2001). The collapse of the real property market in Malaysia was due to the excess of supply and high vacancy rates, particularly in the high-density areas such as Kuala Lumpur, Selangor and the Klang Valley during the peak years of 1990 to 1996 (Talib, 2000).

Table 1.3 Annual price changes of MHPI in pre-crisis and post-crisis period.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biggest annual price drop</td>
<td>1.9%</td>
<td>-9.4%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Biggest annual price increase</td>
<td>18.3%</td>
<td>1.9%</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

Source: Rating Agency of Malaysia Report (RAM, 2007)

In 1999, surplus properties in the country were valued at 14% of GDP, a result of the economy rebounding (Jomo, 2001). There were roughly two million square feet of vacant office space in Malaysia and a surplus of about 90,000 housing units, mainly in multi-family condominium units (Malaysia National Valuation Property Statistic, 2000). The large quantity of residential stock (supply) showed that the government simulation packages and polices to build up real estate sector in Malaysia (see section 2.7) were successful. Furthermore, the MHPI rose by 17.34% from 2001 to 2005 (Global Property Guide, 2007).

In the post crisis period, Malaysian real estate transactions and bank lending to the real estate sector increased. For example, in September 2001, the amount of loans outstanding in the Malaysian real estate sector was approximately RM160 billion or
37% of all total loans. In addition, the service sector within Malaysian real estate industry contributed 12% in terms of GDP towards the growth of Malaysian economy in 2002 (Ministry of Finance Malaysia- Economic Report, 2002/ 2003).

Given the importance of the real estate sector in generating and stimulating higher growth in the Malaysian economy, this study attempts to investigate whether the Malaysian housing market experienced a house price bubble from 1990:Q1 to 2004:Q4. The study uses two approaches of single model and switching model. Thorton (2005), Kindleberger (1978) Minsky (1982) and Bordo (2005) each provide theoretical views on housing bubbles. However, none of the authors has attempted to construct effective techniques for examining house price bubbles, which can then be applied to the real economic situation and produce a rational explanation about the occurrence of a bubble.

The theoretical model developed in this study is inspired by the work of Abraham and Hendershott (1996) and their focus on the demand factors. The model is tested with several econometric techniques such as multivariate regression, Generalized Auto Regression Conditional Heteroskedasticity (GARCH) and regime-switching, MS-GARCH which can empirically examine the existence of bubbles in the Malaysian housing market.

1.2 Problem Statement

Bubbles can benefit an economy through reduced capital outflow and increasing investment inflow, but the cost of a bubble is expensive since it can expose a country to bubble-crashes and capital reversals (Caballero & Krishnamurty, 2005). The bursting of a bubble in the housing market can also generates a stronger negative impact on the economy compared with the stock market collapse due to the high transaction cost, illiquidity and heterogeneity of the housing characteristic (Helbling & Terrones, 2003). The bursting of a house price bubble can cause a slow adjustment process as house prices revert to their equilibrium price. As a result, inefficient houses prices will prevail in the market for longer period (Helbling & Terrones, 2003).
As the real estate market plunged, banks and financial institutions lost billions as a result of overexpansion to the real estate markets (Kallberg et al., 2002). This soon spread to other parts of the financial sector resulting in different types of financial problems such as a currency crisis, a banking crisis and a stock market crisis (Kallberg et al., 2002).

In Malaysia, more than 140 industries and 2.5 million people are engaged, either directly or indirectly in the construction and property sector (Liong, 2007). Therefore, given the importance of housing in the Malaysian economy, the impact of a bubble burst in the housing market will be large and significant. This however raises issue of how to model accurately the existence of bubble in house prices in Malaysia.

According to Pugh and Dehesh (2001), although the real estate bubble is not a new phenomenon, the impact of the recent US subprime crisis differed in size and magnitude compared to past bubbles crises such as those in Florida in 1920 and Japan in 1989. The authors explain that due to globalization and the interdependence of property and larger sectors of the economy, past theories and explanations used to explain bubbles are less reliable in today’s new era of bubble crises. Currently, there are fewer homeownership policies and fewer risk-taking activities by banks, which did not exist in historical bubbles crises (White, 2009).

Property markets, which are complex and contain unique characteristics such as durability, illiquidity and heterogeneity, require more than one theory to be used in their analysis (Pugh & Dehesh, 2001). Therefore, this study combines several theories such as price expectation theories, housing bubble theories and several statistical techniques to examine the existence of a house price bubble in the Malaysian housing market in the context of house price level (mean of house price) and house price volatility (variance of house price) with some economic fundamental variables.

From an empirical perspective, the issue of a house price bubble has generated interest from policy-makers, investors, buyers and sellers in the real estate market. The interest in house price bubbles is motivated by the direct impact of residential properties on other industries such as the construction sector, raw material markets and labour markets (Ball et al., 1996). For example, during a recession, a tight money policy forces the demand for houses to fall (Schnure, 2005) as more people are
reluctant to make higher purchases like houses. This action leads to a decrease in the value and quality of collateral prices to a credit crunch and to an increase in bankruptcy and foreclosure of financial mortgages and other related institutions (Kiyotaki and Moore 1997; Mishkin 2001, 2007).

In Malaysia, the decline of confidence in the market can be seen in the outflows of large portfolios and the decline in equity values and property prices in the post crisis period (Ito & Hashimoto, 2007). As a result, the corporate sectors, which used real estate assets as bank collateral, experienced huge losses that lead to an increase in non-performing loans (NPL) by 5.7% at the end of 1997 with an increasing peak of NPL at the end of 1998 (Ito & Hashimoto, 2007). The NPL in the Malaysia real estate sector includes the construction sector and the purchase of residential and non-residential property (Ito & Hashimoto, 2007). In December 2000, the amount of NPL reported from the real estate sector was RM1717 million, which is 39.2% of the total NPLs in the Malaysian banking sector (Ito & Hashimoto, 2007).

Modeling the housing market is important since the the volatility of residential properties, especially house prices, directly influences the levels of investment in other related sectors, such as the construction, raw material markets, labor markets and consumption (Ball et al., 1996). In Malaysia, the active promotion of the Malaysia My Second Home (MM2H) programme by Ministry of Tourism Malaysia has encouraged foreigners to purchase residential property with the annual growth of foreign property investments increasing 10% from 2003 to 2006 (Su, 2010). This figure shows the importance of monitoring and protecting the residential properties in Malaysia from a potential bubble price crisis.

As the real estate property market expands, household spending will also increase and this in turn will increase consumption and stimulate economic growth (Subhanji, 2007). The Housing Industry Association of Australia (HIA, 1993) also states that the income multiplier for housing is 2.4; where 100 million investments in housing development will increase income by 240 million. This proves that stabilizing the housing market is crucial for economic growth and living standards especially in a developing country like Malaysia.
The 1997 Asian financial crisis affected not only homeowners but also on the rental sector in Malaysia. For example, in 1998, the leasing of residential in Malaysia remained slow and depressed due to the decline in corporate housing budgets and the number of expatriates renting the properties (Yong, 2000). The Malaysian housing market was also affected negatively by the increase in Malaysian economic uncertainty, strict mortgage financing by banks and financial institutions and higher mortgage rates (Yong, 2000).

1.3 Research Objectives

This study develops a dynamic model to investigate house price bubbles in the Malaysian housing market.

The objectives of this study are to:

- identify whether a bubble existed in the Malaysian Housing Market from 1990:Q1 to 2004:Q4 using three economic fundamentals (interest rates, inflation and income).
- examine the efficiency of the Malaysian Housing Market by looking at the period of adjustment (correction mechanism which diverts house prices back to equilibrium prices) during the post-bubble crisis.
- suggest a new technique to model house price bubbles in the Malaysian housing market using the single model approach (linear way) and switching model approach (nonlinear way).
- provide appropriate risk management techniques to manage housing bubble crisis in Malaysia.

1.4 Significance of the Study

The literature on bubbles has focused primarily on the financial markets. Only a few studies have been conducted on the real estate market (for example Abraham & Hendershott, 1996; Ayuso & Restoy, 2003 and Bourassa et al., 2001). Numerous studies on the real estate market have tried to establish a link between economic fundamentals and their effects on property prices (Mankiv & Weil 1989). However, the empirical findings of these studies have produced mixed results due to different approaches in modeling the fundamental variables.
Several private agencies have also conducted in-depth analyses of the housing market in Malaysia (newspaper, consultation agencies, RAM). However, the variables used were inadequate as they were based on the previous studies conducted in developed countries. Therefore, the outcomes of such research are less useful for policy implementation in Malaysia.

In Malaysia, research on the real estate market has been carried out in different areas, such as land regulation (Bertaud & Malpezzi, 2001), customer satisfaction (Chee & Peng, 1996), pricing of condominiums (Chin et al. 2001) the effect of regulation and tax on housing subsidy (Malpezzi, 1997) and the role of the state in the Malaysia housing market (Agus, 2002). There remains a lack of research on modeling the house price bubble in Malaysia. This study contributes several new insights regarding the Malaysia housing market. These insights include:

- Expanding the research of house price bubble to other countries, which experience house price bubble crises using the econometric techniques and theoretical framework of modeling house price bubbles.
- Increasing the awareness in housing market players (investors, sellers and buyers) of the house price bubble process and its impact on the economy.
- Providing a better picture of the Malaysian housing market and facilitate in understanding of the boom and burst process so that adequate preventive measures can be designed.
- Using a combination of the single model and regime-switching model in modeling house price bubbles. The techniques used in this study employ comprehensive modeling approaches, to examine the bubbles in Malaysian housing market such as the VAR/VECM model, GARCH and MS-GARCH (Markov-Switching-GARCH).

1.5 Organization of Thesis
This thesis consists of six chapters. Chapter One includes the introduction and background of the study, problem statement, research objectives and significance of the study. Chapter Two presents an overview of the real estate market in Malaysia. Chapter Three discusses the literature review on “bubbles” in housing markets and the
real estate cycle. Chapter Four elaborate on the proposed house price bubble model used in this study. Chapter Five discusses the data and methodology of the study and Chapter Six presents the analysis and findings. The conclusion and recommendations are presented in Chapter Seven.
Chapter 2
An Overview of the Housing Market in Malaysia

“Unlike some of its neighbors, Malaysia makes it fairly easy to buy property. Thailand, the Philippines, Indonesia and even Singapore all prevent foreigners from owning land, restricting them to buying apartments or to using leasehold arrangements...”

(Alex Frew McMillan, International Herald Tribune, August 2006).

2.0 Introduction

This chapter presents an overview of the Malaysian housing market. Section 2.1 provides a general background to Malaysia. Section 2.2 addresses the structure, characteristics, pricing and property cycles of the Malaysian housing market. The mortgage market and housing policy in Malaysia are discussed in sections 2.3 and 2.4 respectively. Other related issues such as capital control and policies to revitalize the real estate market in Malaysia are outlined in sections 2.5 and 2.6 respectively. Section 2.7 concludes the chapter.

2.1 Background of Malaysia

Malaysia has a total land size of 328,550 square kilometres and only 1,200 square kilometres of water. The country consists of two regions; Peninsular Malaysia (West Malaysia) and East Malaysia (see Figure 2.1) In West Malaysia, there are four regions; Northern (Perlis, Kedah, Penang, Perak and Georgetown, the growth centre), Central (Selangor, Federal Territory of Kuala Lumpur, Negeri Sembilan, Melaka and Kuala Lumpur as the growth centre), Eastern (Kelantan, Terengganu, Pahang and Kuantan as the growth centre) and Southern (Johor and Johor Bahru, the growth centre) (Aslam & Hassan, 2003). As for East Malaysia, there are two regions; Sabah (Sabah and Federal Territory of Labuan and Kota Kinabalu, the growth centre) and Sarawak (Sarawak and Kuching, the growth centre).

The country is located between the Indian Ocean and the South China Sea, sharing land boundaries with Indonesia, Thailand and Brunei (Zakaria, 1999). Based on the Malaysian population statistics as on January 2010, Malaysia has a population of 28.8 million people from different ethnic origins including Malay, Chinese and Indians.
(Department of Statistics Malaysia, 2010). Approximately 51% of these people live in urban areas (www.aaph.net- Asian Association of Planning and Housing).

**Figure 2.1 Map of Malaysia**


The economic policies of Malaysia are based on exports and international trade. Malpezzi and Mayo (1997) describe Malaysia as a middle income developing country, with an average per capita income growth of 3%. During the period 1971 to 1990, the Malaysian economy grew at an average rate of 8% (Chamburi & Mohd Yusof, 1997) while the urban sector grew by 5% per year and the demand for housing increased by 7.1% (Malpezzi et al., 1997).

From 1990 to 1996, the Malaysian economy expanded rapidly with exports growing at an annual rate of 18%, which was 10% higher than the Gross Domestic Product (GDP) (World Bank, 1999). This growth created higher demand for capital investment into Malaysia, since more funds were needed to sustain the economic development and growth.

In early 1990s, the Malaysian economy expanded and attracted a huge foreign capital inflow due to the liberalization of financial markets and some reform in the real estate market (Kind & Ismail 2001). According to Glindro et al., (2007) during early 1990s, many Asian countries including Malaysia, experienced reforms in the real estate market. These reforms were the positive result of the liberalization in housing and financial markets. In Malaysia, the reformation of the real estate market could be seen in the innovation of investment instruments such as real estate investment trust (REITs), the development of a secondary mortgage market and other organizations related to real estate market (CAGAMAS and DANAHARTA) and the introduction of Islamic financing in the Malaysia mortgage market. All of these reforms have
possibly improved the efficiency of the Malaysian housing market and led to an increase of housing prices and demand. This is evident in the two highest peaks recorded by MHPI in 1993 and 1995 (see Figure 2.3) which accelerated the formation of bubbles in the Malaysian economy (Kind & Ismail, 2001).

However, this expansion has created several drawbacks. For example, the inflows of foreign capital into Malaysia have imposed higher foreign debt on the Malaysian government where the debt was reported to be US$45.2 billion in June 1997 (30% was in short-term debt) (Kind & Ismail, 2001). Furthermore, the flows of foreign debt were invested in the stock market and the real estate market instead of economic productions such as land, labor and capital. The flow of this capital into the non-productive sector of the real estate market caused a boom in the real economic sector due to the temporary procyclical effects on both consumption and investment (Hui, 2009).

The expansion of investment and credit into the Malaysian economy has brought extraordinary growth in the real estate market and the construction sector. For example, the Malaysian Government has invested a large amount of capital in improving infrastructure and building ‘mega’ projects, such as, the Multimedia Super Corridor, the Malacca Strait Bridge, the Artificial Island Project and other projects which contributed to the overheated real estate market and construction sector (Han, 2008). In 1995, rental cost in Kuala Lumpur increased by 55% and house prices increased by 66%, while the vacancy rate increased from 5% in 1990 to 25% in 1998 (Han, 2008).

In 1997, the growth of Malaysian economy ended with the outbreak of the Asian financial crisis. The performance of Malaysian economy deteriorated with the decrease of the Kuala Lumpur Composite Index (KLCI) from 1077.3 points on June 30th 1997 to 594.44 points on December 31, 1997 and the devaluation of the Malaysian currency against the US dollar (Kind & Ismail, 2001). There was also a significant drop in the daily trading of the Malaysian real estate market by 37% in July 1997 as housing prices dropped sharply (Han, 2008).
2.2 Overview of the Malaysian Property Market

This section describes the property market in Malaysia. Understanding the characteristics and functions of the Malaysian property market may help to extend the assessment of house price bubbles in the Malaysian housing market. In Malaysia, property markets are categorized into residential, commercial (shopping complexes and offices), industrial (factory), recreational facilities, agricultural and resort and hotels (Awil, 2007). Residential property in Malaysia is in high demand with highest number of transaction recorded ever year (Malaysian Property report 2002). Table 2.1 shows the residential market relative to the total property market in Malaysia.

The residential property market is a model of a heterogeneous utility-bearing product consisting of a package of characteristics and structural attributes which are connected to the residential unit price (Mar Iman, 2006). The structural attributes are floor size (Mok et al., 1995) and number of rooms, bathroom and bedrooms (Linneman, 1980; Rodrigues & Sirmans, 1994). These attributes and other structural and external factors have a long and short-term impact on house prices (Morris et al., 1979; Kain & Quigley, 1970).

Yu (2004) describes a house as an untied commodity bundle that has various structural and spatial attributes. Basu and Thibodeau (1998) identified seven group of housing characteristic: improvement, accessibility, proximity, externalities, lot and land-used and time of data collected. These characteristics are further classified into two large groups by Can (1992): housing structural characteristics and neighbourhood characteristics. Yu (2004) found house attributes such as the number of bathrooms, air conditioning and floor sizes added value to houses in rich area compared with other suburban poor areas.

The property index for the Malaysian housing market which is the Malaysian house price index (MHPI) uses the hedonic model. According to Rosen (1974), the hypothesis underlying hedonic method is that goods (house price) are valued for their utility bearing attributes or characteristic. The MHPI, which uses the hedonic method, is able to capture significant determinants of house prices by taking into account both the spatial and structural attributes of housing (Yu, 2004).
Table 2.1 Percentage shares of residential markets from total property market in Malaysia from 1996 to 2005

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Property Transaction (in volume)</th>
<th>Residential market (in volume)</th>
<th>% of residential from total property market</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>270,538</td>
<td>170,007</td>
<td>62.84%</td>
</tr>
<tr>
<td>1997</td>
<td>274,749</td>
<td>175,644</td>
<td>63.93%</td>
</tr>
<tr>
<td>1998</td>
<td>186,077</td>
<td>122,881</td>
<td>66.04%</td>
</tr>
<tr>
<td>1999</td>
<td>225,901</td>
<td>157,082</td>
<td>69.54%</td>
</tr>
<tr>
<td>2000</td>
<td>240,068</td>
<td>170,932</td>
<td>71.20%</td>
</tr>
<tr>
<td>2001</td>
<td>242,634</td>
<td>176,208</td>
<td>72.62%</td>
</tr>
<tr>
<td>2002</td>
<td>231,394</td>
<td>162,296</td>
<td>70.14%</td>
</tr>
<tr>
<td>2003</td>
<td>243,376</td>
<td>164,723</td>
<td>67.68%</td>
</tr>
<tr>
<td>2004</td>
<td>293,212</td>
<td>195,243</td>
<td>66.59%</td>
</tr>
<tr>
<td>2005</td>
<td>276,508</td>
<td>181,762</td>
<td>65.73%</td>
</tr>
</tbody>
</table>

Source: Property Market Report, various years.

According to the RAM report in 2007, the residential market which is made up of four million households, is the largest segment of the entire property sector and accounts 68% of total transactions in the Malaysian property market (see Table 2.1). The percentage share of the residential market has increased every year even in the post crisis period in 1998 (see Table 2.1). This shows that the Malaysian residential market, which makes up about two thirds of the total property transactions in Malaysia (Mar Iman, 2002) has a significant impact on the changes in Malaysian house prices. With a total value transaction of RM60 billion, or 20% of the country’s GDP, the Malaysian residential market is the largest market in the Malaysian property sector (Property Market Report, 2005).

Today, people have begun to acknowledging the importance of residential property as a basic necessity in a household’s overall wealth (Ting, 2004). As family income increases, purchasing a house is seen as fulfilling the basic need of a family (Shuid, 2003). This has forced many households to allocate a proportion of their savings or funds to own a house.
In Malaysia, people are reported to allocate one third of their income for housing investments such as paying rents or loan repayment (Mar Iman, 2002). Terrace or linked houses are the preferred choice (Ting, 2004) and constitute the majority of residential buildings in Malaysia. Approximately 57% of terraced houses were being built in 2002 (Kubota et al., 2005). These houses are reported to be the least risky asset compared to other type of houses in Malaysia (RAM, 2007). Other types of houses built in Malaysia are bungalow or detached houses, semi-detached houses and condominiums or apartments (RAM 2007).

2.2.1 The Characteristic of Malaysian Housing Market

Housing price is different from that of non-residential properties such as office, industrial or retail properties (DiPasquale & Wheaton 1996). Therefore, it is very important to understand the characteristics of the Malaysian Property Market before discussing bubbles in the housing market.

In Malaysia, there are two forms of property ownership; freehold and leasehold. With regards to leasehold title, the ownership of the land returns to the state authorities when the lease period expires (30, 60, 90 years but not exceeding 99 years) (National Land Code 1965). However, owner(s) of a leasehold property can make an application for renewal, subject to the state authority’s approval and a further payment of premium based on the current market value of the leasehold property. In addition, a leasehold property can also be transferred to another party, as long as the leasehold period has not yet expired (National Land Code, 1965).

In a freehold title, the owner can transfer the title to the next of kin or sell it to other people and the right of the land belongs to the new owner. For this reason, freehold properties are in high demand (60% of Malaysian property buyers) (RAM, 2007).

The Rating Agency of Malaysia,(RAM) states that properties which carry freehold titles create more demand and are more liquid than leasehold properties (RAM, 2007). Table 2.2 shows that in 1991 approximately 85% of the properties in Malaysia were owner-occupied (RAM, 2007). In addition, the 1991 housing census showed that there were about 2.3 million people in Malaysia who were homeowners (Valuation and Property Service Department, 1998). This indicates that housing price stability in
Malaysia is very important as more people are home-owners as opposed to speculators.

<table>
<thead>
<tr>
<th>Country</th>
<th>Malaysia</th>
<th>Indonesia</th>
<th>Thailand</th>
<th>Philippines</th>
<th>Singapore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner-occupancy</td>
<td>85%</td>
<td>95.9%</td>
<td>82.1%</td>
<td>71.1%</td>
<td>92%</td>
</tr>
<tr>
<td>Rental rate</td>
<td>12.8%</td>
<td>4.1%</td>
<td>10.1%</td>
<td>10.1%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Others</td>
<td>2.2%</td>
<td>n.a</td>
<td>7.8%</td>
<td>18.8%</td>
<td>1.0%</td>
</tr>
</tbody>
</table>

Year of census; Malaysia 1991; Indonesia 2001; Thailand 1996; Philippines 2000; Singapore 2005
Source; UN, National statistics various years.

Malaysian residential properties are built in different floor sizes and plot sizes. According to Mar Iman (2006), the standard land size of landed properties in the housing projects is between 1,200 and 3,000 sq. ft depending on the type of residence. The standard size of land for single storey and double storey houses is between 100.3 sq meters and 174 sq meters, whereas for bungalow lots, the land area covers between 371sq meter and 929 sq meters (Mar Iman, 2002). The standard residential units are 22ft. x 70ft. and 25ft. x 65ft. for terraced houses and 45,000 sq. ft. for bungalows.

The price volatility of residential properties in Malaysia does not only depend on the type of properties but also on the location of the properties being built (RAM, 2007). Research by RAM indicates that the supply and demand dynamics for properties in less industrialized or developed states such as Kelantan, Kedah and Perlis which are different compared to the more industrialized or developed states such as Penang, Selangor, Federal Territory of Kuala Lumpur and Johor. Higher demand in several metropolitan cities such as Kuala Lumpur and its surrounding areas is due to the increase in urbanization since independent years (McGee, 1976, 1982). For example the Federal territory of Kuala Lumpur is occupied by more than 5 million people (Statistic of Malaysia, 2008). Moreover, the existence of larger metropolitan areas such as Shah Alam and Bandar Baru Bangi in the state of Selangor contributes to high urban development which attracts investment and people to these bigger states. This show that the population in more industrialized or developed states creates a greater demand for houses (high liquidity).
There has been some variation in demand for different types of property based on the changes in absolute price and the timing of the changes, but the movement of the property market in Malaysia has displayed a common upward trend (RAM, 2007). Detached houses and high-rise units have shown vast changes in the last five years with 21.5% and 19.5% of changes occurring in their prices respectively (see Figure 2.2). This has been followed by the semi-detached houses (19.1%) and terraced houses (10.6%). In term of price stability, the detached houses are reported to have displayed the greatest volatility while the least volatile type of residential property during the pre-crisis period (1989 to 1997) and post-crisis period (2000-2006) has been terraced houses. Figure 2.2 shows the overall price changes in Malaysian houses according to type (terraced, semi-detached, detached and high rise-units) from 1990 to 2003.

**Figure 2.2 Annual percentage changes in price of Malaysian houses from 1990 to 2003**

Although the property market in Malaysia is growing rapidly, information about the market is very limited and difficult for access by local and foreign customers to access (Nasir, 1999). Reasons for this difficulty include the confidentiality and tight control policies adopted by the Malaysian government and relevant agencies in the real estate market (Nasir, 1999).
2.2.2 Malaysian House Price Structure

In the 1990s, the prices of Malaysian house particularly those middle income house owners were relatively stable. This was due to the increasing growth of middle-income houses, which were funded by the Malaysia Government under the supervision of The Ministry of Housing and Local Government of Malaysia. This housing scheme was known as the special low-cost housing financing scheme (Shuid, 2003).

The Ministry of Housing and Government of Malaysia has classified the houses in Malaysia into four categories according to their selling prices (Shuid, 2003). The categories include; 1) low cost (LC); 2) low-medium cost (LMC); 3) medium cost (MC) and; 4) high cost (HC) (see Table 2.3). The Malaysian Government used the target income groups and house price categories as a benchmark in setting and regulating the housing policy in Malaysia (Mar Iman, 2002). After the 1997 Asian financial crisis, the Malaysian government revised the new price range of the low-cost (LC) and low-medium cost (LMC) category houses. Table 2.3 lists four types of target income group that qualify for LC, LMC, MC and HC types of houses in Malaysia.

The two new prices for the low-cost (RM40,000 per unit) and the low-medium cost houses (RM42,000-RM60,000 per unit) are affordable and reasonable for the target income group shown in Table 2.3. Following the 1997 Asian financial crisis, construction costs such as labour, and raw materials have also increased (Ting, 2003). This in turn has caused the house prices to increase due to falling demand for houses and an increase in interest rates (RAM, 2007).

Furthermore, a review of LC and LMC house prices by the Ministry of Housing and Local Government of Malaysia is needed to reduce the burden of developers due to higher building costs and housing expenditure (Agus, 2002). Figure 2.3 shows that prior to the 1997 Asian financial crisis, the real construction output growth in Malaysia was higher that the real GDP growth. This condition implies that higher construction costs were passed on to the buyers of property through higher demand for houses in Malaysia during the boom period of 1991 to 1995 (see Figure 2.3)
The increased construction costs of LC and LMC in Malaysia were borne by developers and the Malaysian Governments thus adding to the completion time for these types of houses. Due to the higher elasticity of demand for LC and LMC houses, developers face greater cost if they wish to complete the housing project in time and to a high standard.

In addition, the lack of regulation in the Malaysian construction industry has caused many housing projects to be abandoned before completion. For example in 2004, the Malaysian government identified 121 housing projects struggling to be completed (Fen, 2007). To overcome this problem, the Malaysian Government has revised the prices of LC and LMC houses in order to provide quality houses for Malaysian.
<table>
<thead>
<tr>
<th>Category</th>
<th>Low Cost house (LC)</th>
<th>Low-Medium Cost house (LMC)</th>
<th>Medium Cost house (MC)</th>
<th>High Cost house (HC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>House price per unit</td>
<td>RM25,000</td>
<td>RM25,100 to RM60,000</td>
<td>RM60,100 to RM100,000</td>
<td>RM100.100 above</td>
</tr>
<tr>
<td>Target Malaysian household income</td>
<td>RM750 below</td>
<td>RM750 to RM1,500</td>
<td>RM1,501 to RM2,500</td>
<td>RM2,500 above</td>
</tr>
</tbody>
</table>

**After June 1998**

| House price per unit           | RM40,000            | RM40,100 to RM60,000       | RM60,100 to RM100,000  | RM100,000 above      |
| Target Malaysian household income | RM1,500 below       | RM1,500 to RM2,500        | Not stated              | Not stated          |

Source: Ministry of Housing and Local Government Malaysia, 1999)
2.2.3 Property Cycles in Malaysia

Ling (2007) explains that people perceived investment in the property market as safe and more secure compared to equity. By analyzing property cycles, people can understand the behaviour of the property market and make good investment decisions. Wallace (1990) claims that over half of the world’s invested wealth (51.5%) is in the real estate or property assets. The characteristics of property cycles are described as long durations, large amplitudes and have strong correlation between property, finance and macroeconomic sector (Pugh & Dehesh, 2001).

The up and down movements in the land and property market in Malaysia may possibly trigger other movements of the macroeconomic variables such as the real aggregate demand and supply, inflation, national income, price of goods, rental and capital gain (Mar Iman, 2002). For example in 1997, the high volatility of the Malaysian house prices triggered instability in the Malaysian banking sector. The lending rate in Malaysia increased significantly due to the tightening of credit in early 1998 (Perkins & Woo, 2003). The lending rate in 1996:Q4 which was 8.9%, increased to 10% in 1997:Q4 and further increased to 12.2% in 1998:Q2 (Perkins & Woo, 2003). The impact of the increase in interest rates is seen in the short and medium term aggregate demand where people are not buying or renovating their houses (Ball et al., 1996).

Hui (2009) explains that from 1991 to 2006, the Malaysian property cycles underwent several periods of boom and burst with two peaks occurring in 1990 to 1991 and in 1994 to 1997. Closely related to the Malaysian property cycles are the urbanization stages in Malaysia. Ghani and Lee (1997) identified three stages of urbanization in Malaysia; 1) Phase I from 1911 to 1947; 2) Phase II from 1947 to 1957 and; 3) Phase III from 1970 to 1980. These urbanization phases coincide with the six property cycles. The cycles include:

a) 1950s-1960s Cycle

The Malaysian Government started to play a major role in providing public housing for the people after independence in 1957. Prior to independence, the Malaysian housing market was classified as ‘institutional quarters’ (Agus, 2002). These quarters
were allocated to upper-class British employees who worked at hospitals, schools and district offices (Agus, 2002).

The period 1957 to 1960, saw stability in the Malaysian property prices as the Malaysian economy started to grow. In addition, the withdrawal of the Commonwealth forces from Malaya in 1960 to 1961, affected the real estate market since many of the Army Forces’s families lived in the housing estates (Rahim & Co, 1992). The changes in the Malaya economy during this period can be seen in the bursting of business around the housing estates and the plunging of rents and house prices (Saw, 1972). According to Ghani and Lee (1997), the recession period in Malaya caused lack of occupancy in most of the ‘kampongs’. For example many landlords reportedly paid some villagers to stay and maintain their houses throughout these periods (Ghani & Lee, 1997). In addition several small shops around the housing estate were also reported to have closed down due to the economic recession (Agus, 1997).

\textit{b) 1961-1970 Cycle}

The next cycle in the Malaysian property market started between 1963 and 1964 as the Malaya government changed its economic policy from agricultural into industrial (Rahim & Co, 1992). Malaysian commodities such as rubber and tin were reported to receive higher value in the international markets (Abd Rahman, 1996). This led to the booming of the Malaysian economy and created more jobs and stability in real estate prices. Idrus and Siong (2008) noted that during this period, the main objective of the Malaysian Housing policy was to provide affordable houses for all the people especially to the lower income group through the implementation of the Second-Five Year Malaysian Plan (1961-1965). The authors also explain that the objective and direction of the Malaysian public housing authority changed from providing houses to being a government servant supporting the concept of home-ownership (Idrus and Siong, 2008).

In 1966, the Malaysian property market was trending downwards due to the global weakening in most industrial countries and political crises in Malaysia (Ghani & Lee, 1997). During this period, Malaysian house prices decreased between 30 % to 50%. 
The contraction in the Malaysian real estate market was worsened by the declining of the rubber prices worldwide (Abd Rahman, 1996).

To stabilize and expand the Malaysian economy, the Government initiated the Malaysia Plan. This strategic plan, which covered every aspect of the socio-economy, was introduced in 1966 and known as the First Malaysia Plan (1966 to 1970). The objective of the plan was to abolish poverty among Malaysian by restructuring and promoting integration among various communities in Malaysia (Yeoh & Hirschman, 1980). Prior to Malaysian independence, the British colonials allocated different areas for different races. For example, Indians were settled in rubber estates, Malays in ‘kampong’ and Chinese in timber mining areas (Yeoh & Hirschman, 1980). Therefore, the aim of the First Malaysia Plan and the New Economic Plan (NEP) in 1971 was to foster unity among Malaysian by eliminating the identification of races in different geographical locations (Agus, 2002).

c) 1971-1980 Cycle


In 1971, the New Economic Policy (NEP) was introduced to restructure the Malaysian economy. In the NEP, housing programmes were managed by the public and private sector. The objective of the NEP was to achieve balanced development (economic and social) in both the rural and urban areas in Malaysia and to promote active participation on the part of local and foreign property investors (Agus, 1986b). As a result of the NEP, the migration of rural dwellers to urban areas increased. For example, the urban population in Malaysia grew at 5% per annum which is higher than the total population growth rate of 3% per annum between 1970 and 1991 (Saw, 1972; Agus 1981). The number of people living in the cities and towns in Malaysia during this period was about 44% of the 18 million total (Malpezzi & Mayo, 1997).
Throughout this period, the Malaysian economy was growing fast with new developments in the public, finance and business sector, along with strong consumer purchasing power sentiment (Abd Rahman, 1996). Because there were more jobs opportunities available in the urban areas, rural-urban migration increased, thereby stimulating the growth of a middle-class (Abd Rahman, 1996). For example, urban housing unit supply increased by 7.1% per annum due to the increase in urbanization and strong economic growth in the Malaysian economy during the 1970s and 1980s (Malpezzi & Mayo, 1997).

Between 1971 and 1973, several programmes were introduced by the Malaysian Government in order to revitalize housing development in Malaysia. Among these programmes were the ‘property owning democracy’ and subsidized housing loans to civil/government servants (Abd Rahman, 1996). The housing loan scheme was a good idea as there were about 600,000 Malaysian working in the government service during that period (Ghani & Lee, 1997). These programmes proved to be successful as the demand for residential properties increased and the prices of property rose by 10 to 15% a year from 1971 to 1973 (Agus, 1997).

The expansion of the Malaysian property market was disrupted due to the global increase in oil prices (1971 to 1973) and a recession which caused an increase in the cost of labour and building materials to increase as well as an increase in houses prices (Abd Rahman, 1996). However, as a result of increased export, the Malaysian economy started to rebound in late 1973 (Cheng, 2003). Consequently, demand in the Malaysian property market increased which led to a boom in the Malaysian economy in 1974. In 1975, the consumer price index in Malaysia increased at 7% compounded annual rate while residential rents also increased at 6.4% compounded annual rate. The trend continued for new housing supply in Malaysia with an annual compounded rate of 18.9% (Malpezzi & Mayo, 1997). To overcome inflationary pressure, the Malaysian government implemented new monetary policies such as increasing the lending and deposit rates (Cheng, 2003).
The migration of people from rural to metropolitan areas such as Ipoh, Kuala Lumpur and Johor Bahru in the late 1970s increased housing demand (Yeoh & Hirschman, 1980). However, because housing supply was slow to meet demand for these particular areas, many of these people lived in squatter settlements (Agus, 1981, 1989a). To increase home ownership, the Malaysian Government introduced guidelines and organizations which provided loan finance (Agus, 2002). These included the Treasury Housing Loans Division (THLD) in 1972 and Malaya Borneo Building Society (MBBS).

In early 1960s the mortgage market in Malaysia was dominated by MBBS taking up 96.8% of the total mortgage loan (Kokularupan, 2008). However, in the 1970s, the MBBS became less prominent in the Malaysian mortgage market as commercial banks and finance companies became active providers of mortgage financing (Kokularupan, 2008). The MBBS only provided 58.1% of total housing loans in 1970 (Kokularupan, 2008). In 1970s to 1980s, there were some changes in the Malaysian housing market, particularly in housing supply where the Malaysian Government privatized the supply of Special LC and LMC projects to private sector developers. These changes reflected the increase of urbanization and the strong growth of the Malaysian economy (Malpezzi & Mayo, 1997). According to Agus (2000), the post liberalization period in Malaysia, which occurred from 1978 onwards, marked an era of financial reforms with the objective of enhancing monetary policy to achieve economic growth.

d) 1981 -1990 Cycle

The increase in property prices in 1981 created concern and anxiety among purchasers, investors, developers and the Governments. Selling prices for terraced houses in Malaysia increased by an average of 18.6 % per annum (Malpezzi & Mayo, 1997). Furthermore, Malaysian household income also increased by 10.8% per annum (Malpezzi & Mayo, 1997). The Malaysian Government was forced to tighten bank credit in order to maintain stability in the property market. As a result the Malaysian property market stabilized in 1982. In 1984, Malaysian house prices decreased by 20%, the result of a 13% decrease in income (Malpezzi & Mayo, 1997). This decrease was due to the slowing down of the Malaysian economy during this period (Awil, 2007).
From 1984 to 1987, the property cycles in Malaysia showed a decreasing trend due to an oversupply of housing stock in several urban areas, a tight credit policy, high interest rate, a slowing down of the world commodities market and economic recession (Cheng, 2003). More housing and condominium projects were abandoned by developers which resulted in increased default loans for banks and financial institution in Malaysia (Rahim & Co, 1992).

In 1986, the Malaysian Government introduced a Special-Low Cost Housing Programme” (SLCHP) with two objectives: to increase homeownership for the lower income groups and to stimulate the Malaysian economy through linkage effect where the increased of household consumption is transmitted into economy (Malpezzi & Mayo, 1997). A low cost house was described as a single storey house of 40 to 45 square meters priced at RM25,000 per unit (Malpezzi & Mayo, 1997). Under the SLCHP, 60% of the low cost houses were built by private developers.

In order to stabilize the Malaysian housing market in 1984, the Malaysian Government implemented several action plans such as restricting the involvement of non-citizen in landed property (except for industries) and tightening the criteria for eligibility of housing loans for civil servants (Rahim & Co, 1992). In 1987, the Malaysian Government made several further efforts to revitalize the property market by cancelling some regulations on foreign involvement in the property market, lowering the base lending rate and the tax rate for Malaysian citizens (Rahim & Co, 1992) and establishing the Secondary Mortgage Market Institution in Malaysia known as CAGAMAS Berhad.

As a result, the Malaysian property market rebounded in 1988 (Malpezzi & Mayo, 1997). The increase of foreign investment in the Malaysian housing market and tourism sector during this period was due to the decrease in value of the Malaysian currency (Ringgit) and the cheaper cost of labor in Malaysia. Furthermore, the abundant credit offered by the Malaysian financial institutions facilitated the growth of businesses, and increased demand in the Malaysian property market (Cheng, 2003). Following this, the Malaysian property market started to expand between 1989 and 1991 (Rahim & Co, 1992).
e) 1991 to 2001 Cycle

The boom in the Malaysian property market continued from 1991 to 1996 with an impressive growth in the Malaysian House Price Index of 25.1% in 1991 and 18.4% in 1995 (Global Property Guide, 2008). Figure 2.4 shows an increasing market for Malaysian houses, except during the Asian financial crisis from 1997 to 1999.

**Figure 2.4 Annual percentage changes in Malaysian house prices from 1990-2003**

![Malaysian House Price Index (1990-2003)](chart)

Source: Malaysian Valuation Property market statistics, various months

In 1991, the central bank of Malaysia (Bank Negara Malaysia, BNM) allowed all banks in Malaysia to set up their own base lending rates (BLR). This action lead to an increase in the borrowing cost for homebuyers and developers as the BLR increased to 10.5% (Annual report of Bank Negara Malaysia, 1993). However, this action was unsuccessful in preventing an increased demand for residential property during the period of 1991 to 1995 (see Table 2.4).

**Table 2.4 Malaysian property transaction from 1991 to 1995**

<table>
<thead>
<tr>
<th>Year</th>
<th>Value (RM billion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>9.2</td>
</tr>
<tr>
<td>1992</td>
<td>10.2</td>
</tr>
<tr>
<td>1993</td>
<td>10.8</td>
</tr>
<tr>
<td>1994</td>
<td>12.65</td>
</tr>
<tr>
<td>1995</td>
<td>15.8</td>
</tr>
</tbody>
</table>

Source: Malaysia Property Market Report, 1998
Overall, the number of transactions (sale of new houses and resale of houses) rose 27% and an increase to 71.5% during the 1991 to 1995 period (Lee, 1996). Urbanization in Malaysia also increased to 51% in 1991 due to the migration of Malaysian to big cities in search of better jobs and a more comfortable life (Lee, 1996). For this reason, the occupancy rate of houses in larger cities, such as Johor, Penang, Federal Territory of Kuala Lumpur and Selangor rose to three or more households in one house (Mar Iman, 2006).

The first half of 1990s (1991-1996), saw a huge increase in the Malaysian house price index (MHPI) which aligned with the increase in housing loans by the financial institutions to the property sector (see Figure 2.6). However, this situation created an overheated environment in the Malaysian property market, which then forced the Malaysian Government to restrict the inflow of foreign investors into this market. Among the policies introduced were the 60% loan granted to non-owner occupied properties and the imposition of a RM100,000 levy on foreign purchases (Lee, 1996).

The growth of the Malaysian housing market was disrupted by the Asian financial crisis in 1997/1998 as the house price index plunged to 9.4% in 1998 before falling to 2.3% in 1999 (RAM, 2007) (see Figure 2.2). Several actions were taken by the Malaysian government to control and stabilize the downward spiral of the property market which including the establishment of CAGAMAS, the homeownership campaign and special funds for developers who were facing financial problems in completing housing projects (Bujang & Abu Zarin, 1999).

In addition, the Malaysian government managed to sell unsold properties worth RM5 billion in values to the homebuyer at a discount price (Malaysia Property Market Report, 1998). The home-ownership campaign, which was also launched between 12th December, 1998 and 12th January 1999 sold 16,000 units of residential property valued at RM 3.8 billion (Malaysia Property Market Report, 2001). This success was due to the incentives and waiver of stamp duty, higher loan margins (95%) and low legal fees offered to the property buyers (Jones Lang LaSalle, 1999).
The effect of the recession was not severe in the residential market, but there was still a large downward movement of house prices in some of the larger cities in Malaysia. For example in 1997 the transaction of residential properties in Johor Bahru decreased by 44.4% due to the impact of Asian financial crisis (Property Market Report, 1998). This situation was probably caused speculation activity in the Johor Bahru residential market since more Singaporeans bought houses in Johor Bahru due to the lower price. The situation in Johor Bahru supports the view of Himmelberg et al. (2005) that higher speculation activity occurs in bigger cities compared to smaller cities.

f) 2001 to 2005 Cycle

The gradual increase in the Malaysian property market in 2001 indicated that the actions taken by the Malaysian government after the 1997 Asian financial crisis were successful. According to the Malaysian property market report (2007), property price inflation was in the range of 1.4% to 5% from 2004 to the end of 2005 (http://www.myoverseasproperty).

Furthermore, the annual house prices in Kuala Lumpur increased by 6.3% in 2004, 7.2% in 2005 and decreased slightly to 6.2% in 2006 (Global Property Guide, 2007). The Global Property Guide (2007) reported that the increase in property prices in Kuala Lumpur was influenced by a strong demand for luxury properties (see Figure 2.5). Other states such as Penang, Johor and Perak also experienced an increase in the house prices by 4.1%, 3.6% and 2.7%, respectively, due to foreign investment.

Figure 2.5 Comparison of annual housing price changes between Kuala Lumpur and Malaysia

![Annual House Price Change Chart]

Source: Global Property Guide (www.globalpropertyguide.com)
2.3 The Mortgage Market in Malaysia

Financial institutions and the banking sector have engaged directly in the expansion of the real estate market through mortgage financing. Many studies have examined the relationship between the real estate market and the banking sector (see Davis & Zhu, 2004; Gan, 2003; Kaminsky & Reinhart, 1999). According to Davis and Zhu (2004), the sensitivity of bank credit to the value of property assets caused a cyclical movement in property prices, followed by a bubble bursting. Gan (2003) studied the decreased collateral value of land in Japan and confirmed the impact of a reduction in collateral values is the reduced in investment.

In Malaysia, mortgage market is monopolized by commercial banks and financial institutions. This market consists of primary and secondary mortgage markets. In the primary mortgage market, home loan financing is provided by the commercial banks and finance companies. The eight primary lenders include Bank Rakyat, Bank Simpanan Nasional, Finance companies, Borneo Housing Mortgage Finance, Treasury Housing Loan Department (THLD), Malaysian Building Society Berhad (MBSB) and Sabah Credit Corporation (Annual Report of Bank Negara Malaysia, 2007).

In 1987, a Malaysian secondary mortgage market institution was formed with the establishment of CAGAMAS Berhad (National Housing Corporation) (Chiquier, 2006). The objectives of CAGAMAS are to act as intermediary between primary lenders and investors and to issue secondary mortgage securities (Chiquier, 2006). CAGAMAS is also used to resolve a shortage of housing loans in Malaysia (Kokularupan, 2005). The shareholders of CAGAMAS Berhad consist of Bank Negara Malaysia which holds 20% of the shares, while the other 80% of the shares are held by the private financial sector (Chiquier, 2006). CAGAMAS offers four types of housing loans to their customers including fixed mortgage purchase, floating rate mortgage purchase, convertible rate mortgage and Islamic financing debt (Kokularupan, 2005).
With the existence of CAGAMAS Berhad, the mortgage lenders such as banks and financial institutions in Malaysia are able to sell their house mortgages to other investors or CAGAMAS for an additional liquidity or hedge against the risks of interest rate volatility (Kukularupan, 2005). CAGAMAS only manages the interest and prepayment risk of the loan it purchases, and credit risk embedded in the CAGAMAS operation is relatively small. The banks, which sell the loans, have to bear the default loans (Kokularupan, 2005).

The basic features of residential mortgages in Malaysia include floating rates, fully amortize long-term loans of twenty-five years to thirty years. Most of the financial institutions offer 80% to 90% financing for new houses (Chiquier, 2006). The remaining balance of the home loan can be withdrawn up to 30% of the homebuyer’s money from Account II in their EPF account\(^1\). The new amendment in the EPF funds took place in 1994 as one of new initiatives in revitalizing the housing market in Malaysia.

Most financial institutions and primary lenders in Malaysia offer two types of mortgage loan: conventional housing loans and Islamic housing loans (Muhamad, 2002). In the conventional mortgage loans, the interest rates can be fixed or variable (Muhamad, 2002). For the Islamic mortgage loans, the interest rates are calculated based on the cost-plus margin basis with a fixed loan instalment paid for the whole term of the loan’s duration (Muhamad, 2002).

The mortgage market in Malaysia boomed from 1990 to the middle of 1997 before a meltdown occurred in 1997/1998 due to the Asian financial crisis. According to Bank Negara Statistics, bank loans to the property and construction sector by commercial banks and finance companies increased from RM32 billion in 1990 to RM127.6 billion in 2000 (see Figure 2.6) (Mohd Isa, 2004).

At the peak of the Asian financial crisis (1997/1998), residential mortgage consist of only 12% of the total banking system’s outstanding loans (RAM, 2007). Since 30\(^{th}\) June, 2007, the Malaysian mortgage market has been in a recovery phase and the

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\(^1\) The EPF (Employees Provident Funds) was set up in 1955 with the aim of raising a monthly contribution from employees and employer for a retirement fund (www.kwsp.gov.my)
residential property mortgage loans amount to RM167.54 million or approximately 52.75% of the total consumer credit loans (RAM, 2007). This market forms the biggest group of all consumer loans and 80% of these domestic mortgages come from the banks (RAM, 2007). Figure 2.6 shows the increase in housing loans approved by the financial institutions in Malaysia from 1987 to 2002.

**Figure 2.6 Total Housing Loans approved by financial institutions in Malaysia (1987-2002)**

As shown in Figure 2.6, the housing loans granted by financial institutions in Malaysia have increase every year since 1987 except for the 1997 Asian financial crisis, where a sharp decrease was recorded. In September 1998, the amount of loans channeled into the housing sectors was recorded at RM9 million, a significant drop from the highest peak of RM20 million in 1997 (Bank Negara Malaysia, report, 2000).

In 2004, the price of the floating rate which is based on the base lending rate (BLR) was capped at a maximum spread of 2.5% above BLR (RAM, 2007). Because of this new financial innovation, banks are now competitive in offering different types of mortgage rates to attract customers. For example, a mortgage financing offer on a fixed rate basis for the first few years before reverting to a floating rate.
The base lending rate for mortgages in Malaysia before the Asian financial crisis was 6.83% (in 1994) which was amongst the lowest rate in Asia after Singapore (5.34% in 1993) and Hong Kong (6.5%). However, the lending rates increased during the crisis period reaching 12.27% in 1998 and then decreased to 5.98% after the crisis.

2.4 Malaysian Housing Policy

The most common issues surrounding housing policies for a country are the welfare policy, improvement of living standards for people, ownership and the production system in the housing market (Muhammad, 2002). In Malaysia, the housing policy began in 1947 when the Committee of the Malayan Union Advisory Council suggested the government take part in the allocation of housing for poor and low income groups who could not afford rental charges during the pre independence era (Yeoh & Hirschman, 1980).

The Council also recommended that the government provide some land for the people to build their own houses (Yeoh & Hirschman, 1980). During this period (1940s), housing development was based mainly on the concept of ‘people build their own houses’ (Muhamad, 2002). Furthermore, housing provisions in rural area was mainly governed by Majlis Amanah Rakyat (MARA) for lower income groups while the Federal Land Development Authority (FELDA) engaged directly in providing houses for people living in the rubber and oil palm estates (Muhamad, 2002).

In 1971, the New Economic Policy (NEP) impacted on the Malaysian housing sector. Public (states government construction) and private construction companies produced affordable housing for lower income groups and improved the housing situation in rural area. After 20 years, the New Development Policy (NDP) took over from the NEP lasting from 1991 to 2000. Table 2.6 shows other housing policies implemented by the Malaysian Government to improve the housing sector in Malaysia.

Malaysian Constitution recognizes the rights of all Malaysian citizens to purchase houses within Malaysia. The Malaysian housing policy’s main objectives, as outlined in the 9th Malaysian Plan of 2001-2005 were “to provide Malaysians of all income levels, particularly the low-income groups, access to adequate, affordable and quality houses for all income groups” (9th Malaysian Plan, Chapter 21, p 461).
Housing is important in ensuring the socioeconomic stability of a country in promoting national development. For that reason, the Malaysian Government has implemented several measures to ensure that the Malaysian people will be provided with adequate, affordable and reasonable housing, especially for the low income group (Shuid, 2003). This is because low-cost houses are limited in supply and are targeted only at the lower income group (see Table 2.3).

In order to accelerate the housing programmes, especially low-cost housing, several measures were taken by the Malaysian Government including the extension of the low-cost housing revolving fund to the private sector (Lee, 1996) to build new housing projects and a new, special low-cost housing programme for the purpose of resettling squatters in urban areas.

There were several programmes initiated for better houses and living conditions, such as the site and service, traditional village regrouping and rehabilitation of dilapidated house programme (United Nations, 2003). The existence of several FELDA housing programmes and Program Pembangunan Rakyat Termiskin (PPRT) are the examples of this type of housing programme.

2.5 Capital Control in Malaysia

Capital control is defined as a measure or action (financial and economic policies) initiated by the policy maker to limit or restrict the outflows and inflows of capital from the domestic market (Sharma, 2003). The underlying motives behind these capital control actions are to assist in preventing the speculative and volatile attack of capital flows from pressuring the stability of exchange rates and reducing the reserve in foreign exchange (Sharma, 2003).

Table 2.6 summarizes the objectives, strategies and impact of the 1994 and 1998 capital control imposed by the Malaysian Government. In 1994, capital control was imposed to stabilize the inflows of short-term funds and in 1998 capital control was again imposed to stabilize the economy following the 1997 Asian financial crisis.
Table 2.6 Capital Controls imposed on the Malaysian economy in 1994 and 1998

<table>
<thead>
<tr>
<th>Motives/objectives</th>
<th>Capital Control in 1994</th>
<th>Capital Control in 1998</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motives/objectives</td>
<td>• To stabilize the inflow of short-term funds into the Malaysian market</td>
<td>• To curb the impact of 1997 Asian financial crisis on the Malaysian market</td>
</tr>
<tr>
<td>Strategies</td>
<td>• Administrative capital control and prudential regulations measurements</td>
<td>• Control on portfolio outflows, limit on the trading of the Ringgit, fixed the exchange rate of RM3.80 to the US dollar.</td>
</tr>
<tr>
<td>Impact on housing market</td>
<td>• Lowering the interest rates helps to stimulate house buying due to the low repayment loan</td>
<td>• Reduced nonperforming loans in home mortgages and stabilized the interest rates in home loan financing</td>
</tr>
</tbody>
</table>

Sources: Sharma (2003); Chiquier (2006)

The falling of interest rates due to the capital control policies has affected the Malaysian housing market in various ways. These include the decrease of interest on loan mortgages charged by the banks and financial institutions (from 5% to 4% in 1999) (Kawai & Takagi 2003) and the decreased number of non-performing loans (NPL) in the housing market.

The 1997 Asian financial crisis negatively affected the property market with the number of overhang properties increasing sharply. There were roughly 90,000 surplus housing units, mainly in multi-family condominium units (Malaysia National Valuation Property, Statistic 2000). Therefore, the Malaysian government initiated a new programme known as the ‘Housing Campaign’, from 12th December 1998 to 12th January 1999 (Abu Zarin, 1999) and a second campaign in October, 1999 (Property Market Report, 2000). These two campaigns were successful in selling properties amounting to RM6.4 billion (Property Market Report, 2000). As a result, the amount
of loans disbursed into the housing sector increased in 1999 and amounted to more than $20 million (see Figure 2.4) (Bank Negara annual reports 2003).

The capital control imposed in 1998 resulted in the establishment of Danaharta on September 1, 1998. The property-related non-performing loans (NPLs) in Danaharta’s portfolio amounted to 30%, which is the largest category of debts under the Danaharta debt management (Danaharta report, 2002). The properties held by Danaharta as collateral amounted to 43% (Danaharta report, 2002). The collateral properties are classified into residential units, agricultural and development land, industrial premises, office blocks, retail and commercial lots, shopping complexes and hotels (Bank Negara Malaysia Report, 2002).

The decrease in NPL from 14.9% in November 1998 to 9.7% in 2000 helped to stabilize the Malaysian real estate market. As a result, bank loans increased from 0.1% in 1999 to 5.5% in 2000 (Bank Negara Malaysia report, 2002). The continuous growth of bank loans to the housing sector is shown in Figure 2.6. In 2007, residential property mortgage loans amounted to RM167.54 billions (RAM, 2007).

The impact of capital control in the Malaysian property market is evident in the increase in supply of residential properties (see Table 2.7) and the amount of loans channeled to the housing market (see Figure 2.6). The fast recovery in the Malaysian housing market proved that capital control was the appropriate tool for managing the impact of the 1997 Asian financial crisis.

2.6 New Policies and Guidelines by Malaysian Government to Restructure the Real Estate Market after the 1997 Asian Financial Crisis.

The effect of the 1997 Asian financial crisis spread from Thailand to neighboring countries, including Indonesia and Malaysia. The property market in Malaysia was badly affected by the devaluation of the ringgit, the huge outflow of foreign capital and the decline in employment and economic growth (BNM, Annual Report 2000). The economic recession in 1997 was followed by a fall in demand for properties and an oversupply of residential, commercial and industrial buildings (Bank Negara Malaysia, Annual Report, 2000).
In the early stages of the 1997 Asian financial crisis, the Malaysian Government through Bank Negara Malaysia (BNM), implemented several policies and guidelines in the hope of stabilizing the property market in Malaysia. These included:

- injecting RM34 billion into the banking sector, and exempting real property investment from an exit on the repatriation of foreign capital (BNM, Annual Report, 2000).
- abolishing capital gains tax in the property sector formerly taxed at 30% on gains made on the disposal of real property within the first five years and 5% thereafter (Malaysian Property Report, 2000)

Other organizations established after the 1997 Asian financial crisis included:

- Danaharta- an Asset Management Fund Agency taking over non-performing loans from and injecting funds into the banking system.
- National Property Information Centre (NAPIC) aimed at providing recent information on the property market in Malaysia.

During the post-crisis period, the Malaysian GDP shrank by 7.5%; transactions in the real estate sector dropped by 35% and the declining value of real estate was 48% (Bank Negara Malaysia, 2000). Prior to the 1997 Asian financial crisis, real estate and several sectors which were indirectly related to the real estate market, (such as the construction, financial and insurance sectors) were contributing 20% to 30% to the country’s GDP (Bank Negara Malaysia, 2000). In 1999, the amount of surplus property in Malaysia was valued at 14% of GDP which included 900,000 housing units (Bank Negara Malaysia, 2000).

The contribution of the real estate market to the Malaysian economy is undeniable. The liberalization of the banking and financial system in Malaysia after the 1997 financial crisis has made it possible for residential property to grow robustly (see Table 2.6). In 2000, Bank Negara Malaysia reported that “the banking system had approved RM2.5 billion of residential property loans on average each month” (RAM, 2007, pp.12). The Bank Negara statement reflects the increasing amount of residential property throughout the country (see Table 2.7).
Table 2.7 National Inventory of residential property

<table>
<thead>
<tr>
<th>Year</th>
<th>Existing stock (units)</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>1,925,679</td>
<td>7.13%</td>
</tr>
<tr>
<td>2000</td>
<td>2,642,228</td>
<td>37.21%</td>
</tr>
<tr>
<td>2001</td>
<td>2,761,242</td>
<td>4.50%</td>
</tr>
<tr>
<td>2002</td>
<td>2,897,455</td>
<td>4.93%</td>
</tr>
<tr>
<td>2003</td>
<td>3,287,733</td>
<td>13.47%</td>
</tr>
</tbody>
</table>

Source: Property Market Reports, Valuation and Property Services Department (JPPH)

2.7 Summary

In 2006, the Malaysian residential market was reported to contribute more than 45% of the total transaction values within the property sector (RAM, 2007). From 1990 to early 1997, the average amount of loans channeled to housing sector was RM20 million. This growth was disrupted by the 1997 Asian financial crisis, which resulted in a decrease of MHPI from 1997 to 1999, a decreased in housing loans disbursed to the housing sector and the increase of NPL from the property-related sector (Malaysian Property Market Report, 2002).

The property cycle in Malaysia consists of six sub-cycles stretching from the 1950s to 2005. Several strategies such as Malaysian Plans and the New Economic Policy (1970 to 2000) have contributed to the development of the Malaysian property market.

Housing policies, which classified different types of houses according to income group have been used as a benchmark to monitor and allocate better home to Malaysians. The capital control imposed on the Malaysian economy in 1994 and 1998 (see Table 2.6) was successful in stabilizing the impact of volatile house price movements. The Malaysian Government has also introduced several regulations and acts to reduce the impact of 1997 Asian financial crisis on the real estate market in Malaysia.
Chapter 3
Theories of Housing Bubbles

‘Real Estate housing bubble, housing bubble and property bubble are all the same things, only the name varies’
(Rahul, October 29, 2008)

3.0 Introduction

This chapter presents an overview of bubbles in the housing market. It consists of two parts. Part A discusses the concept of bubbles in the housing markets and part B reviews the literature of housing bubbles. The chapter is organized as follows. Section 3.2 defines what are bubbles and the impact of a house price bubble. Section 3.3 explains the three types of price expectation theories and section 3.4 describes theories of housing bubbles. The signs and indicators of bubbles in the housing market are discussed in section 3.5 and section 3.6 discusses relevant literatures, which support the existence of housing bubbles.

PART A

3.1 The Concept of Bubble in the Housing Market

The sharp increase in house prices in several industrialized economies such as the US, UK and Spain (Glindro, et al., 2007) has attracted much attention due to the distorted impact created by the bursting of bubbles in the economy (Gyntelberg & Remolona 2006; IMF, 2005; Labonte, 2003). Governments and organizations such as the Bank of International Settlement (BIS), International Monetary Fund (IMF) and Organization for Economic Cooperation (OECD) have raised concern about the issues of asset price instability (overshooting the fundamental variables) in the housing market (Gyntelberg & Remolona, 2006). Therefore, it is important to understand the theoretical and conceptual framework underlying housing bubbles before suggesting any monetary or fiscal policies that might prevent future housing bubbles crises.
3.1.1 Definition of Bubbles

Researchers have defined bubbles in many ways. According to Garber (1990) there are different terms used by economists to explain the behaviors of market-asset prices such as ‘bubbles’, ‘tulipmania’, ‘chain letter’, ‘Ponzi scheme’, ‘panic’, ‘crash’, ‘herding’ and ‘irrational exuberance’.

Garber (1990) claimed that the word bubble lacks a clear and precise meaning and it should not be used without relevant reasons. Garber’s conclusion was based on his study of several historical bubble events such as the Tulip mania and the South Sea events. Garber (1990) also added that the majority of market elements reported in those events, such as the outrageous price of the tulip bulbs causing the manic behaviour of investors in the South Sea bubble were incorrect and there was a fundamental explanation behind it (Cochrane 2001).

The common definition of a bubble is a sharp increase in an asset price in a continuous process (Kindelberger, 1987). Increased asset price is caused by an investor’s expectation of a future increase in asset price (Stiglitz, 1990). This leads to the purchase of an asset in the anticipation that the asset can be resold to other people for a higher price (Blanchard & Fisher, 1989). The people who buy the asset also hold the same beliefs about the asset price (Blanchard & Fisher, 1989).

Case and Schiller (2003) describe a bubble as a condition in which public expectation of an excessive price increase leads to a temporary increase in prices. Furthermore, a bubble exists when there is a constant exogenous probability of the bubble collapsing. Camerer (1989) and Weil (1987) define bubbles as a change in the real economic environment. These changes caused by bubbles are described as a specific type of financial crisis (Knight, 2002).

In the real estate market, bubbles occur when property values increase rapidly and reach levels that are unsustainable given the current economic condition that exist (Knight, 2002). The bubbles in housing prices start when the appreciation of house prices become irrational and does not depend on economic fundamental factors such as inflation and interest rate (Malpezzi & Wachter, 2005).
The general definition of bubble in relation to housing market can be summarized as follows: the observable characteristic of a bubble in the asset market (housing) is an increase in price levels and this is due to the expectation on the part of market participants of a future increase in the asset prices. This increasing in house price is not caused by macroeconomic factors (Coleman, 2008)

3.1.2 Impact of House Price Bubbles
Binswanger (1999) argues that the existence of bubbles in the economy is not necessarily bad. The negative perception held by people regarding housing bubbles is due to the over-emphasis in modern finance literature on negative impact caused by speculative bubbles in the real economy. This statement, however, was made based on stock market bubbles (Binswanger, 1999). Some researchers such as Girouard and Blondal (2001), Pollin (2005) and Muellbauer and Murphy (2009) have found evidence to support the positive effects caused by the existence of housing bubbles in the economy. These effects include an increase in household consumption and expenditure, an expansion in the credit sector and an increase in economic output, showing that growth in the economy may be caused by the existence of housing bubbles (see Baker, 2002; Liow, 1998; Kallberg et al., 2002).

Baker (2002) discusses the short-term impact of increasing house price, or a bubble in the economy. Among the impacts are increased house sale and construction of new houses since people purchase houses in the expectation that future house price will exceed the inflation rate. The increasing house price motivates consumer to spend which increases the household’s consumption (Baker, 2002). This is evident in several studies, which show that the value of a house is perceived to be significant source of wealth for the future (see Case et al., 2001; Maki & Palumbo, 2001). The collateral values of loans, which are based on the increasing house price, help homeowners to borrow more for their future consumption (Baker, 2002).

Levina (2007), however, rejects these positive impact created by increasing house price (bubble). According to Levina (2007), the increased in house price causes speculative bubbles to exist and create instability in the financial system and inconsistency in capital accumulation. This, in turn exacerbate into recession and caused the spread of bubbles crisis into the economy. In addition, the author explains
that the growth in the economy during the bubbles can be caused by several other factors and not by the bubbles alone. These factors include changes in resource allocation (new technology), changes in people’s expectations, the introduction of new housing-related policies and the action of the economy itself in protecting from changing the nature of distribution (Levina, 2007). Thus, Biswanger’s (1999) conclusion on the beneficial impact of bubbles has on the economy is rejected.

Many studies (for example Ball et al., 1996; Helbling & Terrones, 2003; Malpezzi & Wachter, 2005; Pollin, 2005) support the negative impact of housing bubbles bursting on the economy. Such impacts can be seen in the decreased in the level of economic activity and economic outputs such as consumption, wealth and construction (Pollin, 2005). Furthermore, a decline in GDP and other economic indicators such as residential and business investment are reported during the early stage of a housing bubble crisis (Jannsen, 2009). For example, the impact of the real estate crash can be seen in an 8% output loss in term of US gross domestic product (Malpezzi & Wachter, 2005).

Case et al. (2005) suggest that the wealth effect caused by changes in residential property prices is bigger than other financial assets such as stock. For example, Helbling and Terrones (2003) show that during the period 1970 to 2002, the declined output effects in US house prices caused by the bursting of housing bubbles were greater than in equity prices bubble bursts. Moreover, the slowing down of an economy after a housing market collapse lasts about twice as long compared to an after stock market crash (Malpezzi & Wachter, 2005). Jannsen (2009) also found a long period of recession and an output loss for 15 OECD countries from 1970 to 2002 caused by a housing bubble crisis. It took four years for the GDP in 15 OECD countries to reach its pre crisis level. This shows the severe impact on the economy caused by the bursting of a housing bubble (Jannsen, 2009).

Ball et al. (1996) claim that fluctuations in house prices affect the world economies in short and medium term aggregate demand. People are postponing buying or renovating their houses as rising interest rates are believed to stimulate an inflationary environment (Black et al., 2006). This results in a decrease in demand for property,
which then creates more difficulties for economies to correct the discrepancy in the housing market (Ball et al., 1996).

Another possible negative consequence of the bubble bursting in the real estate market is the potential adverse impact on economic stability. Several researchers (for example, Byamugisha, 1998; Caprio & Honohan, 1999; Kaminsky & Reinhart, 1999; Mera & Renaud, 2000) discuss the relationship between the real estate market, banking failure and economic growth.

According to Caprio and Honohan (1999) “(i)n industrial countries, the most characteristic cause of bank failure has been over-exposure of banks to a real estate property boom, itself fuelled by an over-expansion of bank lending” (p. 3). This condition also holds for other countries. For example, Kaminsky and Reinhart (1999) identify twenty countries in which a stock and real estate market collapse was typically accompanied or followed by banking crises. This was true for Japan in 1990, Scandinavia (Norway, Finland and Sweden) in the 1980s, Mexico in 1994 and East Asia in 1997. Further evidence of banking crises caused by the real estate mortgages is found in Hong Kong, Thailand, Chile and Malaysia (Byamugisha, 1998).

Davis and Zhu (2004) discuss the two impacts of expanding bank lending in the property market. The first impact can be view positively, where an expansion of bank credit occurred in a short-term period. For example, in a booming housing market, banks were less concerned about the default risk caused by an adverse selection problem as the lending premiums were lowered and the credit constrains were reduced (Glindro et al., 2007). Given the expectations of house price increases, banks were more relaxed in their lending standards (DeGreef & De Haas, 2000). The combination of lower interest rates and less restriction in housing loans contributed to an increase in housing demand and profit to the banks and financial institutions.

The second impact occurs in the long term, where the excessive supply of new construction property causes a negative impact on banks and financial institutions (Davis & Zhu, 2004). The fall in the real estate market causes enormous losses to the banking sector due to the decreased value of the bank’s own real estate asset (Zhang & Sun, 2006). The home mortgage is now worth more than the value of the house
(Powell, 2008) and problems of asymmetric information and moral hazard occur (DeGreef & DeHaas, 2000). Banks can no longer depend on the collateral values of the assets and are forced to focus on the repayment capabilities of their existing borrowers. Therefore, the loan mortgages supply is restricted as the credit standard is increased (De Greef & De Haas, 2000).

The decrease in the mortgage supply in the real estate market also affects the real economy, causing instability in the economy. For example, bank lending is associated with real estate cycles and the bursting of bubbles, which results in large non-performing loans (NPLs), financial instability and crises in the economy (Zhang & Sun, 2006). Kallberg et al., (2002) explain that the plunged of real estate market caused banks and financial institutions to suffer billions of losses due to the overexposure in financing the real estate market.

Banking crises and real estate booms are not new since historical evidence of similar crises can be traced back to the 1990 (Calomiris, 1997). Events such as the 1997 Asian financial crisis indicate that East-Asian economies were heavily exposed to the real estate market especially the housing market (IMF, 1998; Quigley, 1999). In Japan, the bursting of a speculative bubble in the early 1990s caused several lending and banking institutions such as Fuji Bank, Daiwa Bank and Nippon Credit Bank to suffer due to the decreased value in asset prices (Far Easter Economic Review, 1997).

Much of the debate on housing bubbles suggests that the impact of housing bubbles bursting is more negative than positive leading to deterioration in the real economy sectors. Therefore, understanding the magnitude of house price bubbles should begin with some economic theories, which can define bubbles and provide explanation in relation to the bubbles formation process.

### 3.2 Theories of Housing Bubbles

Thornton (2005) suggests three bubble theories, which describe the acceptance and rejection of the existence of bubbles in the housing markets. The three theories are; supply side economics theory, Keynesians and Shiller theory and Austrian school theory. These theories provide a good framework for understanding the existence of house price bubbles. However, many researchers (see Bordo, 2005; Cargill et al.,
1996; Kindleberger; 1978; Minsky, 1982,) fail to predict the timing of a bubble boom or burst in the housing market and the most relevant fundamental factors, which contribute to the volatility of the housing prices.

3.2.1 Supply Side Economics Theory

The supply side economists and the Chicago school of economists rejected the existence of a ‘bubble’ in the housing market. They believed that the ‘bubble’ was caused by real factors (Thorton, 2006). People who believed in the increase in house prices, due to fundamental values such as higher inflation and interest rates could make a profit by selling their houses at inflated prices, and this deflates the bubble long before it ever becomes over-inflated and bursts (Thorton, 2006).

Researchers such Carliner (2002), Case and Schiller, 2003, McCarthy and Peach (2004) and Himmelberg et al., (2005) believe that the recent trend towards increasing in house prices is not caused by bubbles. Carliner (2002) explains the bubble in the US in the early 2000 was caused by the slowing down of the US job market and not by the increase in house prices in the US. Case and Schiller (2003) argue an increase in house prices does provide sufficiently strong evidence to conclude that a housing bubble exists, rather it may be caused by some other economic fundamental (Case & Schiller, 2003).

Using a price to income ratios approach for the US housing market, both McCarthy and Peach (2004) and Himmelberg et al., (2005) studies suggest that the increase in price to income ratio is caused by changes in personal income and nominal mortgage rates. In the Swedish housing market, Hort (1998) reveals that the mean reversion recorded in 22 cities reflects rational overshooting of equilibrium prices, which supports a rejection of the existence of bubbles in the housing market.

All of the studies above conclude that a bubble cannot occur in the housing market as suggested by supply side economics theory. However, the supply side theory suggests government interventions to reduce people’s perception and miscommunication about housing bubbles (Thorton, 2006).
3.2.2 Keynesians and Shiller Theory

The second view on housing bubbles states that bubbles are caused by psychological factors. This view received a lot of support from economists including Paul Krugman and Robert Shiller. According to this view, real factors may contribute to the deviation in the business cycle but the important causal factors are psychological. When people become confident or overconfident, it will generate a boom in the economy since there is an increase in risk taking (Thorton, 2006).

Speculative behaviours are created when economic decisions are made without relying on the fundamental values. As investment mania forms rapidly in the housing market, the bubble expands and creates a housing boom (Thorton, 2006). Schiller (2008) explains that the housing boom caused by over confident and irrational exuberance, will have to burst due to the reversal of people’s expectations of future house prices.

According to Brunnermeier and Julliard (2008), households fail to differentiate between real and nominal changes in interest rate and rent, and therefore make housing purchase decisions without considering future decreases in price and rent. This psychological factor causes house price to increase and creates a booming condition in the housing market. Thorton (2006) explains that investors react negatively to disappointing news in economic reports. However, investors in general believe downturn events are temporary. As prices continue to fall and investment projects are postponed, a bubble in the economy can trigger off panic among investors, resulting in a depression.

There are three important factors causing housing bubbles (see Schiller, 2004). The first factor is the increasing risk and chaos in the world market due to the technology boom and terrorist attacks of 9/11 that caused people to invest in more conservative markets such as houses. In addition, Shiller (2004) sees the explosive growth in global communication contributing to the build up of bubbles in the housing markets. People are attracted to appealing pictures and news about beautiful and glamorous cities or states and tend to overspend their money (Thorton, 2006). The last factor is the psychological factor which is “the speculative contagion that underlies any bubbles”
(Thorton, 2006, p.8). Shiller (2004) explains that once people form a speculation expectation on house prices in one city, this will continue to spread into other cities, creating a contagious effect in the housing market. This is consistent with Roehner (1999) who shows that speculative behaviour caused an increase in house price for other districts in the Paris housing market.

### 3.2.3 The Austrian School of Thoughts

Finally, Austrian economists believe that there are changes in real factors and market psychology during bubbles, which are driven by the business cycle. The business cycle is seen as a flow of awareness and emotions (Thorton, 2006). This theory is based on the Austrian business cycle (known as ABC) theory (Thorton, 2006). In this theory, the central banks create the business cycles by driving up the supply of money, which in turn lowers the interest rates and leads to a ‘boom’ situation. This bubble boom is only temporary as the misallocation of capital resources will soon be corrected and channelled towards more efficient uses through a process of ‘burst’ or recession (Thorton, 2006).

Thus, it has long been recognized that different people hold different expectations of housing bubbles. First, people who believe that the movement in house prices is caused by economic fundamentals (interest rates and income) reject the theory of bubble existence in the housing market. Second, people who accept the theory of bubble existence believe that the increase in house prices is caused either by psychological factors or by a buyer’s expectation (i.e. whether he/she is optimistic or pessimistic about the future direction of house prices and business cycles).

### 3.3 Price Expectation Theories

The future price appreciation of houses, set by households’ expectations is very important. The people’s expectation has tremendous impact on housing demand if their expectations are prolong into the future without any decreased in the house prices (Coleman, 2008). According to Thomsett and Kahr (2007), the most significant feature about bubbles is the price.
In general, as prices increase, more people are willing to participate in a booming market due to the higher return expected from their investment. This same expectation is also found in the real estate market (Thomsett & Kahr, 2007). For example, Hendry (1984) highlighted the existence of “the process of expectation formation” (p 228) in the housing market and Shiller (2007) describes the booming of the housing market as a classic type of speculative bubble, caused by high expectations for a further increase in house prices in the future. Shiller (2007) also confirms this finding from a survey conducted to measure the consumer’s expectation of high (boom) house prices in the US.

Furthermore, in the boom phase, the demand for housing construction is high as consumers with higher income expectations are ready to buy new or better homes and most homebuyers expect capital gains from their housing investment (Kraiser, 1997). The increase in supply has induced ‘a mania for building’ houses (Pugh & Dehesh, 2001). During this booming period or rising market, residential properties sell quickly at values near to or frequently higher than seller asking price (Genesove & Mayer, 2001).

According to the stock-flow hypothesis, in the short-run, demand for houses depends on the expectation of future prices of houses as well as other fundamental variables such as income, population and house price levels (DiPasquale & Wheaton, 1996). Minford and Peel (2002) explain that expectations are the fundamental factor in economic decisions. Changes in people’s expectations of the future house prices can determine the types of bubbles in the housing market. However, this expectation is not driven by the shifting supply condition, which is inelastic in the short-run (Levin & Wright, 1997).

Understanding the expectations of buyers, sellers, investors or real estate agents helps to improve the efficiency of and the impact of sudden shock occurring in the housing market (Lee, 2003). The reaction of property prices towards different economic shocks can be explained using three types of price expectation theories; rational expectation hypothesis (REH), adaptive expectation hypothesis (AEH) and exogenous expectation hypothesis (EEH). Each of these price expectation theories behave differently in different economic conditions (boom or burst).
3.3.1 Rational Expectation Hypothesis (REH)

Originating with the work of Muth (1961), the rational expectation hypothesis (REH) holds that market behavior follows a rational expectation where: 1) people have rational information processing and know about the structure condition of the economy; 2) households are believed to be perfectly informed about the housing market and are able to predict correctly the movement of housing market prices with regard to any unforeseen shocks (DiPasquale & Wheaton, 1996) and 3) people use all available information to forecast future prices as they have perfect information about the future without any information cost (Malpezzi & Wachter, 2002). With REH, the cyclical behavior usually occurs under a laissez faire economy (see Boldrin & Woodford, 1990).

Several researchers (for example, Capozza & Seguin, 1996; Clark, 1995; Clayton 1997) in housing market studies adopt the REH. The econometric formula of REH is as follows (Clayton, 1997).

\[ Hsg^* = \frac{Hsg_{p,t+1} - Hsg_p}{Hsg_p} \] ................................. (3.1)

Where, \( Hsg_{p,t+1} \) is the forecasted house price in one year, \( Hsg^* \) is the equilibrium house price and \( Hsg_p \) is the current house price. However, if the housing market follows the REH, the house price forecast one year from now, using all the information available about housing market’s operation is:

\[ Hsg^e_{p,t+1} = E_t \left[ Hsg_{t+1} | Inf_t \right] \] ................................. (3.2)

Where \( Inf_t \) is the information available to people in the housing market at period t. Equation 3.2 implies that people have full knowledge about the factors and parameters which caused the movement of current and past values of house prices (Dong-An, 2005). Therefore, the difference between house price expectation and real house price occurs by a random error (see equation 3.3)
\[ H_{\text{sg}_{p,t+1}} = E_t \left[ H_{\text{sg}_{p,t+1}} | \text{Inf}_t \right] + \epsilon_{t+1} \quad \cdots \cdots \cdots \cdots (3.3) \]

Clayton (1997) explains that house price expectations rely on understanding of house prices, rents and other exogenous variables in the current market. Assuming other things to be constant (Ceteris paribus), the future expectation of house price is positively associated with house price and negatively related to rents (Dong-An, 2005).

Eugene (2006) explains the consequences of violating the assumptions underlying the REH. Violation of the first assumption causes an irrational bubble (mania) to exist and the existence of a rational bubble is caused by violating the second assumption. The asset prices will deviate from economic fundamentals when all the assumptions under the REH are violated (Blanchard & Watson, 1982).

In reality, this assumption is not rational, since the future is unpredictable (Malpezzi & Wachter, 2002). However, ‘rational bubbles’ do exist due to the self-fulfilling calculation by investors who buy assets in short-term expectation that the price will increase and other people will follow (Loeys & Panigirtzoglou, 2006). Rational investors believe that higher return from the increase in asset price will reimburse them for the effects of a market crash and justify staying in the market even though it is overvalued (Chan et al., 2001). This situation is described as a ‘greater fool theory’ where one can profit in buying an overvalued asset if other, greater fools will pay a higher price for the asset (James, 2003).

The two types of bubble according to the REH, are the explosive bubble and the intrinsic bubble (Eugene, 2006). In an explosive bubble, the cause of the deviation in house prices from the fundamentals is the factors which are not relevant (extraneous) to the asset values (house value) (Black et al., 2006). Some examples of these factors are the changing weather in the surrounding areas; the number of children living in a house and the types of plants used for landscaping. For this type of rational bubble, the bubble is constantly diverging, as the asset value cannot be negative (Diba & Grossman, 1988).
The intrinsic rational bubble originated with the variability in the exogenous fundamental factors (Froot & Obstfeld, 1991). This type of bubble is more rational in explaining the housing price bubble with economic fundamentals such as interest rates, inflation and income. Furthermore, intrinsic bubbles do not diverge all the time but sometimes reverts to their fundamental values (Black et al., 2006).

The market participants in this type of bubble also believe that, based on rational expectations, house prices may be different from the fundamentals due to the uncertainty of prices in the rational model. The rationality of the bubble in the house price is determined through the bubble component which is the expected discounted value of the future bubble (Eugene, 2006).

Lee (2003) explains that, using the concept of expectation, efficiency of the housing market can be determined. In the efficient market hypothesis, expectation of future prices is similar to the rational expectation hypothesis assumptions (Malpezzi & Wachter, 2002). The efficient market hypothesis was introduced by Kendall (1953) and developed further by Fama (1970), who suggests that prices follow a random walk and are unpredictable (Lee, 2003). The life cycles model, under the rational expectation hypothesis, explains that a house price only follows a random walk when there is a random movement in the behavior of exogenous variables (Meen, 2003).

Rosenthal (2008) explains that housing market efficiency studies are based on three categories. These categories include studies, which compare quality adjusted house prices with discounted present value of rents; studies which examine a serial correlation in house price; and studies which model changes in house prices due to changes in the real determinants such as income, inventories and interest rates.

However, many researchers (see Arrow, 1987; Gatzlaff & Tirtiroglu, 1995) suggest that the real estate market may be inefficient (Rosenthal, 2008). Gatzlaff and Tirtiroglu’s (1995) study of the real estate market efficiency shows that the housing market may not be as efficient compared to financial assets such as equities, because housing markets are less liquid and require greater information and transaction costs. Moreover, there is difficulty in estimating the observed patterns of rational expectation in the housing market (Arrow, 1987). This is due to the irrational
assumptions underlying the REH (Malpezzi & Wachter, 2002). Belke and Wiedmann (2005) argue that if people behave rationally, not everyone will be able to sell a house in the future.

Further evidence for rejecting the rational expectation hypothesis is found in Clayton’s (1996) study for single-family detached house prices in Vancouver, Canada using data from 1979Q1 to 1994Q4. Clayton’s study suggests that irrational expectation hypotheses are the underlying theory characterizing the Vancouver housing market. Evan (2004) also argues against the rational expectation hypothesis by suggesting that irrational house price expectations and psychological factors caused the housing price boom. Moreover, homogenous expectations held by all people in the REH are difficult to apply to heterogeneous assets such as houses (Mueller, 2002).

### 3.3.2 Adaptive Expectation Hypothesis (AEH)

Future house prices in the adaptive expectation hypothesis (AEH) are determined using past information and trends in house prices. The AEH is also known as backward-looking expectation (DiPasquale & Wheaton, 1996) or extrapolating behavior, which is common in the housing market (Case & Shiller, 1988). This hypothesis is also used in macroeconomic inflation models (Sommervoll et al., 2010).

Using the information embodied in previous sold assets, sellers, buyers, investors and real estate agents estimate the market price of an asset (Hwang & Quigley, 2002). The adaptive model was first developed by Cagan in 1956. The myopic expectation by market participants causes failure in predicting for potential reversals in house price trends (Malpezzi & Wachter, 2005). Furthermore, the expectation based on past information, causes house prices to increase continuously even though new construction of houses is available in the market. Speculators also contribute to the rising of house prices (Malpezzi & Wachter, 2002). Speculators such as the feedback trader in AEH based their demand for houses on the past values of house prices and not on market fundamentals (Riddel, 1999).
The expectation of optimistic economic growth drives the housing cycle to its peak (Kaiser, 1997). According to Hoyt (1933), speculative influences may push real estate activities far out in advance of real economic growth. This concerns homebuyers who are now unable to buy a house in the future due to a higher increase in house prices (Case & Shiller, 1988). However, investors who believe in the AEH are optimistic during the rising prices of the property market. Such optimistic beliefs are held even when property market values are decreasing, as market participants are still willing to pay a higher price (Davis & Zhu, 2004).

Based on the AEH or backward-looking expectations, the house price’s expected rate in each period is associated with past trends in house price movements and it could also be assumed to be the same as the moving average of current price appreciations (Dong-An, 2005) as described by the following equation (see equation 3.4)

\[ H_{sg, t} = E \left[ \Delta_{H_{sg, t}} \right] = \left( \frac{H_{sg, t-1} - H_{sg, t-n}}{H_{sg, t-n}} \right)^{1/n} - 1, n \geq 1 \ldots \ldots \ldots (3.4) \]

Where \( H_{sg, t} \) is the expected future house price, \( E \) is the expectation and \( \Delta_{H_{sg, t}} \) is the change in house price at period \( t \).

Several studies such as Levin and Wright, (1997), Hamilton and Schwab (1985) and Malpezzi and Wachter, (2002) support the use of the AEH to explain house price movement. The movement of UK house prices from 1974 to 1994 is believed to be associated with the historical movement of house prices, or AEH (Levin & Wright, 1997). This result is derived using the previous changes in the UK real house prices to predict the future changes in the UK real house prices.

Hamilton and Schwab (1985) explain that the cause of bias in predicting the expectation of appreciation rates in house prices for 57 metropolitan areas in the US housing market is due to the failure to incorporate past appreciation house prices rates into their calculations for future appreciation in house prices. Consequently, the authors used house appreciation rates from 1974 to 1976 to predict the 1976 to 1979
house price appreciation rates in US housing market. The results strongly reject the efficient market hypothesis.

The peak in house price is reached when there is an overflow of housing stock supply from the construction sector (DiPasquale & Wheaton, 1996). This causes speculators to exit from the market immediately. Based on such expectation, a speculative bubble occurs in the housing market (Malpezzi & Wachter, 2002).

A speculative bubble is frequently used to explain persistent overvaluation followed by market collapse (Kindleberger, 1987). The bubbles arise because of the uncertainties surrounding the ‘fundamentals’. The definition of a speculative bubble is reinforced by this statement from Stiglitz (1990), “If, the reason that the price is high today is only because investors believe that the selling price will be high tomorrow - when “fundamental” factors do not seem to justify such a high price - then a bubble exists” (p13). Economists describe speculative bubbles as the source of recent economic crises, such as the 1992 Argentina crisis, 1998 Russian crisis, 1997 Asian financial crisis, 1994 Mexican crisis and 1992 European Exchange Rate Mechanism (ERM) crises (Quigley, 2001). A detailed history and explanation of the way speculative behaviour has caused boom and burst cycles in the global economy can be found in the works of Kindleberger (1987) and Aliber (1990).

Malpezzi and Wachter (2002) explain that, in an AEH, the real estate market does not follow a ‘random walk’ because it draws on past information. Hence, the efficient market hypothesis is rejected in the property market due to the less efficient information available to all people. According to Ott et al., (2000), many researchers such as Englund et al. (1999), Quigley & Redfearn (2000) and Hwang & Quigley (2002) support the violation of random walk for the real estate market.

Englund et al. (1999), who investigated eight regions in Sweden from 1981 to 1993 using a repeat sales method for single-family dwellings, found that the random walk hypothesis is strongly rejected for individual house prices. Using the US housing market, Quigley and Redfearn (2000) also rejected the random walk hypothesis in real estate. In addition, Hwang and Quigley (2002) found that condominium prices in Singapore from 1990 to 2000 also did not follow a random walk hypothesis.
3.3.3 Exogenous Expectation Hypothesis (EEH)

In the exogenous expectation hypothesis (EEH), households believe that the local housing market is not affected by future growth in the economy (DiPasquale & Wheaton, 1996). It is formed independently of local market behaviour (Lee, 2003). The EEH assumes that people’s expectation is constant over time and is not affected by any recent changes in the market (DiPasquale & Wheaton, 1996). When a positive demand shock triggers the housing market, house prices and construction costs increase to new long-run equilibrium level (DiPasquale & Wheaton, 1996).

The literatures discusses the three price expectation theories held by people. In each theory, different types of bubbles emerge in the housing market. Other important point identified is that households only know relevant information about the housing market such as the interest rates and the amount of mortgage, therefore the rational expectation hypothesis is rejected (Hendry, 1984; Muellbauer & Murphy, 1997). It is also suggested that the underlying price expectation hypothesis held by households in the housing market is a ‘semi rational’ expectation hypothesis (Hendry, 1984). Furthermore, the expectations made about the future movement of the fundamental values which determine house prices are based on subjective opinions of market participants’ regarding the probabilities of such events (boom or burst) occurring.

Therefore, assessment of market fundamentals is inherently subjective and the actual price of the property will only be the same as the ‘fundamental value’ by chance (Shiller, 2001; Xiao & Tan, 2007). This means the property price will contain a bubble element (Xiao & Tan, 2007).

3.4 Signs and indication of bubbles in the housing market

Bubbles in the housing market may be difficult to detect or analyse given the difficulty in determining the fundamental variables causing the variation in the house prices (Flood & Hodrick, 1990). Therefore, researchers in the housing market have established some indicators or signals, which can assist in detecting the possible existence of housing bubbles.
Sanchez (2003) listed several indicators of bubble existence in the housing market. These include a sharp increase and fall in the house prices which can not be explained by the economic fundamentals, an increase in the purchase of houses for capital gain (speculation) purposes and the excitement of buyers in purchasing a house regardless of the price and their financial condition. According to Shiller and Case (2003), a housing bubble occurs when a house is defined as an investment and not as a house to occupy. Other indicators of bubbles include the amount of housing stock available in the market (Thomsett & Kahr, 2007). Housing stock of six to twelve months should be available to fulfil the demand for houses and any amount exceeding twelve months will cause an ‘over-supply’ in the housing market (Thomsett & Kahr, 2007).

In addition, a bubble exists when people start to purchase an asset based on expectation of future price increase (Case & Schiller, 2003). The signs of disruptions in real economy and financial sector are a deflationary pressure which reduces economic output and the emergence of banking crises due to the bursting of housing bubbles (Bordon & Jeanne, 2002). Other signs of a bubble booming in the housing market are liberalized loan conditions, low interest rates, overpriced properties and positive expectations for the future (Bordon & Jeanne, 2002).

According to Bibish IV and Kenan (2005), an asset becomes a bubble in the presence of three conditions. First, the existence of uncertainty about future returns on the asset. Rising prices are based on people’s expectation of economy conditions, which can change overnight. Second, the transaction cost of purchasing or selling the asset decreases (inducing speculative buying). Therefore, more people will be attracted to purchase a house, as the cost is lower. Third, the holding period of the asset becomes shorter than historical norms; this is exceptionally true for speculators who buy a house for capital gain purposes.

### 3.4.1 Phases of Bubbles in the Housing Market

This section reviews the relevant phases of housing bubbles suggested by Thomsett and Kahr (2007) in their book *Beyond the Bubble*. The authors documented three different stages of housing bubbles which are bubble inflating, bubble bursting and bubble crises or default.
Thomsett and Kahr (2007) describe the first stage of a bubble as financial liberalization (or a decision by central bank to increase lending) and an expansion of the credit market. Fewer restrictions in loan qualifications by financial institutions is the contributing factor for the expansion of the credit market. This then leads to a higher disbursement of home mortgages to homebuyers (Thomsett & Kahr, 2007). Houses now become more affordable and this pushes up the demand for houses substantially (Kritayanavay, 2008). Such situation creates a ‘platform’ for housing bubbles to inflate into the housing market. Thomsett and Kahr (2007) describe this initial stage as an ‘upswing’ in the property cycles process.

The increase in real estate prices continues for some time, possibly for several years, as the bubble reaches its peak. Throughout this period, house prices become too expensive for the public and only investors and speculators dominate the housing market (Kritayanavay, 2008). Furthermore, the real estate bubble includes a ‘buying frenzy’ that comes with irrational actions and behavior from the buyers (Thomsett & Kahr, 2007). The peak of a real estate bubble occurs when a buyer places an offer to buy an asset for a price which is above the true value of the asset. This situation creates a temporary ‘hot’ or over-booming market in real estate since people are willing to buy an asset for a price higher than the market value (Thomsett & Kahr, 2007).

Stevenson (2008) also points out that during the booming period, people perceive housing as the best way to increase their wealth compared to equities. This is supported by the increase in housing loans distributed to the housing sector during the boom period. For example in Malaysia, RM20,000 million of loans were allocated to the housing market in early 1996 (see Figure 2.4). At this stage, people tend to be over-optimistic (Kritayanavaj, 2008). According to Hoyt (1933), speculative influences may push real estate activities further in advance of the growth of the real economy. For example, the boom in house prices caused the Malaysian house price to deviate from its equilibrium or true values from 1990 to 1991 (see Figure 6.3). During these boom periods, other macroeconomic fundamental variables (such as income, interest rate and inflation) did not change in accordance with the movement in Malaysian house prices.
In Malaysia, the booming of the real estate market started and lasted from early 1991 to 1995 as the Malaysian house price index (MHPI) increased by 25.1% in 1991 and 18.41% in 1995 (see Figure 2.2) (Global Property Guide, 2008). Prior to the 1997 Asian financial crisis, the fragility and instability in the structure and condition of the Malaysian real estate market were displayed by; 1) the excessive planning approval for building residential and commercial spaces granted by the local authorities and; 2) the easy loan approval offered by banks and other financial institutions. According to a Bank Negara Malaysia report in 1993, $6 million of housing loans were approved and the amount increased to $20 million in 1997 (Bank Negara Malaysia, 2004). These factors have attracted inflows of foreigners into Malaysian property markets (United Nations, 2002).

All commercial loans in Malaysia require collateral and since real property is the only form of collateral, there is an added reason for a firm to build in an appreciating market in order to borrow funds for further expansion (Quigley, 2001). Thus, the overextension of credits in the Malaysian real estate market is believed to have caused the booming of Malaysian real estate during the pre-crisis period in 1996 (see Table 1.1). As for the East-Asia housing markets, the bubble began when there was a huge inflow of capital into the East Asian economies in the early 1990s, as these emerging economies were experiencing strong economic growth (Koh et al., 2005).

In general, real estate properties have been used as collateral assets for banks and financial institutions (Glindro et al., 2007). The increases in interest rates cause a decrease in the collateral value of the real estate loan (Kritayanavaj, 2008). The sensitivity of bank credit to the value of property assets causes a cyclical movement which appears as a boom in property prices, followed by a bubble bursting (Davis & Zhu, 2004). Gan’s (2003) study on the decreased collateral value of land in Japan confirms this perception. Based on the author result, the impact of a reduction in collateral values and investment is the dependence on internal funds by financial institutions to finance other assets and investment. When the housing market is overheated by higher demand (investment) and reaches its peak, the bubbles then bursts causing a substantial drop in house prices (Kritayanavaj, 2008). Stiglitz (1990) defines bubbles bursting as a decline in market price that occurs without any obvious new information.
The bursting bubble stage, which is the second stage in the bubble process, shows how consumers will postpone buying new or better homes and may adjust to changing housing needs by modifying their existing dwelling units (Kaiser, 1997). For developers, the excess supply of houses causes a decrease in the construction sector, while financial institutions are more cautious in approving home loans. These conditions will cause a collapse in the housing industry and a decline in related sectors, particularly in the financial sector (Kaiser, 1997). For example in Malaysia, the post 1997 Asian financial crisis caused a 35% decline in real estate transactions, a 48% decline in the value of real estate and a surplus of 900,000 housing units (Bank Negara Malaysia, 2000).

Moreover, during the burst period, fewer transactions are recorded as the selling time for residential houses is greater and the growth of house prices is at a moderate level or negative (Jose & Javier, 2006). For example, in the post 1997 Asian crisis period, which varies for different countries most of the Asian house price indexes recorded negative values (see Table 1.2).

The housing bubbles in the Asian markets were believed to have deflated in early 1996. This happened when the US interest rates started to increase and caused the US dollar to appreciate (against yen and other major currencies) which in turn increased the value of exports for many Asian countries (Sulaiman, 1998). In Malaysia, the bursting of the bubble in the housing market occurred in late 1997 to 1998. Several economic indicators such as inflation and interest rates were reported to rise rapidly. Inflation rose significantly higher in the fourth quarter of 1997 and reached the highest peak in the first quarter of 1998 with 1.96% while the short-term rates (3 months interest rates) rose to 11.03% in the fourth quarter of 1998 (Annual Report of Bank Negara Malaysia, 2000).

Mar Iman (2002) explains that during the bubble crises, credits in Malaysia were restricted causing a decrease in the amount of loans for home mortgages (see Figure 2.4). This in turn caused a decrease in the demand for houses in Malaysia. For developers, conflict arose as a result of the increase in the time between the completion of houses and sales - caused by the slowing down of demand in the
housing market (Mar Iman, 2002). All these factors contributed to the panic and bursting of the real estate market bubble.

J.P Morgan (1998) reported that from 1997 to 1998, 40% of the property values in Asian cities plunged due to the bursting of housing bubbles – an outcome of the 1997 Asian financial crisis. In most of the crisis-ridden countries, a boom and burst in the asset market occurred prior to the occurrence currency and banking crises (Krugman, 1998). This was then followed by a decrease in stock and land prices and a plunge in asset prices (Krugman, 1998). The collapse in real estate asset prices can be short term, such as a day, or longer (Dolde & Tirtiroglu, 2002). As for the real estate market, decreasing prices will go through a slower process than stock prices. This is because of the illiquidity of the real estate market and the smaller number of participants in the market compared to the stock markets (Dolde & Tirtiroglu, 2002).

Pugh and Dehesh (2001) explain that throughout the booming period, the interdependence between the property market and capital market increased sharply. This can be seen in the third stage of the bubbles where the financial institutions and real estate-related sectors begin to crash and foreclose. According to Kritayanaj (2008), the imbalance in supply and demand in the housing market contributed to the bursting of bubbles and the default of many firms and other agents who had borrowed to buy real estate at inflated prices.

Banking practices in Asian countries, which induce moral hazard as well as the undeveloped market for real property were possible factors contributing to the 1997 Asian financial crisis (Quigley, 2001). Mera and Renaud (2000) also support Quigley’s argument and identify Asia banking and financial problem, such as lack of transparency, more relaxed policies, and unsophisticated credit risk management leading to high loan collateral value.

Many countries in East Asia gave out loans of up to 90% of the collateral values of the properties (Mera & Renaud, 2000). This action led to a higher liquidity, caused a sharp increase in asset markets (prices of houses), inflated collateral value, and rapidly expanded credit as asset prices climbed (Koh et al. 2005). This situation is
referred to as Ponzi scheme as described in the financial instability hypothesis by Minsky (1982).

The condition of the Malaysian real property market in 1999 strongly reflected the argument made by Quigley (2001). Koh et al. (2005) state that from 1992 to 1996, 70% of lending in Malaysia was going into real estate and the stock market and the number of housing loans issued by financial institutions reached its highest peak in mid 1997 (prior to the crisis) (see Figure 2.4).

The final stage of bubble process shows the bursting of bubbles into other crises. In the real estate market, the bursting of the bubble can be seen in two different forms. Firstly, it usually occurs when there is imbalance between the supply and demand sides of the housing market. The signs or symptoms include a supply overhang, an increasing number of unsold houses or a rise in new construction in an area of weak housing demand (Bibish IV et al. 2005). The second form of the bubble burst is when house prices exceeded the affordability of the average family in a geographic area and fewer people can afford to buy new houses in that particular area (Bibish IV et al. 2005).

Thomsett and Kahr (2007) describe the classical model of a bubble in five stages: 1) improvement in the economy; 2) growth of overinvestment; 3) expansion of credit; 4) existence of speculation; and 5) prices start to fall. This classical model can be used to describe all types of assets such as bonds, equities and real estate (Thomset & Kahr, 2007). This model is similar to the Asset-Price Bubble Model proposed by Kindleberger (1989).

In the first phase of a bubble, the improvement in the economy creates affordability and opportunities for people to spend and consume more. Subsequently this causes a rise in the asset prices as more people are spending and entering the asset market, thus creating an overinvestment in the market (Thomsett & Kahr, 2007). The increase in asset prices causes a growth in the economy and the expansion of credit from financial institution by lowering the cost of borrowing through higher collateral values (Bean, 2004). These situations indicate an imbalance and signal future distress for the financial institutions (Borio & Lowe, 2002).
The fourth phase of the bubble model explains the opportunities for speculation in the housing market due to the different interest rates between the time of purchase and the sales contract (Levin & Wright, 1997). If the expected growth in the house price exceeds the home mortgage interest rates and no transaction cost is involved in selling the house, a speculator will earn profit by buying and reselling the houses (Levin & Wright, 1997). However, profit can only be earned if the speculator still believes that the future house price will increase (expectation price theory). When the speculator behaves as a leader in the market, speculative bubbles might emerge (Levin & Wright, 1997).

The final phase of the bubble model occurs when the asset prices fall or decrease. The bursting of the bubble usually appears unexpectedly in the housing market with several indicators such as a supply overhang, an increased number of unsold houses and new construction of houses in the areas with weak housing demand (Bibish IV et al. 2005). Other possible causes are the deterioration in economic fundamental factor such as interest rates and a decline in economic growth (Himmelberg, 2005). When the house price bubble bursts, people panic and become pessimistic (Himmelberg, 2005). The panic in the housing market usually occurs somewhere between three to six months following the peak in the business cycle (Eisenbeis, 1997).

The above discussion of bubble formation is important to policymakers, analyst and economist in order to create and implement contingency plans (i.e. law and policies) for managing house price bubbles. Although housing bubble theory and evidence supporting bubble existence has been criticized, the next section discusses relevant studies which provide evidence support the existence of housing bubbles.
PART B

3.5 Review on Housing Bubbles Studies

The asset pricing literatures have highlighted the difficulty in explaining the existence of bubbles in the housing market (Flood & Hodrick, 1990). These include: 1) difficulty in determining fundamental variables which affect the movement of house prices (Flood & Hodrick, 1990); 2) undeveloped models for estimating house prices (Englund et al., 1999) and; 3) arguments from other researchers about the theory and method used in explaining the existence of housing bubbles (Cho, 1996).

Despite this complexity in measuring housing bubbles, many researchers have found empirical evidence to support the existence of bubbles in housing markets globally (see Abraham & Hendershott, 1992, 1994, 1996; Ayuso & Restoy, 2003; Chan et al., 2001).

Several researchers have found quite modest housing bubbles in countries such as Australia (Bourassa & Hendershott, 1995), Sweden (Hort, 1998), and New Zealand (Bourassa et al., 2001). The housing markets in London (Levin & Wright, 1999), Paris (Roehner, 1999) and Dublin (Roche, 2001) were also reported to be affected by a regional speculative behavior. Furthermore, countries such as Ireland, South Africa, Israel, Greece, Russia and China have also displayed signs of a bubble in their real estate markets since 2005.

Zhou and Sornette (2008), Goodman and Thibodeau (2008) and Abraham and Hendershott (1992, 1994) examined housing bubbles in the US. For example Abraham and Hendershott (1992, 1994) reveal that there was a 30% above-market premium in house prices in the Northeast US and about a 15% to 20% premium in house prices on the West Coast. Abraham and Hendershott (1992) integrate two proxies in the real estate market; one for the tendency of a bubble to burst and second the tendency of a bubble to swell. These proxies were found to be working well in explaining the large cyclical swings in real estate prices on the West Coast of US (Abraham & Hendershott, 1992).

Goodman and Thibodeau (2008) examine house price bubbles in 84 Metropolitan Statistical Areas (MSA) in the US from 2000 to 2005. The comparison of computed nominal appreciation rates with observed appreciation rates from the Office of Federal Housing Oversight (OFHEO) data indicate that only 39 MSA were experiencing a house price bubble and California was reported to have the highest rates of appreciation (149.7%). The same conclusion is found in Clithero and Pealer (2005), where individual home sales in Irvine, California showed strong evidence of a housing bubble.

Capozza et al. (2004) also found a variation in the movement of 62 house prices in US metropolitan areas. Using economic variables such as information cost, supply costs and expectations, Capozza et al. (2004) show that the variation in these house prices was not caused by a common reaction to different economic shocks but rather that house prices produce different reactions to different economic shocks. This shows that the variation in US house prices is not coming from fundamental factors and that bubbles are the only rational explanation.

The bubbles in US house prices were believed to occur in mid 2006 (Zhou & Sornette, 2006). This conclusion is based on the strongly increased curve of the linear-logarithmic plots of US new houses average sales, which suggests a faster price growth rate than exponential growth rate. Zhou and Sornette (2006) describe the exponential growth rate as ‘a straight line in linear –logarithmic plots’ (p 301).

Case and Schiller (2005) support the existence of speculative bubble in some regional US housing markets. The authors’ results were based on a survey of consumers’ attitudes toward housing, which reported that 90% of the people in San Francisco, Boston, Milwaukee and Los Angeles expected an increase in house price in the future.
and that there was evidence of speculative bubbles in single-family house prices in these areas in 1998 and 2003.

The increase in US house prices motivated Labonte (2003) to examine the movement of the US Housing Price Index (HPI) with other economic fundamentals factors such as income, inflation and interest rates. At a national level, Labonte (2003) failed to identify any bubbles, but at the regional level, the author presents evidence of bubbles in California and New England between 1997 and 2002.

In another US housing market study, Gallin (2006) concludes that the rapid growth in US housing prices after 2000 is unexplained by changes in the economic fundamental variables, such as interest rates. The study uses panel data for the US Metropolitan Statistical Area (MSA) and panel data stationary test. The author found that the house price dynamics in the US housing market could not be explained by the fundamental factors.

Further tests on the MSA market were conducted by Wheaton and Nechayev (2007). The authors used the demand fundamentals factors such as income growth, population and interest rates to discover whether these factors could explain the growth rates in 59 MSA houses prices from 1998 to 2005. The OFHEO repeat sales indices for 59 markets were examined using an AutoRegression (1) model. Their study showed that the growth in house prices exceeded the implied economic fundamentals.

The issue of speculative bubbles caused by speculation on the anticipated change in the future house price in UK was examined by Garino and Sarno (2004) and Zhou and Sornette (2003). Using a cointegration and Markov-regime switching model, Garino and Sarno (2004) tested the UK house price with fundamentals factors such as real personal disposable income per capita, treasury bill interest rates, mortgage rate and consumption expenditure deflator (CED) over the period 1983:Q1 to 2002:Q4. Zhou and Sornette (2003) used a mathematical equation to study the existence of bubbles in the UK residential market from December 1992 to April 2003. In both studies (Garino & Sarno, 2004: Zhou & Sornette, 2003), speculative bubbles were proved to exist in the UK housing market.
Clark et al. (2008) modeled the macro movement of UK national income, the London stock market and the UK house price index over the period 2001 to 2007. The authors used ARIMA model to estimate the growth rate in house prices and found evidence of bubble existence in UK house prices from 2001 to 2007. This is similar to the findings of Leamer (2007) and Taylor (2007), concerning the effect of high expansionary monetary policy in the housing market after the US September 11 attack.

Hall et al. (1997) use a switching error correction model to examine the house price in the UK. The authors use data from Baton Rouge and Case-Schiller from 1967 to 1994 and conclude that the estimation coefficient from the error correction model shows that a boom in UK real house prices is associated with an unstable regime. Hall et al. (1997) tested for heteroskedasticity in the changes of house prices for the presence of a random walk. The result of their study proved that both data, Baton Rouge and Case-Schiller, rejected the random walk hypothesis.

Levin and Wright (1997) show that speculation is a significant factor in determining house prices in the UK from 1972 to 1994. Speculation causes volatility in house prices for London City, the South East and South West in the UK. An OECD (2005) study of international house prices in 17 international housing markets points to a 30% overvaluation in UK house prices in 2003 to 2004 as evidence of house price bubbles. The OECD result was drawn from a comparison of house price to rental ratios and the use of backward looking price expectation hypothesis in calculating the user cost of housing. The UK housing bubbles were believed to have ended in 2003 (Zhou & Sornette, 2003).

More evidence of speculative bubbles is found in Dublin house prices from January 1976 to January 1999 (Roche, 2001). The author analyzed Dublin house prices using two different models; a fundamental model and non-fundamental models using a regime-switching model developed by Van Norden (1996). In the fundamental model, the supply and demand models are used. In the non-fundamental models, the inverted demand model, a standard asset pricing model and a comparison of house price with new house price and building cost ratio are employed. The exogenous variables included in the Roche (2001) study consist of disposable income, expected real rates, mortgage rate and demographic variable.
In the Paris housing market, the house price bubble started in 1994 and burst throughout 1990 to 1991 (Roehner, 1999). By examining twenty districts in Paris, Roehner (1999) described the price movement of house prices in different districts and characterized each district in terms of relative strength based on speculative trading versus supply inelasticity. The result of Roehner (1999) study points to the transmission of speculative behavior by economic agents as a significant factor in generating price increases in other districts even those with a lower income and poor housing standards.

In the Australian housing market, Hatzvi and Otto (2008) used the asset pricing theory to explain the behavior of 36 Local Government Areas (LGAs) property prices and rents in Sydney from 1991 to 2006. Using house price, income growth, population growth, building costs, mortgages rates and consumer prices, two bubbles were identified in the Sydney housing market. The property prices of LGAs in the outer western suburbs of Sydney showed a large percentage (60%) of variation, which is not explained by the variation in the fundamentals (rent growth and real interest rates). Using only housing data (without apartments), the variation in Sydney’s house prices (rent ratios) is not explained by the asset pricing fundamentals. Similar conclusions are drawn by Bourassa and Hendershott (1995) and Bodman and Crosby (2004) with regards to the Australian housing market.

Bourassa and Hendershott (1995) examine speculative bubbles in five capital states in Australia, including Canberra, using annual data of real wage growth, growth in employment, growth in real construction costs, after tax real interest rates and population growth from 1979 to 1993. The authors conclude that speculative bubbles do exist in the Australian housing market. Bodman and Crosby (2004), used Bourassa and Hendershott’s (1995) model and data (add real rents, demographic and Australia GDP) and found supporting evidence that the Australian housing market experienced speculative bubbles.

In addition, studies have documented substantial evidence of the existence of bubbles in Asian and East Asia countries such as Japan, Korea, Hong Kong, China and Thailand. According to Quigley (2001), the over booming and fluctuations of real estate markets in Southeast and East Asia countries contributed to the 1997 Asian
financial crisis. For example in Thailand real estate market, the existence of bubbles is believed to have caused the 1997 Asian financial crisis (Kritayanavaj, 2008). The house price index in Thailand decreased to 19.54% during the crisis period in 1997 to 1999 (see Table 1.2).

Calhoun (2003) examines the house price indexes (HPI) in Thailand from the pre-crisis period (1992) to the post-crisis period (2000). Using a hedonic property valuation models, Calhoun (2003) found a significant regional difference in house price appreciation rates for both the pre-crisis and post-crisis period. Thirty of 76 provinces in Thailand showed negative HPI appreciation rates from 1992 to 1997 while eight other provinces showed negative HPI appreciation rates of more than 30%. In the post-crisis period (1997 to 2000), the negative HPI appreciations are recorded in 69 of 76 provinces. Therefore, during the boom in Thailand real estate market, many provinces seemed to experience negative growth in house prices (Calhoun, 2003). This is supported by Wong (2001) who also describes the formation of bubbles in Thailand’s housing market prior to the 1997 Asian financial crisis.

In regard to the Korean housing market, researchers such as Kim (2004) and Kim and Suh (1993) provide empirical evidence of the existence of bubbles. Kim (2005) uses two approaches: 1) linear regression in a time series analysis and; 2) the concept of discounted cash flow (DCF), in examining the presence of bubbles in the real estate market in Korea. The author uses interest rates, income, inflation and real GDP growth rates from 1988:Q1 to 2002:Q4 from Kookmin Bank. Using the first approach, Kim’s study shows evidence of housing bubbles occurring in two periods: 1) 1991:Q1 to 1993Q4 and; 2) 2001:Q3 to 2002:Q4. In the second approach, the results indicate a greater likelihood of bubbles occurring in the Gangnam district in Seoul. This finding is consistent with the situation in Gangnam district which is the most expensive and speculative area in Seoul (Kang, 2007).

Kim (2004) uses a Kalman Filter approach to estimate the size of housing price bubbles in Korea. The data includes monthly Korea housing price indexes from 1987 to 2003. The author shows that bubbles existed in the Korean housing market in the period 1992 to 2001 (except for 1998) with overvaluation in house prices by 44% to 55%. In another study, Kim and Suh (1993) found a particular form of bubble in the
Japanese and Korean housing markets. The authors used an equilibrium price equation, which included the GDP stock price index and household consumption expenditure and found evidence of both nominal and real bubbles in the Japanese market. They were unable to reject the null hypothesis of no bubbles in the Korean real housing prices.

Ito and Iwaisako (1995) examined Japanese property prices in order to determine whether the variation in property prices could be attributed to the fundamental factors. Their results suggested that during the early 1980s rational explanation and fundamental factors can not be used to explain the changes in asset price in Japan.

Chan et al. (2001) used the signal extraction approach of Durlauf and Hall (1989) to detect the unobservable model noise and the misspecification error in three urban areas of the Hong Kong property market. Evidence of the existence of a bubble caused by the misspecification error, is found in Hong Kong Island, Kowloon and New Kowloon with a bubble explosion from 1990 to 1992 and from 1995 to 1997.

Wong (2005) found similar bubbles in the Hong Kong residential housing price. This study examine the movement between the house prices in Hong Kong with fundamental factors such as housing stock construction cost, population growth and interest rates from 1992 to 1998. Xia and Tan (2007) used a Kalman Filter on the Hong Kong property market to test for any existence of bubbles from the 1980s to the 1990s. Using a combination of fundamental variables and speculative bubbles, Kalra et al., (2000) and Peng (2002) examined the Hong Kong property price model. Their study showed that half of the movements in Hong Kong property prices were explained by fundamental variables and the other half were due to the inflating of a bubble which follows by bubbles collapsed or bursting.

The strong growth in China’s economy and rapid development in the real estate market have contributed to the increase of house prices in China (Shen at al., 2005). Qi and Li (2004) and Shen et al. (2005) have examined the Chinese real estate market to determine the possible existence of housing bubbles. Qi and Li (2004) built a model to explain the increase in China’s real estate prices by examining the relationship between real estate prices and bubbles. The results of their study show that three main
factors contribute to the increase of real estate prices in China and the formation of real estate bubbles. These factors include increased market demand for real estate assets, more opportunities in terms of credit from financial institutions and an oligopoly competitive market (Qi & Li, 2004).

Shen et al. (2005) examined the Beijing and Shanghai housing markets using a Granger causality test and generalized impulse response analysis. The economic fundamentals include disposable income of urban household, GDP and stock price index for both cities. The authors’ result suggests that only the Shanghai housing market was found to be experiencing housing bubbles in 2003. The Shanghai housing prices deviated 22% from the market fundamentals values and this deviation can be attributed to the bubble (Shen et al., 2005).

Studies in the Swedish property market indicate that bubbles existed in the market in different periods (see, 2004; Bjorkland & Sodenberg, 1999; Jonung et al., 2006; Yang & Turner, 2004). Yang and Turner (2004) examined the private housing market in Sweden from 1971 to 2001 to determine and understand the influence and characteristics of fundamental factors and bubbles. The bubble is explained by the deviation of house price from these fundamentals factors (Yang & Turner, 2004). The authors used a common trend (CT) model where the model decompose permanent and transitory shocks into cointegration model. Their study showed that bubbles and speculative expectations exist in the Swedish property market as a result of the volatility in housing demand and the fundamental factors. The interest rate was found to be important in explaining the fluctuation of house prices in the long-run and short-run. The authors used the impulse response function to capture the time-path of fundamentals and bubbles (Yang & Turner, 2004).

Bjorkland and Sodenberg (1999) found that the ratio of property value to rent increased significantly during the sample period from 1985 to 1994 in the Swedish property market and concluded that property prices in Sweden were driven by speculative bubbles. Jonung et al. (2006) recorded the boom and burst caused by expansion in credit and rising house prices in Finland and Sweden during 1984 to 1995 period.
The literatures discussed above support the existence of housing bubbles in different parts of the world. Economic fundamentals such as income and interest rates are the most significant factors influencing the movement of house prices. In most of the housing markets described above, the housing bubbles started as a boom in the mid 1980s to early 1990s, with the bubble bursting in early 2000.

3.6 Conclusions

This chapter reviewed the concepts, theories, expectation models and relevant studies on the housing bubbles. The chapter began with a definition of housing bubbles and an account of the impact of housing bubbles on the economy. Housing bubbles are generally seen to have a negative impact on the economy. The bubbles in housing are defined as an increase in house price above the economic fundamental values. Housing bubbles are believed to be caused by the expectation of an increase in future house prices. The three price expectation theories: rational expectation hypothesis (REH), adaptive expectation hypothesis (AEH) and exogenous expectation hypothesis (EEH) are used to rationalize the behavior of people in creating housing bubbles.

Thornton (2005) suggests that some people reject the existence of housing bubbles following the supply side economics theory while others believe that housing bubbles exist based on the Keynesians and Shiller theory and Austrian school of thought.

The description of bubble formation occurs in different stages. The over-booming in the housing market, which is due to the liberalization in financial institutions and the lowering standard in credit mortgage, causes a higher demand for houses. This in turn pushes house prices above the implied economic fundamental values and creates housing bubbles. Minsky (1982), however, does not blame ‘mania’ or ‘irrational exuberance’ for the boom in the real estate market. Policy-makers and investors should be blamed (Minsky, 1986). The bursting of housing bubbles started when people’s expectations about the increase in future house prices no longer held. A further deterioration in economic activities (increase in interest rates and inflation rates) and in the financial sector (increase in non-performing loans, higher bankruptcies in financial institutions) caused greater pessimism.
Chapter 4
Housing Bubble Model

“...the housing market is a large sector of the economy and it is highly possible that the housing market and the economy interact. Although the feedback mechanism is possible, it is not very clear. It is not only important to determine a timing relationship, but also a direction relationship between house price and its aggregate determinant series”.

(Maclennans, D 1994)

4.0 Introduction
This chapter provides an overview of the theoretical framework used to examine the existence of bubbles in the Malaysian housing market. Section 4.2 discusses the fundamental variables used to determine house price. Section 4.3 describes general structure of the housing market including housing demand, housing supply and the mortgage market. Section 4.4 explains four conventional house price models used to determine house price bubbles and section 4.5 provides details on the theoretical housing price bubble model applies in this study. Section 4.6 concludes the chapter

4.1 Macroeconomic Fundamental Variables of House Price
The property market is described as complex and difficult to interpret due to several factors. These factors include high interaction between the housing market and other sectors of the economy cyclical changes in the property market (Malpezzi & Wachter, 2001) and the lack of attention given by researchers on the changes of house prices caused by changes in macroeconomic fundamental variables (Chen & Patel, 1998). Moreover, the presence of various fundamental variables used as determinants for house price and the lack of standardized methods to measure these fundamental variables added to the difficulty in understanding property market (Hui & Yue 2006). Faust (1998) suggests that a lack of theory and evidence in the housing market literature causes the estimation of fundamental variables to be less accurate.

Despite these problems, researchers suggest various approaches to examining house price bubbles (Hui & Yue, 2006). One approach is to examine the relationship between exogenous fundamental variables and house prices. Fundamental variables
can be categorized into two: fundamental values and macroeconomic (market) fundamental variables (Hui & Yue, 2006).

Economists define fundamental value as the present value of all expected future cash flows generated by the asset (Gerding, 2007). The fundamental values of an asset are determined by the following cash flows: inflows received, the terminal value of an asset and the discount rate (Hui & Yue, 2006). However, there is a problem with obtaining longer period data that can be used to specify the intrinsic value for each fundamental value (Flood & Hodrick, 1990). As a result, the use of market or fundamental variables to determine house price is preferable (Hui & Yue, 2006).

The determination of house price based on fundamental (market) variables implies that the value of the house is determined by ‘market’ value with macroeconomic variables influencing house price (Alhashimi & Dwyer, 2004). According to the real estate market literatures, most house price models focus on macroeconomic variables (i.e. population growth, employment, interest rate, inflation and income) which are believed to influence the movement of house prices (Herring, 2006).

Case (1986) used macroeconomic fundamental variables of population growth, interest rate, income tax growth, employment growth and construction cost to determine housing price in Boston, US. Using these variables, Case (1986) failed to rationalize the 39% increase in house prices in Boston in 1985. Hui and Yue (2006) further group these fundamental variables into housing demand and housing supply factors. Berry and Dalton (2004) divide a list of factors which determine the housing market into three parts; short-term, institutional and long-term. In the short-term they found interest rates, investment demand, and current economic climate affected the housing market. The institutional factors include financial deregulation and innovation, land supply and the land-use planning system, and government taxes, levies and charges. The long-term factors include demography, economic growth, wealth levels and distribution of income. The authors’ findings suggest that the causes of changes in house price are complex and some variable effects are different across markets.
Other researchers such as Shiller (2005) and Gallin (2006) have used data on house price, interest rates, income, population, building cost and user cost of housing to examine the changes in US house prices after 2000. The authors concluded that the rapid increase in the US house price is not caused by macroeconomic fundamental variables, but it is caused by people’s perception. In China, Hu et al. (2006) used fundamental and non-fundamental components to examine the existence of housing bubbles from 1990:Q1 to 2005: Q1. The authors conclude that fundamental components can explain the movement of house prices in China.

Apart from fundamental variables, housing demand is positively influenced by people’s expectation about future increases in house prices. This then becomes a self-fulfilling prophecy. An increase in house price greater than the justifiable level of fundamental factors causes housing demand to decrease, and results in a housing boom to becoming a housing burst (Herring, 2006).

Chen and Patel (1998) explain that the lack of understanding about the relationship between house price and its determinants caused a failure in previous house price models. This failure may be caused by the difficulty in accurately identifying the determinants of house prices (Kluey, 2008). From the perspective of behavioural finance, the inconclusive findings about the existence of bubbles in historical bubble crises is caused by people’s perception. For example, both the public and researchers find it very difficult to accept the historical Tulip mania episode as a bubble (Garber, 1990). This may be possible due to the lack of attention given by researchers on the psychological and behavioural finance factors which cause the bubbles in the asset prices (Garber, 1990).

Further information on the theoretical background used to find various determinants of house prices can be found in Gallin (2006), Timmermann (1995) and Poterba (1984). Table 4.1 shows several housing market studies, which use these fundamental variables to explain housing market behavior. These variables help to explain the variation in the housing market across different countries.

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2 The expectation of higher house prices causes current house prices to be higher since people rush to purchase a house before prices start to increase sharply and the house becomes unaffordable (Herring, 2006).
Overall, most of the studies listed in Table 4.1 show a significant relationship between house price and macroeconomic fundamental variables of income, unemployment, interest rates and inflation.

The changes in financial and monetary regulations in Malaysia may have affected the house prices in Malaysia. Therefore, interest rates and inflation variables are used to show the impact of credit market liberalization on the demand of housing in Malaysia. This is consistent with the empirical findings of Modigliani and Cohn (1979). Modigliani and Cohn (1979) found that housing was wrongly mispriced by many people. The falling of inflation and interest rates caused people to underestimate the real cost of future mortgages. Modigliani and Cohn (1979) also explained that the mispricing in housing contributed to a large and significant increase in house prices in UK and US. In addition, the use of interest rate is important since it can be used to assess the affordability of homeowners (McCarthy and Peach, 2004).
Table 4.1 Common variables used to determine the house prices

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Egert and Mihaljek (2007) studied the house price determinants for eight Central Eastern European (CEE) and 18 Organization for Economic Cooperation and Development (OECD) countries and found that CEE house prices are determined by institutional developments, housing markets and the housing finance system. Thus, understanding the interaction of housing market with relevant sectors/markets helps to provide a better understanding of bubbles in housing market.

### 4.2 Housing Market and Interrelated Sectors/Markets

The evolution of the housing market is driven by two factors: stock of housing capital and flow of housing service (Dong-An, 2005). The stock of housing capital determines house prices, while rents are determined by the flow of the housing service market (Dong-An, 2005). Consequently, Grimes et al. (2005) argue that rents reflect house prices. This is due to the impact of shocks on house prices, which can be seen from either of these markets due to, the linked of these two markets via the rent levels. Furthermore, Cheng et al. (2009) explain that the same people- the owner occupants - determine rents and price of houses.

A house (and other types of real property) is a differentiated or heterogeneous assets which implies that every unit is unique and different (Lecat & Mossonnier, 2005). As a result, many researchers (see Goodman & Thibodeau, 1998; Macleennan, 1982; Whitehead, 1999) reject the existence of a unitary housing market model. This is due to the presence of various interrelated markets (Yu, 2004) which cause different movements in house price based on different regulations and policies governing a country’s housing market. The structure of housing markets and levels of home ownership are closely connected to various markets /sectors, which include the mortgage market, economic sector, construction sector and consumption sector.

A housing market is generated by the interaction of demand for housing and supply of housing (Kenny, 1998). In theory, equilibrium house price occurs when both the demand for, and supply of, houses is equal (Hong et al., 2007). An increase in housing demand against fixed housing supply will cause an upward movement in house price, encouraging developers to supply more houses (Pornchockchai, 2007). However, in the residential market, the adjustment or reaction caused by changes
(shift) in housing demand is slow due to inefficiency which characterize most of the real estate market (Pornchockchai, 2007).

According to Warnock and Warnock (2008), demand and supply factors govern the availability of housing. A traditional view of the housing market suggests that the interaction between housing demand and supply determines house price relative to other goods (Kenny, 1998). According to Quigley (1992), housing is different from other goods or services due to the high cost of supply, durability, fixed location and heterogeneity. These factors create greater difficulty in analysing housing market.

Case and Shiller (2003) and Himmelberg et al. (2005) use housing demand equation which consists of disposable income, changes in demographic factors, tax system, interest rates and wealth accumulation in their housing market studies. In Case and Shiller (2003) study, the authors conclude that the increase in US house prices since 1995 is caused by fundamentals factors. Similar result are found by Himmelberg et al. (2005) study on US city level data in 2004 where house prices in US are in line with fundamental factors. However, several cities such as Boston, San Francisco and New York are considered expensive (Himmelberg et al., 2005).

In the long-term, the demand factors which affect house prices, are income, interest rate and inflation (Tsatsaronis & Zhu, 2004). According to Whitehead (1999), most of the analysis conducted in housing demand function involves estimating the house price and income elasticity relationship.

Housing supply factors consist of the cost of land, construction cost and the existing stock of housing (Malpezzi, 1996). The housing supply factors are used to differentiate between the factors which affect investment in the existing housing supply (existing stock of houses), and the factors which determine the new supply of housing (new houses). Thus, Malpezzi (1996) explains that researchers in the housing market seldom use housing supply factors. This may be due to the lack of reliable techniques for examining supply factors (Quigley, 1979) and various restrictions imposed on housing supply factors (i.e. land restriction, types of houses produced by developers) (Garcia & Hernandez, 2008). These restrictions cause an inelastic housing supply in the short-run (Capozza et al., 1997; Garcia & Hernandez, 2008). The
inability of housing supply to meet housing demand is also caused by other factors such as the large number of second houses available in the market and the longer time for new house to be completed (Levin & Wright, 1997). For these reasons, many researchers (for example Green & Hendershott, 1992; Mankiw & Weil, 1989) prefer to use only demand factors which influence house price. Warnock and Warnock (2008) suggest that housing demand and housing supply be examined separately due to the complexity of the housing market. The effective demand for houses is translated into supply for houses through the availability of mortgage financing by the banks and other financial institutions (Mackmin, 1994).

### 4.2.1 Financial Sector and Mortgage Market’s Factors

The mortgage market is reported to be the main factor contributing to the boom in the real estate market (Kallberg et al., 2002). The mortgage financing offered to borrowers depends on two factors; the credibility or financial condition of the borrower and the collateral (security) offered for the financing of the property (Mackmin, 1994).

Warnock and Warnock (2008) explain that mortgage financing is a significant factor in generating housing demand. In the short-run, house price is affected by the cost, availability and flexibility of the mortgage market (Tsatsaronis & Zhu, 2004). For example, the International Monetary Fund (IMF) (2006) reveals that the increase in most house prices in industrial countries in late 1990s was caused by a decrease in the short-term interest rate. Mortgage financing become cheaper as mortgage payments for borrowers were reduced (Hering, 2006).

Another factor believed to have caused an increased in the industrial house prices involved new developments in the secondary mortgage market which improved credit terms (IMF, 2006). This includes the Real Estate Investment Trust (REIT’s) and different types of mortgage rates, which are more flexible to borrowers. The booming of the real estate market caused banks and other financial institutions to expand credit to the real estate sector (Kallberg et al., 2002). However, the plunge in real estate markets caused banks to suffer losses due to their over-exposure to the real estate market (Kallberg et al., 2002). This banking crisis then spread to other housing-related sectors such as the consumption, construction and economic sectors.
4.2.2 Consumption Sector Factors

Housing is a necessity for people since they cannot avoid purchasing it (Grimes et al., 1997). An increase in household income or wealth causes an increase in purchasing power and leads to higher consumption of better housing (Ofori, 1990; World Bank, 1993). A bubble is believed to cause excess consumption (Grimes et al., 1997). For example, during a boom in the housing market, people are very optimistic about the future increase in prices (Pornchockchai, 2007). This in turn creates ‘mania’ (Kindleberger, 1989).

Several studies in the housing market show the relationship between house price and the consumption of homeowners (see Engelhard, 1996; Hoynes & McFadden, 1997). For example, using the Panel Study of Income Dynamics (PSID) data, Engelhard (1996) found a relationship between the increase in house price and consumption for homeowners. The result shows that marginal to consume for homeowners based on real capital gains is 0.03. However, this result is based on an assumption that homeowners respond similarly. Engelhard (1996) explains that homeowners who experience profit from increased house prices (capital gain) do not change their consumption and saving immediately. The consumption behaviour of homeowners only changes when they experience capital losses. Hoynes and McFadden (1997) studied the US housing market using PSID data. The authors found no correlation between individual saving rates and capital gains from appreciated house prices. These inconsistent findings may suggest that households regarded buying a house as a necessity rather than realizable purchasing power (Elliot, 1980).

Muellbauer and Murphy (1990) explain that the consumption is stimulated by the increased in asset prices. In relation to house prices, Pagano (1990) and King (1990) describe the upward movement of expected future income may possibly push the demand for housing service and consumption to increase.

4.2.3 Construction Sector Factors

Housing is supplied through the construction sector. The construction industry produce housing to homebuyers through the development of housing projects.
According to Case and Quigley (2007), the residential construction is important to the banking sector due to the over-exposure of the bank’s balance sheet in the residential mortgages. During a property market boom, ‘myopia’ (rule of thumbs) causes property prices to be overvalued (Hendershott, 1994; MacFarlane, 1998). Therefore, more housing is demanded, causing the increase in the construction of houses. However, in the short-run, the easy credit for mortgage financing boosts the property market causing excessive supply of new housing construction in the long-run (Davis & Zhu, 2004). Developers and constructors build new housing projects when the real estate price increases above replacement cost (Chen & Leung, 2003). The housing stock (supply) is oversupply due to the longer period for housing construction to complete and the slow adjustment process (Chen & Leung, 2003). Therefore, this would also affect the activities and productivity in the economic sector.

4.2.4 Economic Sector Factors

The housing industry represents an important indicator of the economy’s health (Alhashimi & Dwyer, 2004). The development of the housing market contributes to expansion in the economy. For example, a booming property market causes the banking, financial, consumption and construction sectors to expand, creating more opportunities and employment (Roehner, 1999). This shows that the housing market can have a significant impact on the economy.

However, the collapse of the housing market, caused by bubbles has a negative impact on the economy due to the high transaction cost, illiquidity and heterogeneity of housing characteristics (Helbling & Terrones, 2003). For example, banks and financial institutions suffer losses due to their overexposure to real estate markets (Kallberg et al., 2002). The problem in the financial sector spreads to other economic sectors resulting in different types of financial problems such as a currency crisis, a banking crisis and a stock market crisis (Kallberg et al., 2002).

The discussion above provides an explanation of the housing market structure and other housing-related sectors (see Figure 4.1). Understanding how each sector and market works provides better information for modelling house price bubbles.
4.3 Models of House Price

According to Palmquist (2003), most of the property value model focuses on residential asset (i.e. housing). However, modeling house price bubbles is difficult due to the limited theoretical housing models that can be used to examine the existence of bubbles in house price (Englund et al., 1999). Various housing market models fail to explain historical and current increases in house prices (Soerensen, 2006) which may be due to the assumption that the relationship between house price and housing attributes is similar in different areas and countries (Yu, 2004).

The literature on housing markets recognizes various techniques used to analyze house price (see Lecat & Mossonnier, 2005; McQuinn & O’Reilly, 2008). For example, Lecat and Mossonnier (2005) suggest two theoretical approaches to examining the level of house prices: asset pricing approach and structural models. In the asset-pricing approach, the investment aspects of buying a property are examined. In the structural models approach, the supply and demand for property is examined by capturing both the return from residential investment and the utility of the property.
An alternative model for determining house price is to use economic and finance based approaches (McQuinn & O’Reilly, 2008). Econometric approaches are determined by an underlying set of housing demand and housing-supply fundamental determinants. The econometric approaches models include asset-market, reduced form and error correction models (McQuinn & O’Reilly, 2008). Many researchers have used these models to analyze house price (Case & Shiller, 1989; Muth, 1988; Poterba, 1991; Roche, 2001).

In a finance-based approach, the returns from investing in housing are compared to other asset investments. This implies that the finance-based approach relies on the underlying concept of arbitrage (McQuinn & O’Reilly, 2008). Furthermore, in the finance-based approach, the cost and benefits of renting a house are compared with those of purchasing a house (McQuinn & O’Reilly, 2008). The standard measurement of the finance-based approach is the ratio of rental income to house prices. Housing price is said to be over or undervalued if the current rental ratio to house price deviates from its long-run average (McQuinn & O’Reilly, 2008).

The important issue of detecting house price bubbles necessitates a discussion of several conventional approaches to modelling house prices. These conventional models can then be adapted and applied to house price bubbles in the Malaysian housing market. The house price models found in the housing market literature are; asset-market, reduced form, error correction and ratio approach models.

### 4.3.1 Asset-Market (User-Cost Approach) Model

Many studies of US house prices are derived from an asset market model or a user cost approach (Guirguis et al., 2005; Poterba, 1984). This approach focuses mainly on the interaction between inflation, taxes and finance (see DeLeeuw & Ozanne, 1981; Diamond, 1978). The asset-market model determines house price by analyzing the relationship between the quantity of housing service demanded and the real estate user cost of housing service (Poterba, 1984). According to Malpezzi (1999), housing is viewed as ‘a composite commodity’, which generates a flow of ‘housing service’ or housing stock. Poterba (1984) used marginal rental values of service generated by a housing stock as a measurement for housing service.
The term ‘housing service’ is defined as the rental service from housing, which generates inflows of income. Pages and Maza (2003) explain that the housing service can also be used for homeowners. Dipasquale and Wheaton (1996) also explain that housing services consist of houses which are rented or purchased for occupancies. An investor, consumer and household buy housing service which is actually rented out to them for an implicit rent (Smith et al., 1988). In addition, the asset price (house price) and rents are both being determined by owner –occupants (Cheng et al., 2009).

The underlying framework for the asset market model is based on the capital theory equation where the equilibrium price of an asset is equal to the present discounted value of future net income derived from owning the asset (Diewert et al., 2009). In the context of the housing market, the model assumes that the price of a house must be equal to the present discounted value of net future service flow, which is the rental of the house (Poterba, 1984).

Equation 4.1 describes the general asset market model:

$$H_{\text{hsg}} = Q_{\text{hsg}} + U_{\text{hsg}}$$ ................................................................. (4.1)

Where;

$H_{\text{hsg}}$ = the price of the house

$Q_{\text{hsg}}$ = the quantity demanded for housing service (real rental service)

$U_{\text{hsg}}$ = the user cost which consists of $(M_r)$ is the mortgage rates, $(P_t)$ the property taxes, $(I_{\text{t}})$ income tax, $(MR_c)$ maintenance and repair cost and $(EC_g)$ expected capital gain.

$$U_{\text{hsg}} = f(M_r, P_t, I_{\text{t}}, MR_c, EC_g)$$ ................................................................. (4.2)

The quantity of housing service is defined as the real rental price of housing, which is the amount paid by consumer in consuming housing stock (Pain & Westaway, 1996) (see equation 4.3)
\[ QD_{hsg} = \left( \frac{1}{(1+R)^t} \right) \] ......................................................... (4.3)

Where \((1/(1+R))^t\) is the discounted real rental price (future inflow of housing service), with \(R\) as the rental price. The unobservable of the real rental price causes many researchers (Ayuso & Restoy, 2006; Diewert et al., 2009) to use proxies, which are disposable income, demographic indicators and real interest rates in determining the demand for housing service (Pain & Westaway, 1996). Therefore, the real rental price of housing service \(R_t\) is proxies with the following observable determinants illustrated in the following equation (Meen, 1990);

\[ R_t = f(Y,P,Hsg_t,W) \] ............................................................. (4.4)

Where \(Y\) = real disposable income

\(P\) = population

\(Hsg_t\) = supply of houses

\(W\) = consumers’ asset wealth

In equilibrium, the user cost and real rental price should be equal. According to Poterba (1984), people use housing service until the marginal value of the housing service, which is \(QD_{hsg}\) (rental price) is equal to their cost.

The house price in the asset market model is determined by combining the housing service demanded (equation 4.3) and the real estate user cost (equation 4.2) as follows (Gallin, 2006 equation);

\[ Hsg_t = R_t + E_t \left[ \frac{Hsg_{t+1}(1-\delta)}{1+i_{t+1}} \right] \] ......................................................... (4.5)

Where \(Hsg_t\) = house price at time \(t\)

\(R_t\) = real rental of housing service at time \(t\)

\(E_t\) = expectation condition on information at time \(t\)

\(i_{t+1}\) = discounting rate
\[ \delta = \text{constant rate of depreciation} \]

The asset market model is based on the rational asset market equilibrium, where house buyers are assumed to have a perfect forecast about the future and the deviation of the price from the equilibrium price caused by the demand or supply shock. According to this model, the movement in house price reflects the shock and adjustment mechanism and the fundamental factors are the only cause of the deviation in house prices. Other deviations in house prices are caused by the rational and efficient factors.

Many researchers (for example, Hendry, 1984; Levin & Wright, 1997; Meen, 1990, 1996) use the asset-market approach or user-cost approach to model house prices. Poterba (1984) examines the inflation effect on tax subsidies to owner occupied housing using a dynamic model of the asset market approach. The author’s results showed that a 30% increase in US house prices in 1970s was due to the tax provision for mortgage interest deductibility. In addition, Poterba (1984) proposed two conditions which can be used to determine the steady long-run state of housing market: a demand for housing (zero capital gain) and a constant stock of housing (zero changes in housing stock).

Meen (1990) employs the user-cost approach model to examine the impact on UK housing market with mortgage rationing. Mortgage rationing is determined by the difference between the demand for mortgage and effective supply (Meen, 1990). Meen’s study shows that the mortgage demand and supply function can be identified and obtained from direct estimation of excess mortgage demand or mortgage rationing using the user-cost approach model. The author also claims that the equation used in his study has been successful in explaining both mortgage rationing (1978-1980) and the absence of mortgage rationing (1981-1987).

According to Adams and Fuss (2010), the advantage of using the asset market approach includes the ability to model an equilibrium condition caused by the arbitrage relationship. In an arbitrage relationship, the housing rent is equal to the user cost of housing.
The drawback in the asset-market approach comes from the unobservable of rental cost charges by homeowner to themselves for the use of their houses (Diewert et al., 2009). It is thus difficult to capture the future income, as the future and people’s expectation are unpredictable. Furthermore, house prices and rents are affected by supply restriction and regulation in the real estate market, which are ignored in this approach (Ayuso & Restoy, 2006).

4.3.2 Reduced Form Housing Equation Model

The reduced form housing equation model is derived from neo-classical theory, which emphasizes the theoretical framework and applied sophisticated econometric techniques (Meen, 1993). This model is based on the consumer demand theory (Duca et al., 2009) and assumes that investors have rational expectations (Blanchard, 1979).

The reduced form housing equation model describes houses as a function of fundamental variables such as interest rates, income, housing stock and other fundamental variables. The model can be applied to a demand equation only or demand and supply equations. The use of the reduced demand form equation model assumes an inelastic housing supply in the short run and therefore ignores supply side factors. The inelastic supply of housing causes real estate prices to increase rapidly (see DiPasquale, 1999; Glaeser & Kahr, 2003; Glaeser & Shapiro, 2003).

The reduced form housing equation is derived from Glaeser et al’s (2003) study.

\[ H_{sg,d} = f(Y,P,W,UC,N) \]  

Where \( H_{sg,d} \) is the demand for houses, \( Y \) is the real disposable income, \( P \) is the price of houses, \( W \) is the wealth, \( UC \) is the cost of housing capital and \( N \) is the user cost which is similar to equation (4.2). The house supply is explained in equation (4.7) below.

\[ H_{sg,s} = f(P,C,Z) \]  

Where \( H_{sg,s} \) is the supply of houses, \( P \) is the price of houses, \( C \) is the construction cost and \( Z \) is the restriction or constraint which caused a shift in supply.
In the reduced housing form equation model, the equilibrium house price \((H_{sg_e})\) equation is given as follows:

\[
(H_{sg_e}) = H_{sg_d}(Y, P, W, UC, N) + H_{sg_s}(P, C, Z)
\]

\[
H_{sg_e} = f(Y, W, N, C, Z) \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots 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demographic characteristics of renters, price of rented properties, mortgage rate, expected appreciation in rented price, real estate taxes, land price and non-land price (building materials and labor). Their results suggest that the reduced-form equation for rental prices can explain 90% of variation in rental prices while for homeowners, the model can only explain 60% of variation in house prices.

The only concern raised by the reduced form model is the difficulty of evaluating rational expectation as many housing market studies employ a backward-looking expectation (Oikarinen, 2009). A detailed discussion of the rejection of the rational expectation hypothesis can be found in section 3.3.1

4.3.3 Vector Error Correction Model

The exogenous shocks in the economy caused the housing market to deviate from the equilibrium market price (Adams & Fuss, 2010). This deviation can be measured using a vector error-correction model (VECM) which can estimate the long-run relationship and short-run dynamics in house prices.

According to Case and Shiller (1989), the housing market takes a longer period to adjust after a shock to the economy. Therefore several studies (see Abraham & Hendershott, 1996; Case & Shiller, 1989; Quigley, 1999) in the housing market also used the lag of house prices to represent a short-run equilibrium mechanism (Oikarinen, 2009). The variables in the VECM include the lagged of house prices, other exogenous macroeconomic variables and an error correction term. The error term is used to correct for short-term deviation in the house price (Sing et al., 2006).

The VECM used by Sing et al. (2006) and Oikarinen (2009) is shown in equation 4.9:

$$\Delta h_{sg,t} = \delta e_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta h_{sg,t-i} + \sum_{i=1}^{q} \beta_i \chi_{t-i} + \epsilon_t, \quad \sum_{t=1}^{\infty} \epsilon_t \Delta$$  \quad (4.9)$$

Where $\Delta h_{sg,t} = h_{sg,t} - h_{sg,t-1}$, $e_{t-1} = \text{the lagged value of house price deviation estimated from the long run relation and } (\delta \neq 0)$ suggesting a cointegrating vector in the model.
\[ \alpha_p \text{ and } \beta_q = \text{coefficient matrixes jointly to be estimated in the VECM with p and q lags.} \]
\[ \chi_t = \text{a vector consisting of macroeconomic variables} \]
\[ \epsilon_t = \text{independently and identically distributed random error terms} \]

The VECM has been used by several researchers in determining the long-run and short-run relationship of house prices with other factors such as household borrowing (Oikarinen, 2009), household mobility (Sing et al., 2006) and the efficiency of housing market (Malpezzi, 1999).

Oikarinen (2009) examined the Finnish housing market, concentrating on Helsinki Metropolitan Area and using a VECM for a sample period of 1975:Q1 to 2006:Q2. The author’s focus was more on examining the household constraint, which uses a debt to GDP ratio, towards the housing price dynamic. The results of the study indicate that in the long-run and short-run, the debt to GDP ratio caused an appreciation in house prices in the Helsinki Metropolitan Area. Furthermore, the adjustment of house price is believed to be backward-looking.

Sing et al. (2006) examined the relationship between house price dynamic and household mobility in public resale and private housing prices in the Singapore housing market. Household mobility is described as the ability of household to purchase and sell houses. The authors use macroeconomic variables of gross domestic product, Singapore exchange all-share index, prime lending, consumer price index and unexpected inflation rate as exogenous variables in their model. The endogenous variables include resale HDB housing price index, apartment price index, condominium price index, terrace price index, semi detached housing price index and detached housing price index. The VECM result shows that the error correction term and lagged public housing prices are significant in explaining the changes in prices for private housing markets in Singapore.

The VECM is also used by Malpezzi (1999) to examine the efficiency of the US housing market while Gallin (2006) uses the VECM to study the relationship between house prices and interest rates. The author found evidence of weak cointegration between US house price dynamics and interest rate.
One of the advantages of VECM is that it can provide short and long-term explanations of the behavior of house prices (Wang et al., 2008). It is also a better forecast model when compared with VAR (Tuluca et al., 2000). In addition, VECM treats each variable in the system as endogenous and associates each variable with its own past values and the past values of other variables (Tuluca et al., 2000). However, the used of VECM is limited to cointegrated variables only (Tuluca et al., 2000). Therefore, the use of VECM on data series which are not cointegrated creates insignificant results.

4.3.4 Ratio Approach Model

The ratio approach model uses two types of ratios: house price to income ratio (Price/Income) and house price to rent ratio (Price/Rent) to determine house price bubbles. Finance and arbitrage theories are believed to be the underlying theoretical framework for the ratio approach model (Duca et al., 2006). The ratio approach is commonly used to test the existence of house price bubbles in the US housing market (Leahey, 2005). The ratio model states that the deviation of these ratios from the long-term true or fundamental values of the house prices is regarded as a housing bubble. This deviation, which implies excess housing demand, is also caused by low occupancy rates, higher land prices and higher construction costs (Cruz, 1998).

The house price to income ratio and house price to rent ratio can be described in the following equation:

\[ PY = \left( \frac{Hsg_p}{Y} \right) \quad \text{and} \quad PR = \left( \frac{Hsg_p}{R} \right) \]  

(4.10)

Where; \( PY \) = house price to income ratio  
\( Hsg_p \) = house price  
\( Y \) = income  
\( PR \) = house price to rent ratio  
\( R \) = rent values
Other transaction costs such as tax advantages to the homeowner and depreciation of housing are significant determinants of rental supply and housing demand. Hence, the inclusion of these transaction costs can be described in the following equilibrium house price to income ratio;

\[
P_Y = \left[ \frac{1}{u} \right] = \frac{1}{\left( \text{inf}_r + r_p + tx - dp - gw \right)} \]

\[(4.11)\]

Where \(\text{inf}_r\) is a risk-free rate, \(r_p\) is risk premium, \(tx\) is tax rate, \(dp\) is depreciation cost and \(gw\) is anticipated depreciation.

The right-hand side of equation (4.11) determines an equilibrium house price-to-rent ratio. In a rational and efficient market, the rental value is equal to the value generated from the housing service (Krainer & Wei, 2004).

The equilibrium house price to rent ratio is compared to the observed ratio of house price to rent to determine whether house price increase (decrease) from fundamentals. The formula in equation (4.11) implies that the increase (decrease) in house price-to-rent ratio depends on the components of user cost. The house price-to-rent ratio increase (decrease) if the user cost decrease (increase) (Clark, 1995). This relationship shows that the increase (decrease) in house price-to-rent ratio does not imply that house price is significantly different from fundamental values.

Clark (1995) explains that based on the asset market efficiency theory, the expected future increase in rent is reflected in the current price-to-rent ratio. The current value of rent must be low, if people expect a future increase in rent. Moreover, the existence of housing market efficiency implies that the current price-to-rent ratio can be used to predict a future increase in rent (Clark, 1995). The current rent value must be low if the future value of rent is expected to increase. Ayuso and Restoy (2006) state that house price and rent are affected by the restrictions and regulations governing housing supply factors, which are very difficult to be capture in a standard asset financial model.
Consequently, the results of the studies which use a ratio approach are inconclusive (Leahey, 2005). For example, Himmelberg et al. (2005), using price-to-income ratio found no bubble existed in 46 Metropolitan Statistical Area (MSA) in the US housing market. According to Himmelberg et al., (2005) the increase in US house prices is caused by changes in long-term interest rate and not by bubble components (Himmelberg et al., 2005). However, Capozza and Seguin (1996) claim that house price-to-rent ratio predicts an increase in the US housing market.

Due to the inconsistent results of the ratio approach model, the price-rent ratio and price-income ratio are not adequate for modelling bubbles in housing prices. These ratios seem to ignore the changes in different market fundamental variables such as demographic changes, house-building credit condition and asset prices, since they only focus on income and wealth factors (Cameron et al., 2006). As a result, policy analysts cannot use the ratio approach to determine whether increases in house prices are caused by strong economic fundamental variables or just speculation activities during a housing price bubble (Cameron et al., 2006). In Malaysia, the house price and rent ratio indicator is not appropriate for measuring the size of a housing bubble because of the small size of the rental market in Malaysia (approximately 85% in 1999) (Cruz, 1998).

In conclusion, the housing models discussed above are not designed to efficiently capture housing bubbles. However, the information provided through these models is used to develop a house price bubble model in the following section.

4.4 Model Specification for Housing Bubble

Much has been written about bubbles in the housing market, but no standard model to model bubbles has yet been developed. The housing market literature shows that the existence of bubbles depends on the specification of theoretical models that are used to model a bubble (Cameron et al., 2006). In addition, there is no consensus among researches on the best design models for capturing the presence of price bubbles. According to Malpezzi and Wachter (2001) the difficulty in creating a house price bubble model can be put down to the unobservable or random behavior of a bubble.
As suggested by Cameron et al. (2006), the development of a house price bubble model should be systematic and comprehensive. Because there is no appropriate house price model to examine price bubbles, this study adopts and combines the reduced demand form model, the vector error correction model and the switching regime model of Markov Switching (MS), to examine the existence of bubbles in the Malaysian housing market.

In this study, the houses are modeled as durable and heterogeneous asset which provide housing services and can be used as a source of income for homeowners who choose to rent out their houses. Furthermore, the mortgages financing are available to purchase a house with a minimum down payment of 10%.

Adopting Coleman IV et al. (2008) model, the specification of a house price bubble starts with a simple housing demand and housing supply equations (see equation 4.1.2).

\[
\begin{align*}
Hsg_D &= \alpha_i + \chi_{0,i} P_i + \chi_{1,i} Inc_i + \chi_{2,i} Intr_i + \chi_{3,i} Inf_i + \epsilon_{D,i} \\
Hsg_S &= a_i + \chi_{0,s,i} P_i + \chi_{1,s,i} R_i + \chi_{2,s,i} C_s + \epsilon_{s,i}
\end{align*}
\]  

Where;

- \(Hsg_D\) = housing demand
- \(Hsg_S\) = housing supply
- \(a_i, and \ \alpha_i\) = intercepts
- \(\chi_{\cdot\cdot}\) = coefficients
- \(P_i\) = house price (demand and supply function)
- \(Inc_i\) = income
- \(Intr_i\) = short-term interest rate
- \(Inf_i\) = inflation
- \(R_i\) = restriction in housing supply regulations
- \(C_i\) = cost for housing supply
- \(\epsilon_{D,i}\) and \(\epsilon_{s,i}\) = error terms
In this study, the supply of housing in Malaysia is assumed to be inelastic in the short-run and there is no credit constraint for borrowers. Therefore, the determinants of Malaysian house prices focus only on demand factors, \( H_{D} \) which results in a reduced form housing demand model with house price \( (H_{D}) \) as endogenous variable

\[
H_{D} = \alpha_0 + \chi_{1} Inc + \chi_{2} Intr + \chi_{3} Inf + \varepsilon_{D,t} \tag{4.1.3}
\]

The reduced housing demand equation (4.1.3) is derived from the consumer’s or household’s perception function, emphasizing the time-series model of house price that can capture the existence of housing bubbles.

The imposition of equilibrium condition to \( H_{D} \) equation in equation (4.1.3) implies that the imbalance in house prices is corrected over time by price adjustment process \( \gamma \) found in the Vector Error Correction Model specification (see section 4.4.3 and equation 4.9). The deviation of house price from fundamental variables suggests that the house price does not reflect actual price in the economy, thus any decision based on a distorted house price may be inefficient (Faust, 1998).

The proposed house price model of this study also captures the movements of house price in linear and nonlinear ways using switching and non-switching models as describe in the following section.

**4.4.1 Non-Switching Model**

With the assumption of linear house price movement, the non-switching model is described as follows:

\[
H_{ns} = f_{D} [Inc, Intr, Inf] \tag{4.14}
\]

Where \( H_{ns} \) is the house price in non-switching model, \( f_{D} \) is the fundamental variables for housing demand which include income (Inc), interest rate (Intr) and inflation (Inf).
Due to the assumption of fixed supply of housing in the short-run, house price in Malaysia are demand determined (more detail in section 5.1). For this reason, the house price bubble model discussed in this study focuses only on the consumer side of the housing market (i.e. housing demand factors). In this model, the household is assumed to have access to mortgage financing without any constraint.

The study then considers the behaviour of Malaysian house prices under a regime-switching specification for different economic states such as expansion (boom) and recession (burst).

**4.4.2 Switching Model**

To ascertain whether Malaysian house prices moves in nonlinear ways, the Markov-Switching (MS) technique proposed by Hamilton (1989) is applied in two models: in the mean (level) model and variance (volatility) of house price. Furthermore, the MS technique computes the probabilities of house price bubble boom and burst in different economic states; state1- boom and state 2- burst. The independent variables (fundamental variables) are the same as in the previous non-switching model. However, in the variance model of house price, the analysis focuses only on changes in the variance or volatility of house price.

Comparison of the estimated coefficient of each macroeconomic fundamental factor with MHPI in mean model will indicate whether the level of each variable varies among different economic states. Equation (4.1.5) describes the switching model for mean (level) of house price with a Markov-Chain governing the process. The R1 represents regime-1 (boom of housing market) and R2 represents regime-2 (bust of housing market). $H_{sg_t}$ is the house price in period, $t$ and $H_{sg_{t-1}}$ is the house price in previous period, $t$. 

$$H_{sg_t} = \begin{cases} 
R1 & \text{if } \text{boom} \\
R2 & \text{if } \text{burst}
\end{cases}$$
\[ H_{\text{g},1} (R1) = \alpha_0 (1) + \beta_0 (1) H_{\text{g},t-1} + \beta_1 (1) \text{Inc} + \beta_2 (1) \text{Intr} + \beta_3 (1) \text{Inf} + \epsilon_1 (1) \]
\[ H_{\text{g},1} (R2) = \alpha_0 (2) + \beta_0 (2) H_{\text{g},t-1} + \beta_1 (2) \text{Inc} + \beta_2 (2) \text{Intr} + \beta_3 (2) \text{Inf} + \epsilon_2 (2) \]
\[ \epsilon_i \sim N(0, \sigma_i) \]

In the variance model of house price, the Markov-Switching GARCH (MS-GARCH) technique focuses only on the variance of the MHPI without macroeconomic fundamental variables. The rationales in using only the variance of MHPI are due to the fluctuations of the MHPI’s variance, which may imply an inflated bubble (Case & Shiller, 1989). The dramatic changes in variance of MHPI (asset prices’ volatility) are a possible sign of an early bubble crisis in the housing market (see section 3.6).

### 4.5 Conclusions

This chapter provides a detailed discussion of previous models and other related housing market theories. The housing market literature reveals several empirical models used by researchers to determine house prices. These include the asset-market model (see Hendry, 1984; Levin & Wright, 1997; Poterba, 1984), the reduced form model (see Cameron et al., 2006; Case & Shiller, 2003; Malpezzi & Maclennon, 1996), the vector error correction model (see Malpezzi, 1999; Oikarinen, 2009; Sing et al., 2006) and the ratio model (see Bjorklund & Soderberg, 1999; Capozza & Seguin, 1996; Himmelberg et al., 2005). Each of these models produces different results regarding the existence of housing price bubbles.

Hui and Yue (2006) and Flood and Hodrick (1990) argue that asset price (house prices) fundamental value is difficult to determine. Therefore, economic fundamental variables are more relevant in modeling the determinants of house prices (Hui & Yue, 2006). These fundamentals are categorized into housing demand function and housing supply function. Among the commonly used variables in the housing market studies are income, interest rates and inflation (see Table 4.1). These variables are believed to influence house prices in the long-run (Tsatsaronis & Zhu, 2004).

Housing demand and housing supply interaction creates a general structure for the housing market (see Figure 4.1). This housing market structure contains other
housing-related markets such as rental, homeowner and mortgage markets. The sectors which are closely related to housing market are the financial, consumption, construction and economic sectors.

The housing bubble models proposed in this study are a combination of two approaches, the non-switching and switching models and a switching regime model. In the non-switching model, OLS, ARCH, GARCH and VAR/VECM techniques are employed. The switching model, which examines the mean of MHPI (with macroeconomic fundamental variables of income, interest rate and inflation) and variance of MHPI, employs a Markov-Switching technique proposed by Hamilton (1989).
Chapter 5
Data Collection and Research Methodology

“What drives these episodes of house price volatility? This is one of the central questions of housing economics”

(Mankiw & Weil 1992)

5.0 Introduction

This chapter provides an overview of the data and research methodology used to investigate the existence of house price bubbles in the Malaysian housing market from 1990:Q1 to 2004:Q4. Section 5.1 describes the time-series data and study period used in this study. Section 5.2 explains the methodology of the study and Section 5.3 summarizes the chapter.

5.1 Data and Study Period

According to Barrot and Takala (1998), the data used to determine a house price depends on the reasons for purchasing the house. A house can be purchased for two purposes: as a consumption good (necessity) or as an investment good (capital gain). In Malaysia, due to the high percentage of homeownership (approximately 85% in 1999), purchasing a house is regarded as consumption good (RAM, 2007).

Many housing market studies report the frequent use of housing demand factors in contrast to housing supply factors (Association of Banks et. al., 1992; Mohd Zain, 1992). Levin and Wright (1997) state that housing demand factors are more preferred due to the inability of the housing supply to fulfil housing demand in the short-run. Furthermore, people’s expectations about future increases in house prices are believed to influence only housing demand factors such as income and inflation (Levin & Wright, 1997). Mueller (2002) adds that economic cycles which have a significant relationship with real estate cycles, influence the housing demand side of the real estate market. Therefore, by focusing on housing demand factors, the interaction between the housing market and the economy can be fully understood. The complexity of the housing market system, suggests that researchers examine housing demand and housing supply separately (Warnock & Warnock, 2008). Following these
arguments, the data selected for this study focus mainly on the demand factor variables (consumer side) that affect homeowners in Malaysia. This is due to the strong preference for homeownership rather than as an investment in Malaysia.

It is interesting to note that in most markets, an increase in the demand for an asset will lead to an increase in the asset’s price, resulting in an increase of supply for this asset (Mackmin, 1994). In the residential market, the response to the increase in demand is slow due to certain economic constraints such as the supply of land, and regulations in the real estate market, etc. (Mackmin, 1994). Therefore, in order to capture changes in the real estate market, many researchers have extended the study period beyond ten years (see Lee, 1999; Riddel, 2004).

Lee (1999) uses a 30-years period (1961 to 1991) to examine the housing investment model in the US market. The results of Lee’s study suggest that a model with at least two lags is important in explaining housing investment and that the average completion period for a single-family house is six to 12 months. Riddel (2004) studied the US housing demand model from 1967 to 1998 using variables such as price index, rent index, income and user costs of housing. The author concludes that the US housing market is characterized by periods of disequilibrium.

This study covers the period from January 1990 to December 2004 (15 years) using quarterly time-series data, which comprises the Malaysian, house price index (MHPI) and macroeconomic factors such as income, interest rate and inflation. During the study sample period, many important events in Malaysia affected the housing market. For example, capital control policies (1994 and 1998) have caused the mortgage rate to decrease which resulted in lower interest rates. The 1997 Asian financial crisis also caused housing prices in Malaysia to fluctuate causing the house price bubble to burst in early 1998 (see Figure 5.1).

The rationale for using these macroeconomic data is discussed in the following section. Other endogenous variables that may affect house prices such as employment, construction and population are excluded from this study due to the incomplete series of the data. To standardize the data into similar frequencies, monthly data of interest rate and inflation are converted into quarterly frequencies.
using E-Views 6.0 software. The conversion of quarterly data is undertaken for several reasons. First, the main housing market data such as income (GDP) and MHPI are reported in quarterly frequency. Therefore, to avoid any distortion in these two variables, other data are also converted into quarterly frequency. Second, the use of quarterly data is consistent with many other housing market studies. For example, Ghent and Owyang (2009) examined the relationship between 51 US house prices using quarterly data of mortgage rates, inflation (CPI) and T-bills from 1982:Q1 to 2008:Q4. The authors found that the decline in the US house prices did not cause a decreased in employment in the US. Gerlach and Peng (2005) used quarterly data of real bank lending, real GDP and real property prices to study the relationship between residential property prices and lending in Hong Kong.

The secondary data for MHPI, income, interest rate and inflation were obtained from Malaysian government agencies such as the Valuation and Property Department (JPPH), the National Asset Pricing Centre (NAPIC), INSPEN, Bank Negara Malaysia, the Statistic Department of Malaysia and several state libraries in Malaysia through manual extrapolation and electronic means. In addition, some of the data were obtained from newspaper archives, journals, books and other sources.

5.1.1 Malaysian House Price Index (MHPI)

A house price index is used to measure changes in price, which is not caused by changes in the quality or quantity of the goods in the index (Lum, 2004). These changes, which include macroeconomic factors, affect the current value of houses (Lum, 2004).

The Malaysian house price index was developed in 1997 by the Valuation and Property Services Department (JPPH). The MHPI consists of 70 sets of sub-indices including national house price indices, state house price indices and five house type sub-indices (terraced, semi-detached, detached, high-rise unit and other houses) for 13 states and two federal territories in Malaysia (Valuation and Property Service Department of Malaysia, 2001). Using these indices, the MHPI can display the long-run trends in the Malaysian house prices and evaluate the condition of the Malaysian housing market (Valuation and Property Service Department of Malaysia, 2001). The
MHPI, which is a Paasche Index, is calculated based on the hedonic price method (HPM).\(^3\)

According to Kagie and Van Wezel (2006), the HPM is widely used by researchers in housing and urban studies to calculate the house price indexes. This is because of its simplicity to estimate (Kagie & Van Wezel, 2006). The HPM modeling approach assumes that the value of the property is measured using housing (i.e. building characteristics) and locational attributes (Portnov et al., 2006). According to Limsombunchai et al. (2004), these attributes are implicitly found in the observed market prices of the good. The hedonic method has been tested in various types of asset valuation such as agricultural (see Brorsen et al., 1984; Ethridge & Davis, 1982; Wilson, 1984), residential assets (see Blomquist & Worley, 1981; Kagie & Van Wezel, 2006).

Blomquist et al. (1988) used the two-step hedonic price demand approach introduced by Rosen (1974) to estimate demand functions for the US owner-occupied housing in 1970. The use of a two-step hedonic approach generates more benefits and differences in the estimation of house prices compared to a one-step approach. In the UK housing market, the HPM has been used to construct several house indexes such as the Halifax house price index and the Nationwide house price index (Kagie & Van Wezel, 2006).

Due to some excessive noise in the MHPI index, the data are normalized using 2000 as the base year. According to Hui (2009), MHPI is a smooth index. The smoothness of the house price index is due to the characteristics of the housing market, which is illiquid (Hilberg et al., 2001), contains short-term speculation (Davis & Zhu, 2004) and is of long-term duration (Wang, 2001). Therefore, normalization of MHPI series can represent the real behaviour of the MHPI (Hui, 2009).

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\(^3\) The HPM uses a multivariate regression analysis to measure house prices (Valuation and Property Service Department of Malaysia, 2001).
Figure 5.1 shows the highest point of the MHPI, which is in 1997:Q2 with an index of 108.18 points. This was a boom period for the Malaysian property market as more affordable houses were available in the market (RAM 2007). The rising period for the Malaysian housing market started in 1995:Q2. During this period (1995), the housing market in Malaysia has experienced gradual bubbles (inflated) until 1997:Q1, prior to the Asian financial crisis. This is shown in the average increase in MHPI from 1991:Q1 to 1997:Q1 which is 3.175% (see Table 5.1).

![Figure 5.1 Malaysia House Price Index (MHPI) from 1990 to 2004](image)

**Sources: INSPEN and NAPIC annual reports (various years)**

After two years of rapid increases in house prices (1995-1997), the Asian financial crisis caused a downward fall in the Malaysian housing market in 1997:Q4 with the MHPI Index dropping by 5.4% from 105.4 points in 1997:Q4 to 99.76 points in 1998:Q1. Since then, the MHPI has gradually moved in an upwards with an average increase of 1% to 3% per quarter (see Figure 5.1).

In this study, the MHPI data is lagged one period $(h_{sg,t-1})$ to represent a short-run equilibrium mechanism (Capozza et al., 2004) due to the slow adjustment of house prices to economic shocks, booms and bursts (Quigley, 1999), the longer time required to build a house and the heterogeneous characteristic of housing (DiPasquale & Wheaton, 1994). The lag in the house price approach has been used by many researchers (for example Abraham & Hendershott, 1996; Case & Shiller, 1989; Quigley, 1999) to examine the housing market. For example, in the US housing...
market, the lagged property prices can explain 29% of the variation in US house prices (Quigley, 1999). Therefore, the lag of one period in the MHPI \((hsg_{t-1})\) is used in all house price equations in this study.

In Malaysia, house prices are determined by real income per capita, people's expectations about future income and economic outlook, demographic characteristics, real lending rates, and total loans outstanding in the banking system (Ng, 2006). To capture the effects of these determinants on the Malaysian house price, the exogenous factors such as income, interest rates and inflation are use as fundamental variables in this study.

### 5.1.2 Income Variable (GDP)

Following Keynes (1936), Goodman (2003) argues that demand for housing increases as a result of higher economic growth (higher GDP) and a higher employment rate. It may therefore be expected that more people would demand higher quality accommodation and environmental amenities when their household income increases (Tse & Love, 2000). The inclusion of income factor into a house price bubble model is consistent with other studies (for example Case & Shiller, 2003; Muellbauer & Murphy, 1997).

According to Muellbauer and Murphy (1997) the shift in UK house prices between 1957 and 1994 was caused by the interaction of several variables in the economy such as wealth, income, interest rates and house prices. In the US market, Case and Shiller (2003) report that a lagged appreciation in the housing fundamentals (such as income, employment and interest rates) with a coefficient of 0.3 is considered a bubble-builder. According to the author, income growth factors could explain the bubble activity that occurred in the US housing market in 1988 (Case & Shiller, 2003). This finding is consistent with other studies conducted in the US housing market, where income factor is reported to cause variation in house prices (see Abraham & Hendershott, 1992, 1996; Goetzmann & Spiegel, 1995; Miller & Peng, 2006). Using 30 MSA house prices, Abraham and Hendershott (1993, 1996) conclude that the after tax interest rates and income growth variable explain half of the variation in US house price appreciation rates.
This study uses Gross Domestic Product (GDP) as a proxy for income factor. Numerous researchers in the residential market have used GDP to measure economic activity, such as investment in the residential market (see Coulson & Kim, 2000; Gauger & Snyder, 2003; Green, 1997). For example, Coulssan and Kim (2000) found that residential investment shocks were an important factor in predicting consumption and GDP growth. Using the Vector error correction model, Green (1997) and Gauger and Snyder (2003) also reported similar results where residential investment has a positive impact on GDP.

**Figure 5.2 Malaysian income variable, proxy by GDP**

Several global economic events occurred during the sample period of this study (for example, the 1997 Asian Financial crisis, the September 11 attack in the US and the war in Afghanistan) causing a slowing down of economic activities with fewer inflows of trade into the economy. In Malaysia, the decreasing trend of the economy performance, measured by GDP, occurred during the 1997 Asian financial crisis with GDP growth rate recorded at (-7.5%) in 1998 (Mohd Isa, 2004). Bank Negara Malaysia also reported a decrease in Malaysian GDP by 6.1% in 1997, leading to a decrease in the aggregate demand of 26.5%. Hun (2005) provided evidence of decreases in the Malaysian economy of 7.4% due to the negative value of GDP growth rate in 1998.

*Sources: Department of Statistics, Bank Negara Malaysia, monthly report (various years)*
Prior to the 1997 Asian financial crisis, the Malaysia economy was booming with an average GDP growth rate of 8.9% per annum between 1991 and 1997 before the crisis period in 1998 (see Table 5.1 and Figure 5.2). Thus, using GDP as an income factor can help capture conditions in the Malaysian economy (Hun, 2005).

Table 5.1 GDP growth in Malaysia

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<tr>
<td>GDP Growth</td>
<td>7.8</td>
<td>9.7</td>
<td>8.6</td>
<td>9.6</td>
<td>8.6</td>
<td>7.5</td>
<td>-7.5</td>
<td>5.8</td>
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Source: Department of Statistic of Malaysia, 2001.

In theory, GDP should move positively with the housing market since increases in income cause the demand for housing to increase through higher prices and higher rentals (Rangel & Pillay 2007). The evidence on the causality relationship between GDP and housing price is inconclusive, but Shen et al. (2005) suggest that high GDP growth rate implies that people expect better economic conditions with higher economic growth. Based on this argument, the income factor is hypothesized to positively be correlated with house prices.

5.1.3 Interest Rates Variable

House prices can be influenced by various factors. One of the most cited factors from the housing study literature is the interest rate (see Table 4.1). Many researchers have used interest rate as one of the independent variables to assess the effects on house prices (see Rangel & Pillay, 2007; Roehner, 1999; Thomset & Kahr, 2007). Cheng et al. (2009) describe interest rate as a common factor, affecting house prices and consumption. In their book Beyond the Bubble, Thomsett and Kahr (2007) argue that one of the causes for a rapid increase in house prices is interest rate. The authors explain that when the interest rate is low, many people qualify for mortgages, thus increasing the demand for houses. In addition, Rangel and Pillay (2007) also argue that a decrease in interest rate leads to a reduction in mortgage payments, resulting in an increase of real estate prices caused by the higher demand for houses.
Poterba (1991) suggests that interest rate is a statistically significant factor in explaining variation in house prices. In Poterba’s study, demographic factors and construction costs do not significantly explain the short-run movement of house prices but interest rate does. Similarly, Hendershott (1991) also reveals that interest rate is a significant factor in the movement of house prices in the US market.

Roehner (1999) analysed real estate bubbles in Paris between 1984 and 1993. The author’s results suggested that the most significant economic variable, affecting house prices is the interest rate. The interest rate is also believed to be used by buyers to determine the real price of a home mortgage (Roehner, 1999). Muellbauer and Murphy (1997) identified real interest rate and income as the most important variables used in explaining and forecasting the volatility of house prices in the UK housing market. Similarly, Lum (2002) studied the Singaporean housing market and revealed that low mortgage costs, resulting from low interest rates and the growth of the economy were the main factors influencing the Singaporean property market from 1975 to 1995.

Figure 5.2 shows the movement of short-term interest rates in Malaysia from 1990:Q1 to 2004:Q4. The increased interest rates were interrupted by the 1994 capital control imposed on the Malaysian economy (see section 2.6). In 1995, the interest rates increased again, reaching a peak in 1998:Q1. The second capital control was imposed in 1998 to curb the effect of the Asian financial crisis on the Malaysian economy. Hun (2005) explained that Bank Negara Malaysia has also injected RM34 billion into the financial and banking sectors in 1998 order to stabilize the higher interest rates (Hun, 2005).

The movement of interest rates in Malaysia was quite volatile from 1997:Q4 to 2000:Q1, as the Malaysian economy recovered from the 1997 Asian financial crisis. In the post crisis period of 1999, interest rates in Malaysia moved between the range of 2% to 4% and were more stable.
This study uses a 3-month interest rate to capture the mortgage costs for homebuyers in Malaysia. The use of the short-term interest in this study is justified because it provides information about the real condition of the Malaysian housing market and represents the floating rate mortgages market used in Malaysia. As explained in Tsatsaronis and Zhu (2004) study, the floating mortgage market used a short-term interest rate in mortgage financing. In Malaysia, the common mortgage rate offered by the bank and financial institutions is a floating rate. The floating rate is in between the 3-month interbank rate and the intervention rate of Bank Negara Malaysia (see Figure 5.3). According to Chen and Patel (1998), short-term interest rates are more reliable and efficient to capture the investment demand for houses. The short-term interest rate is also closely linked to the monetary policy stance (Chen and Patel, 1998).
Figure 5.4 Comparison of the Bank Negara Malaysia (BNM) intervention rate, 3 months interbank rate and commercial base lending rate in Malaysia after the Asian financial crisis.


5.1.4 Inflation (Consumer Price Index)

Macroeconomic uncertainty, such as inflation is included in this study since price instability is one source of uncertainty. Pain and Westway (1997) suggest the use of inflation as a proxy for people’s expectation of a future increase in house price. Several researchers (for example Kearl, 1979; Muth 1986) have used past behavior data of inflation as a proxy for future expectations. Therefore, in this study, the inflation variable is use to measure people’s expectation of future increase in house prices in Malaysia.

The increase in house prices signals an inflationary pressure in the economy, which results in a decrease in housing demand and lower price of an asset (house price) (Barot & Takala, 1998). According to DisPasquale and Wheaton, (1996), the increase in initial mortgage payments due to higher interest rates and real growth in housing
equity are triggered by the inflationary pressures from the housing market. Kearl (1979) explains that these impacts (a combination of higher mortgage payments and housing equity) results in a decreased demand for housing. For example, between 1990 and 1993, housing prices in Finland and Sweden decreased by 20% and 30%, respectively, causing inflation to increase to 0.58 in Finland and 0.38 in Sweden. These situations signalled an inflationary pressure in these countries (Barot & Takala, 1998).

Kim (2004) examines Korean house prices using the Granger causality test. The author shows that inflation and house prices in Korea tend to move together and there is a two-way relationship between house prices and CPI inflation. Similarly, Lee’s (1999) study shows that only house price has a positive effect while the inflation and real interest rates have a negative impact on housing investment. This indicates that as inflation increases, the house price also increases and fewer people will invest in buying houses.

Hofmann (2004) and Tsatsaronis and Zhu (2004) found that economic growth, inflation, interest rates and bank lending have a significant explanatory power in determining house prices in several industrialized economies. These variables (such as GDP, inflation, interest rates and bank lending) help to explain the recent housing markets booms in countries such as Sweden and the Netherlands (Hofmann, 2004). In this study, the natural log of Malaysia consumer price index (CPI) is used as a proxy for the inflation variable. The CPI, which was rebased for different base years (for example 1990, 1994 and 2000), caused the data to be unreliable. To avoid this problem, this study uses the CPI data, with 1994 as the base year, for the whole study period. As illustrated in Figure 5.4, the inflation rates in Malaysia were quite volatile, with the highest peak of 1.96% occurring in 1998. Then, during the 1997 Asian financial crisis inflation was very volatile rising from 0.988 % (1997:Q4) to 1.1277% (1998:Q1).
5.2 Research Methodology

In order to apply housing demand analysis to the Malaysian housing market, a number of assumptions are included in the standard theoretical housing bubble model. Given the limitation of data and the difficulty in combining the conceptual and theoretical aspect of bubbles in the housing market, this study employs several assumptions, as follows:

- The secondary data used for this study are assumed to represent the true condition of the Malaysian housing market.
- The insignificant data such as employment, construction sector and other housing supply factors are excluded from this study. This is because the housing supply variables are assumed to have a less significant effect on the movement of the house prices in the Malaysian housing market.
- There is no credit constraint in the Malaysian housing market.
- The scope of this study focuses on Malaysia as a whole without dividing it into regions.
- The supply of houses in Malaysia is fixed in the short-run.
- The house prices term used in this study refers to asset prices of houses and the land they are associated with.
To analyze the possible existence of bubbles in the housing market, two main points are addressed; the standard definition of bubble (percentage of deviation from the fundamentals) and the empirical analysis of the bubble (econometric modelling) (Stevenson, 2008). According to Flood and Hodrick (1990), there are some econometric difficulties in testing for the existence of bubbles. These include the heterogeneous characteristics of each house and the complexity in the demand, supply and regulations of the housing market. The econometric modeling in this study attempts to mitigate these difficulties.

In the housing market literature, the most commonly used technique for modelling house price bubbles is the price-to-rent ratio or price-to-income ratio (affordability ratio) (see section 4.2.4). However, mixed results have been obtained using these ratios, as reported in Himmelberg et al. (2005) and Bjorklund and Soderberg (1999). The ratio approach may provide non-significant results for policy analysis due to ignorance of the variation in the economic fundamentals variables and be less reliable in determining whether the rising house prices were caused by economic fundamentals or by speculative house price bubbles (Cameron et al., 2006).

Hui and Gui (2009) explain that the outcomes of bubble studies depend on two aspects; the selection of data set and the techniques employed. In this study the data include macroeconomic factors such as income, interest rate and inflation, are analyzed using a combination of non-switching and switching models.

The use of non-switching and switching models differentiates this study from previous researchers. The combination of modeling house prices (MHPI) in a linear (non-switching model) and nonlinear approach (switching model) provides reliable results when examining the existence of bubbles in the Malaysian housing market. This study also provides alternative ways to model a house price bubble by examining the mean (level) and variance (level) of MHPI in different economic conditions such as boom and burst.

The proposed housing bubble model used in this study adopts a general to specific approach with a simple multivariate linear regression model and proceeds to more sophisticated models such as the Markov-switching GARCH model (MS-GARCH).
5.2.1 Non-Switching Model

This section explains the techniques used to model MHPI, which is conditioned on the macroeconomic variables such as income, interest rate and inflation. The underlying assumption in this model is that house prices in Malaysia do not react asymmetrically to different economic shocks. The econometric techniques used in the non-switching model are multivariate regression, ARCH and GARCH tests and the cointegration approach of Johansen and Juselius (1988).

5.2.1 a) Multivariate Linear Regression Model

The multivariate linear regression model begins with the following equation:

\[ Hsg_t = \beta_0 + \beta_1 Hsg_{t-1} + \beta_2 Inc + \beta_3 Intr + \beta_4 Inf + \varepsilon_t \]  

(5.2.1)

Where;

\( Hsg_{t-1} \) = last year’s index value of the Malaysian house price

\( Inc \) = proxy for income factor

\( Intr \) = 3 months interest rates

\( Inf \) = inflation

\( \beta_i \) = constant (parameters)

\( \varepsilon_t \) = error term is assumed to be an independently distributed random variable \( \varepsilon_t \sim iid N (0, \sigma^2) \).

Equation 5.2.1 is estimated using Ordinary Least Square (OLS) via the Eviews 6.0 software. The parameters \( (\beta_1, \beta_2, \beta_3) \) and \( \varepsilon \) the stochastic or residual are components of our model specification.

The OLS regression has been tested in the housing market by several researchers such as Kim (2004) and Labonte (2003). For example, in the Korean housing market, Kim (2005) used an ordinary least square regression to explain the relationship between house prices and economic fundamental variables for the period 1998:Q1 to 2002:Q4. Similarly, Labonte (2003) constructed five econometric models to detect housing bubbles in the US and for each model the author used the ordinary least square to
explain the relationship between the house price index and the associated independent variables.

As suggested by Lin and Lai (2003), the use of time-series regression may possibly create a spurious relationship between MHPI and the fundamental variables. Consequently, the time-series residual of the OLS is sometimes serially correlated (autocorrelation) with its own lagged values (Stambaugh, 1999). This contributes to the bias and inconsistency of the OLS estimations (Stambaugh, 1999).

Hence, to determine whether the residual values in our model display any dependent relationship (autocorrelation) with its past residual value, the serial correlation test of Breusch-Godfrey (BG) is applied to the residual values.

The importance of the Breusch-Godfrey (BG) test is to examine whether any autocorrelation effects exist in the residual by allowing for higher order alternatives and for the existence of lagged dependent variables in the regressors. The BG test is used due to its simplicity and non-restriction by the residual (see Breusch, 1978; Godfrey, 1978). Other tests conducted on the residual include the unconditional heteroscedasticity test of Breusch-Pegan-Godfrey (BPG) and the conditional heteroskedasticity of the ARCH model. The BPG test is used to test for non-constant variance in the residuals (see Breusch, 1978; Godfrey, 1978).

Other tests conducted on the residual include the unconditional heteroscedasticity test of Breusch-Pegan-Godfrey (BPG) and the conditional heteroskedasticity of the ARCH model. The BPG test is used to test for non-constant variance of the residuals.

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4 The OLS test is consistent and unbiased when the variables used are stationary and the $\varepsilon$ are i.i.d with mean zero and constant variance. The problem arising from modelling the non stationary data is the spurious problem. This happens when the results obtained from the regression model show statistically significant relationships among the variables in the model whereas the result is actually showing only evidence of contemporaneous correlation not the true casual relationship (Pesaran & Wickens, 1995)
5.2.1b) Autoregressive Conditional Heteroscedasticity (ARCH) Model and General Autoregressive Conditional Heteroscedasticity (GARCH) Model

Engle (2001) states that the variance of residuals changes during different period according to the expansion (boom) and contraction (burst) of the economy. The change in variances implies that the variances of residuals are not equal over time. To investigate this possibility, Engle (1982a) created an Auto Regressive Conditional Heteroscedasticity (ARCH) model.

The ARCH model is used to examine the time-varying nature of price volatility (conditional variance) which is a function of past values error terms, while keeping the unconditional variance constant (Engle, 1982). The starting values for the ARCH procedure are derived from the estimation of the mean equation from the OLS. In the presence of ARCH, the regression coefficients estimated from OLS are consistent but inefficient (Engle, 2000). The consistency of the OLS estimation is in the regression coefficients but the confidence interval and standard errors of the OLS will produce false precision, which is inefficient (Engle, 2000). Thus, to overcome this problem, the ARCH and GARCH models include time-varying heteroscedasticity as a variance to be estimated (Engle, 2000).

In the ARCH test, the null hypothesis of no ARCH effect is tested and rejected if the probability of chi-square is less than the significance level. Engle (1982) points out that the test statistics will be asymptotically chi-square when the series in the null hypothesis is a random sequence of Gaussian disturbance.

Equations (5.2.2) and (5.2.3) are used to test the ARCH model as suggested by Engle (2001). Equation (5.2.2) denotes the conditional mean equation of $H_{sg,t}$, which consists of exogenous variables such as interest rates, inflation and income in vector $X_t$ and equation (5.2.3) as the conditional variance, which consists of $\epsilon_{t-1}$ the previous period of error term (ARCH term) and a constant term $\omega$ that is related to the unconditional mean of the process.
\[ Hsg_t = X_t + \epsilon_t \] ........................ Mean equation (5.2.2)

\[ \sigma_i^2 = \omega + \alpha \epsilon_{t-1}^2 \] ........................ Conditional variance (5.2.3)

In equation (5.2.3), to ensure that the variance cannot have negative values, the restrictions \( \alpha > 0 \) and \( 1 > \alpha > 0 \) as necessary. The ARCH model is use because of its ability to handle the nonlinearities and clustered errors, its simplicity and its comparative ease in applying to the data.

However, the ARCH model is limited in its ability to detect some significant characteristics of the research data such as leverage effect, excess kurtosis and high degree of nonlinearity (Bollersley, 1992). Furthermore, the ARCH model is less parsimonious in parametization as it requires a large number of parameters (Hamilton, 1991). The ARCH model also assumes that positive and negative events have the same effects on volatility (i.e. symmetry) because it depends on the square of the previous shocks (Bollerslev et al., 1994).

Since the ARCH model has limitations in modelling the conditional variances, a more generalized ARCH model known as Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model is proposed to model the time-varying conditional variance of the MHPI. As illustrated in Figure 5.1, the MHPI distribution displays some changes in the index points and follows an autoregressive process with a GARCH (1, 1) type conditional variance structure.

Equation (5.2.4) is the GARCH (1, 1) model applied to our data.

\[ \sigma_{hsg,t}^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{hsg,t-j}^2 \] ........................ (5.2.4)

Where \( \sigma_{hsg,t}^2 \) = the conditional variance of the MHPI given the information available at time t-1

\[ \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2 \] = is the ARCH term
\[ \sum_{j=1}^{p} \beta_j \sigma_{hj,t-1}^2 = \text{the GARCH term} \]

\[ \epsilon_t = \text{random error term with (0,1) and N (i.i.d)} \]

The restriction imposed on the \( \alpha_t, \beta_j \) parameters is similar to equation (5.2.3) to ensure the stability and positive value of the conditional variance. The GARCH model produces an estimation of all the parameters in our model, such as the model constant, \( \alpha_0 \), volatility constant (mean variance) \( \omega \), \( \alpha \) and \( \beta_j \).

The GARCH technique, which was first proposed by Bollerslev (1986) and Taylor (1986) is used by many researchers to model the stochastic volatility of asset return for financial time series data (see Bollerslev et al., 1992, 1994). In the housing market, the GARCH can model and capture the conditional variance of house prices because of the inclusion of the moving average (MA) and the autoregressive component into the GARCH model. Moreover, the forecast of the future variance in the GARCH model uses the past variance’s information and fewer parameter are used compared to the ARCH model (Bollersley, 1986). Several researchers use the GARCH technique to capture changes in house price (see Folde & Tirtiroglu, 1997a; Guirguis et al., 2007; Miller & Peng, 2006).

Miller and Peng (2006) use the GARCH technique to examine time variations in the volatility in the single-family house prices in the metropolitan area of the US. The authors reveal that 17% of the house prices in these areas displayed volatility-clustering effects caused by the increase in house price and personal income growth. Similar volatility clustering is also found in the Spanish housing market (see Guirguis et al., 2007).

Dolde and Tirtiroglu (1997) use the GARCH model to estimate the effects of innovations in house price mean returns and variances in Connecticut and San Francisco. The authors reject the null hypothesis of homoscedasticity, which implies that the US house price mean and variances are heteroscedastic.
5.2.1 c) Cointegration

The econometric literature suggests various techniques for examining the long-run and short-run relationships in time series variables (Carol, 2001). In the housing market studies, the long-run relationship equation can be estimated using a co-integrating technique. The cointegration estimation is also used to solve problem of ‘spurious regression’ caused by the OLS estimation (Lee & Gholami, 2002).

The concept of cointegration refers to the situation where, in a non-stationary process the variables (which individually drift randomly) tend to converge in the long run through a linear combination (Harris, 1997). This cointegrating relationship implies a the co-movement between endogenous and exogenous variables and, consequently, it can test for the presence of an equilibrium relationship within the Malaysian housing market. Hence, the extent of the deviation of MHPI from its estimated long-run equilibrium price will be used to test for the existence of bubbles in the Malaysian housing market.

Enders (1995) notes that two time-series data are cointegrated if the unit root test for all data indicates nonstationary, but the combination of these two variables is I (0) and stationary. There are two common approaches to testing for cointegration; the Engle-Granger tests and the Johansen test. The use of Johansen’s (1988) multivariate technique allows us to test whether there is a unique cointegrating vector between MHPI, income, interest rate and inflation.

The Johansen multivariate approach of cointegration is used in this study because the approach allows all the variables to be endogeneity and estimates the adjustment to equilibrium price simultaneously (Kenny, 1998). The Johansen cointegration test starts by specifying an unrestricted vector auto-regression (VAR) using all the variables of exogenous and MHPI. The result of the VAR test determines whether all the variables are exogenous.

The Johansen cointegration test (1988) is based on the VAR model, which estimates the parameters of the dynamic relationships amongst MHPI and the macroeconomic fundamental variables such as income, interest rates and inflation. To avoid any
spurious or false identity restrictions in our model, the unrestricted VAR model is formulated where all the variables are treated as endogenous (Sim, 1980).

Several authors have used the non-stationary test in residual from a static model between asset prices and fundamental variables to detect a bubble in the stock market (Campbell & Shiller, 1987; Diba & Grossman, 1984, 1988; Hamilton & Whiteman, 1985). The authors conclude that a bubble exists in the stock prices by rejecting the unit root hypothesis.

However, the use of the unit root test for modeling a bubble is not suitable in the housing market. According to Mikhed and Zemlick (2009), a bubble in the house price can be determined if the price has a unit root, as suggested by the theory. Furthermore, the authors explain that, due to the stationarity of housing demand and supply and the non–cointegration of demand and supply in house prices, the unit root test is not efficient in capturing house price bubbles (Mikhed & Zemlick, 2009).

Evans (1991), finds that using a Monte Carlo simulation, the rational bubbles cannot be detected using a conventional unit root test due to the over-rejection of the bubble test, which tends to collapse (collapsible bubble). The unit root test is rejected because the collapsible bubble is not a conventional unit root process and, thus, it is not similar to the hypothesis of a unit root (Evan, 1991). Therefore, the conclusions made using the conventional unit root approach have prevented the detection of bubbles in house market prices (Evans, 1991).

Munro and Tu (1996) use the Johansen co-integration technique and find that household income, real mortgage rate and housing affect the UK housing market at the national level.

Prior to applying the cointegration test, the data (MHPI, income, interest rates and inflation) needs to be stationary. This study used the Augmented Dickey Fuller (ADF) to test for the stationarity of the data via Eviews 6 software. The number of the lags (p) is determined by minimizing the Hannah-Quinn Criterion.
The cointegration test starts by selecting an appropriate number of lags (p) to include in the VAR model. The lag length (p) is determined using standard model selection criteria, which minimizes Aikake Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ), Loglikelihood criterion, and Final prediction error criterion.

Using a Vector-Auto-Regression (VAR) model, Kim and Lee (2000) conducted the Johansen cointegrating test to verify whether a long-run stable relationship existed between real estate prices and major macroeconomic variables. As the land price index was cointegrated with market fundamentals, the authors concluded that no evidence of a real estate bubble could be found in Korea from 1974 to 1999 and the possibility of real estate price bubbles can be ruled out.

Due to the small sample, in this study, only small lag-lengths were included in the VAR model. The standard VAR equation taken from the Pollakoswki and Ray (1997) model and is given in equation (5.2.5);

\[ X_t = L(\Gamma) X_{t-1} \]  \hspace{1cm} \text{(5.2.5)}

Where \( X_t \) is the vector of changes in MHPI, income, interest rate and inflation and \( L(\Gamma) \) is the lag order polynomial.

Thus, the unrestricted VAR (k) model is given as follows:

\[ X_t = \Gamma_1 X_{t-1} + \Gamma_2 X_{t-2} + \ldots + \Gamma_p X_{t-p} + \mu_t \]  \hspace{1cm} \text{(5.2.6)}

Where

- \( X_t = \) A vector of 4 variables each of which is I (1)
- \( \Gamma = \) A (4 x 4) matrices of short-run parameter for MHPI, interest rates, inflation and income
- \( \mu_t = \) a (4 x1) vector of constants.
- \( \epsilon_t \sim MVN (0, \Omega) \) i.e. “well behaved” random disturbances.
In the VAR (equation 5.2.6), each variable is regressed on its own lags and lags of other variables. In addition, the $\Pi$ matrix (4 x 4) holds the information on the long-run equilibrium relationship between the variables of concern; the rank in the $\Pi$ matrix describes the number of cointegration relationships. Furthermore, the $\Pi$ matrix is used to test whether we can reject the restriction implied by the reduced rank $\Pi$ (Johansen 1988; Johansen & Juselius, 1990).

In the unrestricted VAR model (5.2.6), no restriction was imposed on possible cointegrating relations. According to Bourassa et al. (2001), the VAR model only contains information on the short-run, thus ignoring the long-run relationship that may exist among variables. This condition in the VAR model is regarded as a specification mistake that can be corrected by imposing restriction. Hence, the Vector Error Correction Model (VECM) is derived from the restrictions imposed on the VAR model (see equation 5.2.6). The use of VECM is also believed to be an efficient method of handling a data series which is short (Bourassa et al., 2001) and this technique simultaneously models both the short-run (changes) and long-run (levels) adjustment process as illustrated in equation (5.2.7);

$$\Delta X_t = \Gamma \Delta X_{t-1} + \Pi X_{t-2} + \mu + \epsilon_t \hspace{1cm} \cdots \hspace{1cm} (5.2.7)$$

Equation (5.2.7) contains two important matrices, $\Gamma$ and $\Pi$. The matrix $\Gamma$ is used in first difference of the variable in $X_{t-1}$ and it contains contemporaneous short-run adjustment parameters. Matrix $\Pi$ is a matrix for the levels variables in $X_{t-1}$ and it contains information about the long-run equilibrium relationship. Furthermore, the rank of the matrix $\Pi$ gives the number of cointegrating vectors. Consider three possible cases of the rank of the $\Pi$:

1. $\Pi = q$; all variables in the system are I (0)
2. $\Pi = 0$; all variables in the system are stationary in first difference (I (1)).
3. $\Pi$ is between 0 and q, indicating that the variables are cointegrated.
Under cointegration, the rank of $\Pi$ is bigger than 0 and less than $q$ with the maximum rank of 3 in this study. When cointegration occurs, $\Pi$ can be decomposed into two $m \times q$ by $r$ matrices and $\alpha$ and $\beta$ matrices such that

$$\Pi = \alpha \beta$$

Where, the parameters of $\alpha$ measure the speed of adjustment of the $\Delta X_t$ with the lag in the error correction term and $\beta$, which is the cointegrating matrix, contains the long-run equilibrium parameters of $r$. The error correction terms in the $\beta'X_{t-k}$ are stationary.

We determine the number of cointegration vectors ($r$) that exist among MHPI, income, interest rate and inflation (i.e. the rank of $\Pi$) using two Johansen tests, the Trace Test ($\lambda_{\text{trace}}$) and the Maximum-Eigenvalue Test ($\lambda_{\text{max}}$). These tests are applied to five possible models of the VEC, which imposes different sets of restrictions on the deterministic trends. The null hypothesis for each model is shown in Table 5.2

**Table 5.2 Model selection for VECM**

<table>
<thead>
<tr>
<th>Types of Model</th>
<th>Hypothesis</th>
</tr>
</thead>
</table>
| Model (1)      | $H_0: \mu_1 = \mu_2 = j_1 = j_2 = 0$  
No deterministic components in the cointegration relations of the data |
| Model (2)      | $H_0: \mu_2 = j_1 = j_2 = 0$  
The existence of intercepts in the cointegration relations. |
| Model (3)      | $H_0: j_1 = j_2 = 0$  
The existence of linear trends and intercepts in the levels of the data |
| Model (4)      | $H_0: j_2 = 0$  
The existence of cointegration relations which include an intercept and a trend. |
| Model (5)      | $H_0: \mu_1, \mu_2, 1, j_1, j_2, 10$ |
According to Harris (1995), the selection of the models is very important, as financial and economic time series data contain both deterministic trends (intercept and trend) and stochastic trends (non-stationary).

Therefore, the VECM, as derived from the restricted VAR model, is applied to our data to correct for any disequilibrium arising from any shock to the whole system. In this study, the VEC model consists of an equation for the MHPI and macroeconomic fundamental variables such as income, interest rate and inflation. The VECM equation, which incorporates both short-run and long-run relationship, is based on the lag of house price (MHPI) and the residual estimated from the cointegration relationship between all the variables used in this study, using equation 5.2.8a. For example, assuming that the rank \((\Pi) =1\), the standard model of VEC in the Johansen approach can be shown in a scalar form as follows:

\[
\Delta \text{hsg}_{p,t} = \delta \epsilon_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \text{hsg}_{p,t-1} + \sum_{i=1}^{q} \beta_i X_{i,t-1} + \epsilon_t \]

Where \(\Delta \text{hsg}_{p,t}\) is the change in house price (\(\text{hsg}_{p,t} - \text{hsg}_{p,t-1}\))
\(\epsilon_{t-1}\) is the lagged value of house price deviation estimated from the long-run relation and \((\delta \neq 0)\) suggesting a cointegrating vector in the model
\(\alpha\) and \(\beta\) = coefficient matrixes jointly to be estimated in the VECM with \(p\) and \(q\) lags.
\(X_t\) = a vector consisting of macroeconomic variables (income, interest rate and inflation)
\(\epsilon_t\) = independently and identically distributed random error term vectors
Where \( \Delta h_{p,t} = h_{p,t} - h_{p,t-1} \) is the change in house price, \( e_{t-1} \) is the lagged value of house price deviation estimated from the long-run relation and \( \delta \neq 0 \) suggesting a cointegrating vector in the model.

\[ a_p, \beta_q = \text{coefficient matrixes jointly to be estimated in the VECM with } p \text{ and } q \text{ lags.} \]

\[ X_t = \text{a vector consisting of macroeconomic variables (income, interest rate and inflation)} \]

\[ \epsilon_t = \text{independently and identically distributed random error term vectors} \]

Numerous studies in the housing market have found significant cointegration between house price and fundamental factors (see Ashworth & Parker, 1997; Muellbauer & Murphy, 1997). For example, Ashworth and Parker (1997) used the Johansen test to model eleven regional house prices in the UK with other economic variables such as per capita income, the real interest rates and the housing supply by private sector. The author’s results reveal there are some similarities in the factors that determine the regional structure of house prices in the UK, with the exception of Scotland and Northern Ireland.

Muellbauer and Murphy (1997) studied the volatile cyclical behavior of UK house prices using explanatory variables such as financial liberalization, the wealth effect and other economic/demographic factors. Their results suggest that the changes in UK house prices in the 1980s were caused by financial liberalization and the wealth effects factors (interest rates and income). This proved that cointegration does exist between the house price and economic fundamentals in the UK housing market.

Gallin (2003) explains there are many rational explanations for the existence of cointegration between house prices and market fundamentals. One possible explanation is the instability in the price elasticity of supply and demand due to the changes in regulatory conditions and demographics (Gallin, 2003).
In the housing market, the price elasticity concept is used to estimate future demand and formulate a policy instrument for housing (Blackley & Follain, 1986). The basic idea behind price elasticity is that it shows different patterns of adjustment to changes in Malaysian house prices and to economic shock. According to Belke et al. (2008), changes in real estate asset prices are much faster than other goods prices due to the inelastic of the real estate supply to meet demand in the required time. Therefore, any increase in housing demand is immediately reflected in an increase in house price. Thus, deviations of real estate asset price from equilibrium price are corrected by the price adjustment (Belke et al., 2008).

The International Comparison Project (ICP) by United Nation conducted a cross country house price and income elasticities for housing demand by decomposing rents of similar units into rental price and quantity index (see Kravis et al., 1982, Chapter 9). Housing consumption is described as a function of total consumption and the price per unit of housing services. The results of the ICP study show that housing demand is slightly inelastic to prices and elastic to income demand (Kravis et al., 1982).

This study estimates the price elasticity of housing demand in Malaysia with macroeconomic fundamental variables such as income, interest rate and inflation. The magnitude of housing price changes depends on the price elasticity demand using equation 5.2.8b.

\[
VECM \ coefficient \ of \ X^* = \left( \frac{\text{avg in } X^*}{\text{avg in MHPI}} \right) \quad \text{………………………………… (5.2.8b)}
\]

* X is the income, interest rate and inflation variable

5.2.1 d) Equilibrium House Price

In the cointegration tests, the error correction model (ECM) is used to examine the adjustment of MHPI from the changes in economic conditions. However, Hendry (1984) argues that ‘equilibrium correction’ is a better description for the term error correction model (ECM) than ‘error correction’. This is because the random drift variables tend to converge in the long-run through a linear combination of
cointegration (Harris, 1995). Therefore, the deviation from the equilibrium price is only temporary and it will be corrected in the long-run.

Assuming a linear relationship, the equilibrium house price equation, $H_p^\ast$ during period $t$ is described by income (Inc), interest rate (Intr) and inflation (Inf).

\[
H_p^\ast = \alpha_0 + \alpha_1 Inc_t + \alpha_2 Intr_t + \alpha_3 Inf_t
\]

\[
H_p_t = H_p^\ast + \theta_t
\]

If all variables (income, interest rate and inflation) are constant, real house price appreciation, $p$ would be constant and equal to $H_p^\ast$. To explain the real house price appreciation model, Bourassa et al. (2001) added an adjustment term of $\theta_t$ which represents adjustment dynamics and error term.

In this section, the extent of the deviation of Malaysian house prices from their actual prices is computed using the predicted values from the VECM. The comparison of both series reveals some signs of boom and burst in the Malaysian housing market. The concept of long-run equilibrium has been tested in the housing market by many researchers such as Miles (1994), Abraham and Hendershott (1996), Chen and Patel (1998) and Jud and Wikler (2002).

Miles (1994) examined the effect of the taxation system on the volatility of UK house price demand. The unexpected changes in property taxes and favorable mortgage rates caused UK house prices to overshoot from their long-run equilibrium in a discontinuous way and subsequently decrease to a new equilibrium price, which was above the original equilibrium price level (Miles, 1994).

In a standard asset pricing theory, changes in asset prices could not be used to predict future changes in asset prices (Weeken, 2004). This is known as weak form efficiency theory. The housing market is unlikely to be an efficient market due to several reasons. First, the imperfection of the housing markets, particularly the inelastic of supply to meet surplus demand for houses (Pornchokchai, 2007). Second, the housing
market is illiquid and requires greater information and transaction costs (Gatzlaff & Tirtiroglu, 1995). These characteristics contribute to the slow adjustment in real house prices towards the fundamental equilibrium prices (Case & Shiller, 1989). For example, Abraham and Hendershott (1996) built a model which allows for a lagged adjustment process in the house price dynamic. The authors used the quality-adjusted Freddie Mac and Fannie Mae repeat transaction database for thirty metropolitan areas and five macroeconomic variables in examining the probability of housing bubble busted. Abraham and Hendershott (1996) revealed that the real house price appreciation is associated with an increase in real income, employment and real construction costs and the appreciation rates of houses is negatively related to an increase in real interest rates.

Jud and Winkler (2002) demonstrated that the short-run dynamics model of house prices in several of the US metropolitan areas showed a strong influence on house prices and on the current growth in income, interest rates, population, construction costs and changes in current wealth. The authors’ conclusion is based on a single equation regression used to estimate the real percentage change in house prices.

Chen and Patel (1998) explain that the long-run relationship between house prices and their fundamentals can drift away momentarily but will return to their long-run equilibrium. All the studies discussed above show that a change in the fundamental values can cause real estate prices to either converge or fluctuate around the equilibrium prices.

Previous studies on house price bubbles focused on identifying signs of bubbles and appropriate techniques to be used in modeling price bubbles (Hui & Gu, 2009). Today, many researchers are more concerned with the inconsistency in the size of house price deviations, which represent a house price bubbles (Bailen, 2006). Various sizes and amounts of deviations or fluctuations in house prices are use to describe bubbles in different housing markets (see section 5.2.4e)
5.2.4 e) Size of House Price Bubbles

Detecting price bubbles is complicated due to the lack of a standardized size. Many researchers focus only on analyzing the increase in the amount of house prices and ignore the importance of reporting the standard size of the bubble (Bailen, 2006). Previous housing market studies report various sizes of price deviation between real house price and its long-run equilibrium price as indicator for the existence of a house price bubble.

In the US housing market, the deviations in house price from its estimated long-run equilibrium values, which indicate the existence of price bubbles, vary from 10% to 40% (see Kluey, 2008; Helbling and Terrones, 2003; Angell & William, 2005). For example, Kluey (2008) study reveals that the increase in US house prices in 2007 vary from 6% in Midwest region to 62% in West region. In addition, a single-family house price, which is measured by the OFHEO purchase index, was 14% greater than equilibrium price in 2008:Q2 (Kluey, 2008). Meanwhile, Helbling and Terrones (2003) indicates that a 32% increase in US house prices, corrected by inflation, is a house price bubble. Using 20 years of US data, Angell and William (2005) explain the boom (bubbles inflates) occurs when there is 30% increase in real house prices during a three-year housing boom.

In Korea, the increase in house price from 44% to 50% is an indicator of the existence of a house price bubble (Kim, 2004). For the Spanish housing market, the excess or deviation of house price from fundamental factors by 8% to 28 % is an indicator of the existence of house price bubbles (see Balmaseda et al., 2002; Martinez-Pages & Maza, 2003).

According to a report from the World Economic Outlook in 2000 (Chapter II) house price bubbles occur when there are 10% to 20% deviations in house prices from fundamental factors such as interest rate and income. The Economist (2005) suggests a 50% deviation in house price from the long-run equilibrium price as evidence of housing bubble. An OECD (2005) study on international house prices in 17 international housing markets presents a 30% overvaluation of UK house prices from 2003 to 2004 as evidence of house price bubbles.
Hatzvi and Otto (2008) state that a 60% variation in property prices in Local Government Area (LGAs) in Sydney is unexplained by the asset pricing fundamentals. This variation suggests the existence of house price bubbles in the LGAs. In Thailand, several provinces recorded 30% appreciation in the house price index during the formation of a house price bubble (Calhoun, 2003). Shen et al. (2005) report that the Shanghai housing market experienced a house price bubble when real house prices deviate by 22% from the market fundamental.

As discussed above, the average amount of deviation or overvaluation in house prices is between 25% and 50%. Therefore, due to the lack of standardization and an acceptable amount of deviation which can substantiates the existence of a housing bubble, this study uses a 30% deviation or overvaluation of MHPI from its long-run equilibrium price as a sign for the existence of a housing price bubble in the Malaysian housing market. This figure is consistent with the study of FDIC, which uses a 30% cumulative increase in house price over three years as a ‘boom’ in the housing market (Lehay, 2005).

According to Abraham and Hendershott (1996), the tendency of housing bubbles to burst are shown in the increase discrepancy between the actual house price level and the fundamental price level; the more distant the deviation of house prices from the fundamental values, the more chance there is that the bubble will burst. The authors also find five variables (growth in real income, real construction cost, changes in real after-tax interest rates, lagged real appreciation and the differences between the actual and equilibrium real house prices) that could explain one-fifth of the variation in US house prices. Abraham and Hendershott (1993) describe the difference between equilibrium and actual house price level as a bubble buster. Using a concept similar to that of Abraham and Hendershott (1993), this study estimates the excess price of MHPI from its equilibrium price using equation (5.2.8d) as follows;

\[
\text{House price excess}_t = \left[ R_{\text{hub}} - LR_{\text{hub}} \right] \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (5.2.8d)
\]
Where *House excess* is a proportion of the bubble that exists in the Malaysian housing market, $R_{hsg}$ is the real price of MHPI and $LR_{hsg}$ is the estimated long-run equilibrium price of MHPI.

Equation (5.2.8d) is used to determine the level of efficiency in the Malaysian housing market. The difficulty in estimating equation (5.2.8d) is due to the unknown value for $LR_{hsg}$ which was first estimated using the VECM technique in Eviews 6.0 software. The percentage change in equilibrium house price $H_{p}^{*}$ is calculated by inserting the value obtained from VECM into equation (5.2.8d).

5.2.2 Switching Model: Modeling the Mean (level) and the Variance (volatility) of the MHPI

This section extends the Markov-Switching model for examining house price level with macroeconomic fundamental factors such as interest rate, inflation and income by allowing the variance of MHPI to vary in different states. The switching regime model in time series data was pioneered by Quandt (1958) with the introduction of the switching regression model (Ismail & Isa, 2008). Further extension of the switching regression model was carried out by Goldfeld and Quandt (1973) which allowed the regime shifts to follow the Markov chain, also known as the Markov-Switching regression model Goldfeld and Quandt (1973). Hamilton (1989) who was inspired by the concept introduced by Goldfeld and Quandt (1973), suggested a new version of the regime shifts model known as the Markov switching autoregressive model (MSAR) which is used by numerous researchers to capture the shifting behaviour of economic and financial time series data (Ismail & Isa, 2008).

Mikosch (1999) discovered that the switching of macroeconomic conditions from expansion to recession is closely related to the changes in the volatility of asset prices. This is further evident in changes in the price level of an asset which contribute to the occurrence of financial crises (Issing, 2003). Because of the nonlinearity of economic conditions which affect housing market prices and returns, many researchers use different methods to examine the dynamics of the housing market (see Brown et
al., 1997; Guirguis et al., 2005). According to Brown et al. (1997), the existence of structural changes (nonlinearity) in the housing market is a result of fewer limitations imposed on the trading activity. The author’s result is based on the forecast of the UK housing market using time-varying coefficients.

Cheng et al. (2009) used the Markov-Switching technique to identify and forecast the boom and bursts of US house prices from 1975:Q1 to 2008:Q4 using data such as real output growth, changes in housing starts, changes in consumption growth, inflation rate, federal funds rate and term spread. These data were analyzed for both in-sample and out-sample forecasts. The author results show that the federal funds rate performs better in the out of sample forecast during the burst regime and that monetary policy is an important factor in the boom and burst cycles of the housing market.

A change in the economic state from boom to burst can cause a significant change in the housing market. For example, the 1997 Asian financial crisis was triggered by the increase in real estate prices, particularly property prices in Thailand, Indonesia and Malaysia (Meen, 1999; Quigley, 1999). The failure to include the switching state of the economy (nonlinearity) in examining house prices will result in misspecification of the house price model (Chen & Patel, 1998).

The phenomenon of regime switching in Malaysian house prices cannot be modelled using a simple linear model. Therefore, our study further examines the non-linearity of the movement in the Malaysian house prices using an appropriate and parsimonious approach of Markov-Switching (MS) regimes model. The MS technique, based on Hamilton’s (1989) framework, consists of a stochastic regime-switching structure governed by a hidden Markov process. This technique is use as a substitute for ARCH and GARCH models in analyzing the heteroskedasticity found in financial and macroeconomic time series data. The GARCH and ARCH model estimations are less significant in examining the changes of volatility in different regimes or states (Kim & Kim, 1996).

The Markov-Switching (MS) model is useful in determining the shifts of MHPI behavior in different economic conditions. In the MS model, we identify states of the
economic condition which is $S_i(i=1\ldots k)$, a variance of $\sigma_i^2$ and a mean of $u_i$. Thus, in our study $k=2$ represents two states; boom and burst of housing market and $y_i$ is a switching state. The movements of unobservable State-1 and State-2 variables are governed by the stochastic process of Markov Chain and can be defined by the transition probabilities equation (5.2.9a) as follows:

\[
\begin{align*}
   P_{12} &= \text{Probability}[\text{Boom in } t | \text{Burst in } t-1] \\
   P_{21} &= \text{Probability}[\text{Burst in } t | \text{Boom in } t-1]
\end{align*}
\] ................................. (5.2.9a)

According to the Markov-Switching model, the transition between the states (boom and burst) is governed by the first order of Markov process. Malpezzi and Mayo (1997) explain that the behavior of the housing market can be understood by analyzing house prices in the levels (mean) and the changes of house prices in terms of variance or volatility. Therefore, the MS model in this study is applied to the mean and variance of the MHPI using RATS software. Similarly, the mean (level) of the MHPI is analyzed using the MS technique.

### 5.2.2 a) Modeling the Mean (level) of Malaysian House Prices in Different Economic States of Boom and Burst

In the housing market studies, researchers examine the variation in house price caused by exogenous shocks. These exogenous shocks include decreases in mortgage interest rates, changes in regulations and laws which govern the housing market, financial deregulation and other unexpected events, such as the 1997 Asian financial crisis, the September 11 incident in 2001, the increase in oil prices, the US housing bubbles, and the currency crisis, which may cause instability in house prices.

Numerous studies have employed the regime-switching of MS model in order to examine nonlinearity and asymmetries which exists in house prices (see Ceroz & Squarez, 2006; Garino & Sarno, 2004). Ceron and Squarez (2006) apply the Markov-Switching model to predict the higher volatility and lower expected price growth in house prices of 14 developed countries during the hot and cold periods. The authors
explain that the latent state variables used in their study are able to capture changes in the increase of real house price volatility.

More recently, Garino and Sarno (2004) conduct a cointegration analysis and a Markov-Switching unit root test in the UK house prices. The authors conclude that a speculative bubble may exist in the UK housing market during that period.

For a more detailed application of Markov-switching models to bubble and asset-price volatility, see Flood and Hodrick (1986) study. Henneke, et al. (2007) suggested that the success of the Markov-switching model relied on the reliability of the parameter estimators. A common technique used in the econometric analysis for the derivation of the parameter estimators is the Maximum likelihood approach (Henneke et al., 2007).

The modelling of house prices in the switching model depends on whether a boom in the Malaysian housing market affects the mean values of MHPI, income, interest rate and inflation.

This study adopts the Markov-Switching formula introduced by Dueker (1997) as follows:

\[
H_{sg,t} = \alpha_t + \beta_0 H_{sg,t-1} + \beta_1 Inc + \beta_2 Intr + \beta_3 Inf + \epsilon_t, \quad \text{where } \epsilon_t \sim N(0,\sigma) \quad \ldots \ldots \quad (5.2.9b)
\]

The Markov process (equation 5.2.9a) allows the MHPI and macroeconomic fundamental variables such as income, interest rate and inflation to change from state 1- boom (S1) to state 2-burst (S2) as described in equation (5.2.9c).

\[
H_{sg,t}^{(R1)} = \alpha_0(1) + \beta_0(1) H_{sg,t-1} + \beta_1(1) Inc + \beta_2(1) Intr + \beta_3(1) Inf + \epsilon_t(1) \\
H_{sg,t}^{(R2)} = \alpha_0(2) + \beta_0(2) H_{sg,t-1} + \beta_1(2) Inc + \beta_2(2) Intr + \beta_3(2) Inf + \epsilon_t(2) \quad \ldots \ldots \quad (5.2.9c)
\]

We use the algorithm of BFGS in the RATS software to estimate equation (5.2.9b). The shifting state/regime is tested by comparing the difference in the parameter values of \((\beta_0, \beta_1, \beta_2, \beta_3)\) in the two states.
5.2.2b) Modeling the Variance (volatility) of the Malaysian House Prices Index

Housing price volatility has become an important issue since recent property bubbles such as the US subprime crisis (2008). Bollersley and Hodrick (1995) explain that the bursting of a house price bubble can be seen in the increase in economic downturn risk.

In this study, the financial time series data of MHPI is used to examine any changes in the variance of house prices from boom state to burst state. The irregularity in the movement of financial data series confirms that the data used in this study exhibits extended periods of low and high volatility, known as ‘volatility clustering’ (Sorenson, 2005). In estimating house price variability (volatility), the conditional mean model equation is assumed to be zero as the direction of the change in house prices is unpredictable. The idea of testing the volatility is adopted from Shiller (1979; 1981a) and LeRoy and Porter (1981) in the variance bounds or volatility tests.

In the real estate market, the variance-bound tests carried out by Scott (1990) and Brooks et al. (2001) examining for rationality of pricing the real estate share. Scott (1990) analysed the share prices of 13 REITs in the US stock market, while Brooks et al. (2001) focused on the prices of UK property stocks. The findings of both studies indicate speculative bubbles may have existed in the property stocks’ prices.

Some researchers, such as Baffoe-Bonnie (1998), Bollersley and Hodrick (1995), Dolde and Tirtiroglu (1997) and Miller and Peng (2004) examined the issue of housing price volatility. For example, Bollersley and Hodrick (1995) explain that the excess of the volatility between the actual asset price and the implied price series calculated from the actual future fundamentals is due to the self-fulfilling speculative bubbles in the asset price, which causes the price of the asset to deviate from the fundamentals.

Baffoe-Bonnie (1998) analysed the US house price using a variance decomposition technique with economic fundamental variables such as inflation, mortgage rates, employment and money supply. Their results suggest unemployment and mortgage growth rate are the main factors driving the US housing market. In addition, Baffoe -
Bonnie (1998) found that the impact of shocks on the economic fundamental variables varied in different regions in the US.

The work of Miller and Peng (2004) reveals that the volatility of the single-family home price appreciation in 277 metropolitan statistical areas (MSA) in the US during the period of 1990:Q1 to 2002:Q2 was caused by the exogenous change in the population growth rate.

Dolde and Tirtiroglu (1997) who studied the house prices in Connecticut and San Francisco from 1971 to 1994, found two interesting results; a positive relationship between the conditional variance and returns and a time-varying volatility in these markets. Similarly, Dolde and Tirtiroglu (2002) discovered 36 volatilities in four regions of the US housing market from 1975 to 1993. These volatilities are associated with the economic conditions during that period. Further result from Mikosch (1999) shows the volatility of asset prices corresponds to changing economy conditions (boom and burst). Thus by examining the volatility aspect of the asset price, we can gain greater understanding of the process of the bubbles.

The evidence and causes of volatility in the housing market and the relationship between house prices and their fundamental determinants have been explored by many researchers (see section 3.3). However, these results appear to be unsuccessful in detecting bubbles in asset prices (Chen and Patel, 1998). One of the reasons could be the lack of attention given by researchers in examining the different volatility movement in asset prices. The GARCH model is used to examine the variance of MHPI which is not constant over time (Francq & Zakoian, 2007). However, many empirical works show that testing only a GARCH model in the long-run is less valid (Francq & Zakoian, 2008).

Due to the changing and unstable economic conditions in the Malaysian economy, a more appropriate and parsimonious methodology of MS-GARCH is adopted in this study. The changes in house price variance which is measured by the volatility in house prices, are examined using a combination of the Markov-Switching (MS) and GARCH model. This MS-GARCH model is used to examine the variance (volatility) of MHPI in different economic states of boom and burst.
Developed by Gray (1996), Dueker (1997) and Klaassen (2002), the MS-GARCH model uses a concept similar to the structural break technique where it allows the underlying parameters of GARCH to change throughout the study period. A Markov chain helps to govern the switching process for MHPI's variance. Due to the nature of path dependence of the GARCH process, maximum likelihood is not feasible. To overcome this problem, Albert and Chib (1993) and McCulloch and Tsay (1994) suggest the use of a Gibb sampler, which adopts a Bayesian approach.

Therefore, this study employs the optimization method of Bayesian framework, using the Markov Chain Monte Carlo (MCMC) algorithm to solve the computational problem in the data. The MCMC includes the state variables \( S_t = p; S_{t-1} = q \) in the parameters and simulates it through Gibbs sampling. The use of the Gibbs sampling in estimating the parameters overcomes the limitations of the Markov Chain (McCulloch & Tsay, 1994). The probabilistic inference in the Gibbs sampling can handle the sophisticated problems arising from the switching regime of the house prices from boom to burst. Furthermore, the use of MCMC method with data augmentation and Gibbs sampling facilitates our estimation of the posterior mean.

The Gibbs sampling process begins with a generation of variates from each distribution of the variables (sequentially) through a stochastic substitution process. These variates are generated using the process of jointly statistical inference from a set of conditional distribution, where it uses the current values of other variables (Hormann & Leydold, 2003).

The Bayesian framework enables the incorporation of prior knowledge, which includes economic theory and previous research about all unknown parameters into the model (Rachev et al., 2008). In addition, one of the aspects of the Bayesian technique, which allows the parameters’ uncertainty to be estimated in the posterior distribution, provides useful information for our study. This is because the size of the difference between states (S1 and S2) is used to represent the existence of house price bubbles in the Malaysian housing market. The Bayesian technique works by imposing a restriction on the coefficient that is less important or requires longer lags by assuming this coefficient approaches zero. However, this assumption can be override
if there exists a strong effect from the less important or longer lags variable (Dua et al., 1996). A few studies of the housing markets have used the Bayesian technique (see Dua et al., 1996; Sam et al., 2009).

Sam et al. (2009) used a hierarchical Bayesian approach in valuation of 10 major residential complexes in Hong Kong from February 2008 to February 2009. The authors show that the valuation of the Bayesian approach outperforms other valuation techniques such as average price-per-square feet and expert assessment (Sam et al., 2009). In the US housing market, Dua et al. (1996) used a Bayesian VAR model to analyse the effect of leading indicators including home prices, the mortgage interest rate, disposable income and unemployment rate in forecasting US home sales.

Consider the following simple scalar equation for Markov-Switching GARCH in the mean model:

\[
Y_t = \beta_o + dh\sqrt{h_t} + \varepsilon_t \quad \ldots \ldots \quad \text{Mean equation (5.2.9d)}
\]

\[
h_t = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \alpha_2\sigma_{t-1}^2 \quad \ldots \ldots \quad \text{Conditional variance equation (5.2.9e)}
\]

Where \(\varepsilon_t \sim N(0, \sigma^2)\) and parameters of \(\alpha_0, \alpha_1, \alpha_2, \beta_0\). Inserting the conditional variance equation into the mean equation results in the MS-GARCH (M) model where \(\sqrt{h_t}\) is a positive volatility process which describes the conditional heteroscedasticity in the observed process of \(Y_t\). The parameterization of conditional variance in the GARCH model leads to a GARCH in mean model. This model relates time varying volatility to the expected mean equation. Hence, the analysis of the switching regime of GARCH (M) model is much more complex due to dependence of conditional mean model (equation 5.2.9d) upon the conditional variance equation (equation 5.2.9e), which was included in the GARCH (mean) model (Krone & Lastarpes, 1993). Therefore, the combination of the Markov-Switching and GARCH models allows for both volatility persistence and the probability of structural changes in the conditional variance. As mention earlier, the estimation using maximum likelihood is not feasible due to path dependence of GARCH term, thus, the Bayesian technique using a Gibbs sampling algorithm is employed.
The MS-GARCH (M) explains that the current prices of Malaysian houses depend not only on past prices but also on the risk and uncertainty in pricing the houses. Both ARCH and GARCH models help to capture the high (boom) and low (burst) market uncertainty in the Malaysian housing market.

Gibbs sampling and a Bayesian approach are used in this study. The MCMC can be defined as follows:

Consider the following equation;
\[ X_j = \left\{ h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2, \right\} \] ................................................................. (5.2.9f)

\( \lambda_i \) is probability with \( 0 < \lambda_i < 1 \)

The conditional distribution of the sample observation \( X_j \) given a value of the parameter vector is
\[ f(X_j / \theta) = \sum_{i=1}^{s} \lambda_i \varphi(X_j / \theta) \]. Denoting Pr (X) as the joint distribution on X with probabilities \( \lambda_i \) equal to 0 or 1, then X is a GARCH (M) model which follows a Markov Chain process as in equation (5.4.9a).

As discussed in the works of Gelfand and Smith, (1990) and Carter and Kohn (1994), the MCMC is used to solve the computational approach in the Bayesian technique in which the full joint posterior is obtained from iterative draws from each parameter’s conditional distribution. The Bayesian technique reports the combination of prior information (through conditional posterior distribution) and current information sample of the parameters (through the likelihood function) (Green, 1995).

However due to the difficulty in obtaining the mean of posterior distribution, the MCMC method is used. In the MCMC process, the parameters can be directly sampled from the joint posterior distribution (Odejar, 1999). To ease the difficulty in sampling the posterior mean, the MCMC process uses a Markov Chain simulation process.
The Markov Chain equation (5.2.9a) is used to stimulate $\theta$ (the parameters $\alpha_0$, $\alpha_1\epsilon_{t+1}^2$ and $\alpha_2\sigma_{t-1}^2$) to converge into a stationary distribution with $p(\theta|X)$. Consider the problem with inference in the parameter of $\theta$ and $X$ where $\theta \in \theta$ and we need to know the distribution of $p(\theta|X)$. The parameters of $\theta^l$ and $\theta^s$ are results of Markov Chain realization where $\theta^l$ converges to $\theta$ distribution (Odejar, 1999).

In this study, the $\Theta$ converges to a stationary distribution $P(\theta|X)$ using 400 iterations drawn from the Gibbs sampling through a simulation approach of the RATS software (see results output of RATs in the Appendix). The 400 iterations drawn from the data are used to find the parameters of $X = \{h_t = \alpha_0 + \alpha_1\epsilon_{t+1}^2 + \alpha_2\sigma_{t-1}^2, \}$ and then we use the fitted model to make inference.

5.3 Conclusions

This chapter explained the modelling approaches and methods used to investigate the existence of house price bubbles in the Malaysian housing market. The study uses time-series data of MHPI, income, interest rate and inflation from 1990:Q1 to 2004:Q4. The analysis in this study includes the use of both linear and nonlinear techniques to capture the existence of any house price bubbles, whereas previous studies relied strictly on only one technique or the other.

In the single equation model approach (linear technique), the MHPI is modelled with macroeconomic fundamental factors such as income, interest rate and inflation using multivariate regression (equation 5.2.1), ARCH (equation 5.2.2 and 5.2.3), GARCH (equation 5.2.4) and cointegration test of VAR (equation 5.2.6) and VECM (equation 5.2.8). In addition, the deviation or overvaluation of MHPI from its long-run equilibrium price by 30% is regarded as a house price bubble in this study.

In the switching model approach (nonlinear technique), the mean (level) and variance (volatility) of MHPI is analysed using a switching regime model of Markov-Switching (MS) technique (equation 5.2.9). A more sophisticated technique of GARCH (M) (equation 5.2.9d and equation 5.2.9e) model is employed in the MS technique (MS-GARCH), to capture the non-constant variance of MHPI.
Furthermore, the Bayesian approach of Gibbs sampler and MCMC (equation 5.2.9f) is also used to solve the computational problem in MS-GARCH estimation.
Chapter 6
Discussion of Empirical Findings and Results

“Modelling of property cycles is an area under-researched in the existing real property market literature”

(Mc Gough, 1995)

6.0 Introduction

This chapter reports the results of the housing bubble model presented in Chapter 5 and discusses the findings for the Malaysian housing market. Section 6.1 provides descriptive evidence of house price bubbles in the Malaysian housing market. The empirical results for the non-switching and switching models are described in sections 6.2 and section 6.3 respectively. Section 6.4 summarizes the empirical findings.

6.1 Evidence of House Price Bubbles in the Malaysian Housing Market

Prior to discussing at the econometric results of this study, it is worth noting the importance of analyzing the observed data series to capture any signs/indications, which may suggest the existence of house price bubbles in the Malaysian housing market. In this section, several economic indicators (i.e GDP growth rate and Malaysian lending growth rate) are compared with housing price movements in Malaysia. The MHPI figures (annual growth rate) relative to annual GDP growth rate (proxy for income) and commercial lending rate in Malaysia from 1992:Q1 to 2004:Q4 are shown in Figures 6.1 and 6.2 respectively. The two figures provide the following significant information. First, the growth of property prices in Malaysia (dotted line) is different from macroeconomic fundamental variables such as income (GDP) and mortgage lending rate by commercial banks in Malaysia, particularly in 1998 to 1999 (post 1997 Asian financial crisis period). Property prices in Malaysia outgrew real GDP in two periods (1992 and 1995) as a result of a boom in the Malaysian property market. Second, the burst in the Malaysian property prices occurred several years after the decline in income, which is lagged several quarters (see Figure 6.1), suggesting inefficiency of the Malaysian housing market to capture the real economic condition.
The property and GDP growth rates move similarly, particularly during and after the 1997 Asian financial crisis. However, in 1992:Q1 to 1998:Q1 (pre-crisis and during crisis period) both series seem to move differently. These differences, particularly during the decreasing trend in 1998 may suggest the bursting of the housing bubble which was formed (inflated) during the peak of the Malaysian housing market in 1995.

To provide descriptive evidence of the existence of housing bubbles in the Malaysian housing market, we compared the movement between MHPI and macroeconomic fundamental variables such as income, interest rate and inflation. Figure 6.3 shows the
trend of the MHPI, income, interest rates and inflation in Malaysia from 1990:Q1 to 2004:Q4.

**Figure 6.3 Malaysian House Price Index, interest rate, income and inflation**

Despite stable, upward and slow movement of the MHPI and income, interest rates and inflation seem to move in a nonlinear trend with several periods of volatilities recorded. For example, in 1994, interest rate and inflation decreased by 0.08% and 0.09% respectively. However from 1997:Q4 to 1998:Q2, both variables increased significantly and reached their highest peak (see Figure 6.3). Interest rates increased by 17.6% while inflation increased by 73.8%.

Similar upward (increasing) movement between MHPI and income are recorded throughout the sample study period. This implies a positive relationship between both series. For example, between 1990 and early 1997, Malaysian household income and house prices are reported to have grown at an average of 8.9% per annum (see Table
5.1) and 18.3% per annum (see Table 1.2) respectively. During these periods, the bubbles formed (inflated) in two sub-periods; 1990 to 1993 and 1996 to 1997. This result is consistent with the housing market theory which states that more houses are purchased when household income increases (Barot & Takala, 1998).

The similarity of movement in income and house price is also due to the near perfect elasticity between expenditure (purchasing a house) and stable income (GDP) (Kennedy & Anderson, 1994). This relationship is known as cointegration. Gallin (2003) explains that theoretically, house prices and income are linked through a stable relationship (long-run), from which each series may drift away temporarily throughout the period. Thus, house price and income will have a tendency to return to their long-run equilibrium relationship price (Gallin, 2003). This explanation supports the consistency in the behavior of MHPI and income in Malaysia with housing market theory and other studies.

Figure 6.3 provides some information on the behavior of MHPI and macroeconomic fundamentals such as interest rate, income and inflation, but it is insufficient to draw conclusive evidence about the existence of house price bubbles in Malaysia. Hence, the main objective of this study is to examine and confirm statistically whether the Malaysian housing market experienced housing price bubbles between 1990:Q1 to 2004:Q4.

Therefore, further analysis of the data is required using a range of econometric methods. This includes simple methods of multivariate regression and cointegration tests to the application of more sophisticated techniques of Generalized Autoregression Conditional Heteroskedasticity (GARCH), and Autoregression Conditional Heteroskedasticity (ARCH) models. This study examines the relationship between the endogenous variable of MHPI and the driving variables of macroeconomic fundamentals such as interest rates, income and inflation in a non-switching model (see section 6.2).

In the switching model, (see section 6.3) the house price is modeled in two different approaches. The first approach determines the MHPI in the mean model with fundamental variables of income, interest rate and inflation using the Markov-
Switching technique (MS). The second approach analyzes the variance of MHPI using a combination of the GARCH model and Markov-Switching (MS) technique (MS-GARCH technique) without the macroeconomic fundamental variables.

6.2 Results of Non-Switching Model

6.2.1 Multivariate Regression

The estimated results of the multivariate regression using equation (5.2.1) are presented in the Appendix 1 and yielded these estimates:

\[ H_{sg, t} = \beta_0 + \hat{\beta}_1 H_{sg, t-1} + \hat{\beta}_2 Inc + \hat{\beta}_3 Intr + \hat{\beta}_4 Inf + \epsilon_t \]  
(5.2.1)

\[ H_{sg, t} = 10.521 + 0.9653 H_{sg, t-1} - 0.04183 Inc - 0.1674 Intr - 2.28 Inf \]

(0.000)  (0.3052)  (0.3984)  (0.0431)

The values in brackets represent the p-values.

All variables have the hypothesized signs except for income, which has a negative coefficient (-0.4183) and is clearly statistically insignificant. This result is inconsistent with other findings, which report a positive relationship between house price and income (see Chen & Patel, 1998; Giussani & Hadjimatheo, 1991). The negative relationship between income and house prices in Malaysia may be due to the non-complementary consumption of other goods with housing consumption. According to Kole and Martin (2009), a house price will only increase if consumption of both goods and houses is complementary. This result indicates that for Malaysian people, buying a house is as important as buying other goods. Moreover, the relationship between house price and income is not well established by the specification in OLS due to the differences in house price appreciation and income growth recorded in Malaysia. According to Kole and Martin (2009), the relationship between income and house price is efficiently captured if the estimation uses a different size for the increase in house price and income growth. Therefore, we may conclude that the decision to purchase a house is not mainly influenced by the increase or decrease in the Malaysian household income. This may also be due to the higher amount of mortgage loans (i.e 90% to 95%) offered by bank and financial institutions in Malaysia. As for the 1.2 millions government servants in Malaysia (Ministry of
Human Resources, Malaysia, 2010), mortgage financing is 100% including stamp
duty and lawyer fees (Ministry of Housing and Local Government of Malaysia, 2010).

The estimated coefficient for short-term interest rate is negative (-0.1674) and is not
statistically significant even at 10% significance level. This result is consistent with
Chen and Patel (1998) study, where the use of short-term interest rate is more
efficient in capturing investment demand for houses. The investment demand for
houses are from investors and speculators who intended to sell their housing
investment during the booming market for capital gain (Chen and Patel, 1998). For
Malaysia, the demand for housing is more for owners to occupy and less for
investment purposes. This is consistent with the condition of the Malaysian housing
market in 1991 which are predominantly, owners occupied (Cruz, 1998). Therefore,
this causes short-term interest rates to exhibit less significance in capturing the
relationship between housing prices and the demand for houses in Malaysia. This
finding also helps to exclude the existence of speculative bubble from this study and
supports the contention that Malaysian people are not influenced by the changes in
short-term interest rate since they have less intention to move or sell their houses in
the near future, due to factors such as financial constraints (Maki, 1993) and liquidity
constraint (Stein, 1995).

The negative relationship between interest rate and house price in Malaysia is
consistent with previous studies in the housing market which state that higher interest
rates cause liquidity problems for households, leading to a decrease in housing
demand (Follain, 1982). The increase of lending rate in Malaysia from 8.9% in
1996:Q4 to 10% in 1997:Q4 (Perkins & Woo, 2000) caused housing demand to
decrease. The decrease in housing demand was caused by tight mortgage financing
imposed by financial institutions which consequently reduced the money flowing to
the real estate market and increased mortgage payments for borrowers (Wong et al.,
2003). For example in September 1998 (during the 1997 Asian financial crisis), the
amount of loans channeled into Malaysian housing sectors amounted to RM9 million,
a significant drop from the highest peak of RM20 million in 1997 (Bank Negara
Malaysia, 2000) (see Figure 2.5). During this period, the interest rate was reported to
be at its highest peak of 11% in 1998:Q2 while the MHPI is decreased with a 99.76
index points.
The estimated coefficient for inflation is negative (-2.28) and statistically significant at 10% significant level. This result implies that Malaysian house prices are sensitive to inflation and the inflationary signal of a future increase in asset prices influences the buying decision of Malaysian people, particularly when purchasing expensive assets such as houses. This result also implies that the decrease in inflation may be perceived as a permanent decrease in the real rates of inflation. As a result, the demand for housing increases leading to higher prices at unsustainable levels, thus causing a bursting of the house price bubble. Furthermore, this shows that the demand for houses in Malaysia is based on expectations about future prices of houses. This is consistent with the underlying theory of stock-flow, which explains that the short-run demand for houses depends on the expected future prices of houses and other relevant economic variables (DiPasquale & Wheaton, 1996).

The inconsistency in some of the results obtained from the OLS estimation may suggest that the OLS estimators are biased and non-convergent due to the used of lagged dependant variables \((H_{sg_{t-1}})\) regressor as suggested by Lecat and Messonnier (2005). Therefore, to avoid any spurious results from the OLS estimation, the Breusch-Godfrey serial correlation LM test and the Bresuch-Pagan test of heteroskedasticity have been applied. These two tests help to determine any possible correlation and endogeneity in the variables. The results are summarized in Table 6.1 (see detail of Table 6.1 in the Appendix 1)

<table>
<thead>
<tr>
<th>Breusch-Godfrey Serial Correlation LM test</th>
<th>(NR^2 = 38.41[0.000])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heteroskedasticity test: Breusch-Pegan-Godfrey</td>
<td>(NR^2 = 14.88[0.005])</td>
</tr>
</tbody>
</table>

* Values in [ ] are p-values

The results in Table 6.1 indicate that in both tests, the null hypotheses of no autocorrelation (BG test) and no heteroscedasticity (BPG test) are rejected. The rejection of both hypotheses suggests the possible presence of the AutoRegression Conditional Heteroscedasticity (ARCH) effect or serial correlation in the Malaysian housing market, since the residual variance is not constant (heteroscedasticity). The
existence of serial correlation in the Malaysian house price is consistent with previous literature which tested the Efficient Market Hypothesis (EMH) in the housing market. According to Cho (1996), in the short-run house prices display a positive serial correlation which implies that the housing market is not an efficient market. Therefore, our result suggests that in the short-run, house price in Malaysia is not efficient due to its dependency on past information and trends. The inefficiency of the Malaysian housing market is due to the use of backward looking expectation or adaptive expectation hypothesis (AEH) in estimating the future price of houses.

Hence, further analysis on the residual is carried out using the ARCH test. Using the starting values from the OLS estimation, the ARCH is using Eviews 6 software. The objective of using the ARCH model is to test the null of no serial correlation in the squared residuals or ARCH effects. Table 6.2 presents the result of the ARCH effect on Malaysian house prices (see detail of Table 6.2 in the Appendix 1).

Table 6.2 ARCH test on Malaysia house price

| Obs*R-squared | 11.44518 | Prob. Chi-Square(4) | 0.0220 |

The result in Table 6.2 implies that the null hypothesis of no ARCH effect on the Malaysian house prices is rejected at 5% significant level. This shows that the current variance of the residual $\varepsilon_t$ does depend on the previous period of the residual $\varepsilon_{t-1}$. This ARCH test result also suggests that the price of houses in Malaysia may possibly be determined using adaptive expectation hypothesis (AEH) where buyers and sellers estimate the market price of a house using past information and historical trends in house prices. Therefore, it can also be concluded that the backward looking expectation or AEH can play an important role in determining the future price of houses in Malaysia.

The ARCH effect exists when the variance residuals occur in clusters (Engle, 2001). For example, in the Spanish housing market, a strong linear dependency and heteroscedasticity (volatility clustering) is displayed throughout the boom and burst cycles of the housing market (Guirguis et al., 2007).
Figure 6.4 shows the plots of MHPI standardized residual. This figure is particularly informative as it shows a certain amount of white noise and the movement of residual in four different clusters: 1990 to 1993; 1993 to 1997; 1997 to 2001 and 2001 to 2004. Among these clusters, the 1997 to 2001 period seems to decrease severely (see Figure 6.4).

Figure 6.4 Standardized residuals of Malaysian house price index from 1990 to 2004

Analysis of the plots in Figure 6.4 shows that there are changes in the variance of the residuals during the expansion (boom) and contraction (burst) period in the Malaysian housing market. This finding is similar to Engle’s (1982) study who suggests that as a result of unpredictable events occurring in the real estate market house price volatility displays a clustering effect.

**6.2.2 Generalized Auto Regressive Conditional Heteroscedasticity (GARCH) Model in the Malaysian Housing Market**

In order to obtain statistically reliable results, a GARCH (1, 1) process was applied to the residual producing a result based on equation (5.2.4). The GARCH (1, 1) model allows us to estimate the influence of past variance (volatility) on Malaysian house prices. In the GARCH (1, 1) model, the forecast variance, which was based on the previous term, is included in the current variance term (see equation 5.2.4).

The result of the GARCH (1, 1) (see Appendix 1) consists of two parts: the mean equation (ARCH terms) derived from equation (5.2.3) and the GARCH term derived...
from equation (5.2.4). The result of ARCH reports on the volatility observed in the previous period, measured by the lagged square residuals \( (e_{t-1}^2) \) and the GARCH term estimate, the lagged variance forecast.

\[
H_{sg,t} = 10.778 + 0.836h_{sg,t-1} + 0.074Inc - 0.0359Intr - 2.230Inf
\]

(48.94) (3.904) (−0.370) (−3.721)

\[
\sigma_t^2 = 0.1446 + 1.3050e_{t-1}^2 - 0.0133\sigma_{t-1}^2
\]

(2.692) (−0.0817)

* Values in ( ) represent t-stats

By allowing the GARCH effects into equation (5.2.4), the estimated results in Table 6.5 improved statistically with all the macroeconomic fundamental variables such as income, interest rates and inflation prove to be statistically significant even at 1% significance level. The inflation coefficient estimated by the GARCH model (2.230) is slightly similar to the OLS estimation (2.28). Therefore, based on the OLS and GARCH estimation, we can possibly conclude that inflation is the most significant and influential macroeconomic fundamental factor affecting the Malaysian house price.

The result also shows that income (GDP) coefficient has a positive relationship with the Malaysian house price, which is consistent with other studies (see Gauger & Snyder, 2003; Green, 1997). Moreover, this result shows that income factor only moves in similar direction with the Malaysian house price with the inclusion of past information and trends in the GARCH equation. The different movement in the MHPI variance, which is measured by the GARCH term, implies the existence of time-varying heteroskedasticity. This finding suggests that Malaysian house prices move in nonlinear ways throughout the study period, thus confirming the possible existence of house price bubbles in the Malaysian housing market.

Consistent with the findings of Abraham and Hendershott (1996), the negative coefficient on interest rates in the GARCH (1, 1) model indicates that appreciation rates of house prices in Malaysia are inversely related to the increase in interest rates (see detail result in Appendix 1). The interest rate also shows less relationship with MHPI with the smallest coefficient of -0.0359, compared to other macroeconomic
fundamental variables such as income and inflation. The negative relationship between MHPI and interest rate may be due to the smaller impact of interest rate in terms of transaction cost, on the Malaysian housing market. This may be due to the high rate of homeownership recorded in Malaysia (in 1991, 85% were homeowners) which is consistent with Thomsett and Kahr’s (2007) argument that transaction costs are not significant for a housing market which is dominated by homeowners.

Although the results of GARCH model in this study are consistent and significant for all of the variables tested, two conditions of the GARCH model are being violated. These conditions are that the GARCH coefficient must not equal a negative value and the sum of the coefficient must not exceed one. However in this study, the coefficient of the GARCH term was negative (-0.0133) and the sum of the coefficient was more than one. Furthermore, the results of GARCH only provide information about the significance of volatility with respect to the lagged information (historical) of house prices. Any changes or shift in the volatility (higher or lower in different economic states) is not captured in the GARCH. For these reasons, the GARCH term was omitted and equation 5.2.4 was re-estimated with a simpler ARCH (1) model as follows:

\[
H_{s_t} = 10.2168 + 0.8996 H_{s_{t-1}} + 0.01819 Inc - 0.1252 Intr - 3.2686 Inf \\
\sigma_t^2 = 0.0557 + 1.6760 \epsilon_{t-1}^2
\]

\[
(55.30) \quad (1.1129) \quad (1.989) \quad (-7.514)
\]

\[
(3.1072)
\]

Values in ( ) represent t-stats

Omitting the GARCH term from the conditional ARCH (1) equation results in a significant change for all the parameters. The interest rates and inflation are significant at 1% level. Although the income variable seems to produce a less significant result, the coefficient value of 0.018 shows a correct sign of positive value, which is consistent with other housing market studies (see Case & Shiller, 2003; Muellbauer & Murphy, 1997).
6.2.3 The Cointegration Relationship between Malaysian House Price Index (MHPI) and Macroeconomic Fundamentals (income, interest rate and inflation)

In testing for cointegration relationship, the data are tested for stationary using the Augmented Dickey Fuller Test (ADF). The ADF test is carried out to eliminate any spurious regression problem in our time series (MHPI, income, interest rate and inflation) and determine the order of integration of all the data. Table 6.3 reports the ADF test results for levels and first differences. The results show that all variables are nonstationary in levels but are stationary at their first differences or integrated of order one, denoted by I(1), at 10% significance level.

Table 6.3 Augmented Dickey-Fuller (ADF) Unit Root Test Results

<table>
<thead>
<tr>
<th>Variables</th>
<th>LEVEL</th>
<th></th>
<th>FIRST DIFFERENCE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADF t-stat</td>
<td>P-value</td>
<td>ADF t-stat</td>
<td>P-value</td>
</tr>
<tr>
<td>MHPI</td>
<td>-1.4754</td>
<td>0.5389</td>
<td>-2.6845</td>
<td>0.0828</td>
</tr>
<tr>
<td>Income</td>
<td>-0.6530</td>
<td>0.8494</td>
<td>-3.747</td>
<td>0.0059</td>
</tr>
<tr>
<td>Inflation</td>
<td>-1.36097</td>
<td>0.5947</td>
<td>-5.7640</td>
<td>0.0000</td>
</tr>
<tr>
<td>Interest rates</td>
<td>-1.818</td>
<td>0.03678</td>
<td>-6.1467</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

Note: Lag Length: Eviews 6.0 based on Hannan-Quinn Criterion with Maximum Lags of 4

Since all the series are integrated of the same order, there may be a long-run relationship among variables, in which case they are said to be cointegrated. The variables are cointegrated with each other. To confirm cointegration among the variables, this study employed the Johansen and Juselius test (1990) for all variables. The cointegration tests are conducted with the VAR model followed by VECM for long-run relationship. The VAR model is used to determine the number of cointegrating relationships among the series. Although the main focus of this study is to examine the existence of a bubble in the Malaysian housing market, further analysis on market efficiency is conducted using the VECM results.

The choice of lag is important in developing significant before estimating the VAR model. As previously explained, there are numerous model selection criteria to be used in choosing lag length. Table 6.4 shows that the majority of the selection criteria
(except for Loglikelihood) select two lags. According to Belke et al. (2008), the two lags for VAR are considered quite ‘sufficient to avoid any serial correlation among the residuals’ (p.16). Following most researchers who used Aikakie information criterion in selecting the VAR lag length (see Braun & Mittnik, 1993; Diebold et al., 1994; Ventzislar & Lutz, 2005) this study chooses two lag-lengths for the VAR model specification in this study.

<table>
<thead>
<tr>
<th>Number of lags</th>
<th>Loglike</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-523.2095</td>
<td>NA</td>
<td>923.4828</td>
<td>18.17965</td>
<td>18.32175</td>
<td>18.23500</td>
</tr>
<tr>
<td>1</td>
<td>-281.6043</td>
<td>441.5547</td>
<td>0.386879</td>
<td>10.40015</td>
<td>11.11065</td>
<td>10.67690</td>
</tr>
<tr>
<td>2</td>
<td>-240.2580</td>
<td>69.86104*</td>
<td>0.162795*</td>
<td>9.526138*</td>
<td>10.82503*</td>
<td>10.02429*</td>
</tr>
</tbody>
</table>

* indicates lag order selected by criterion

In this study, the restriction imposed in the VAR model lead to the formation of a Vector Error Correction Model (VECM). The VECM is a VAR in first differences, plus a vector of cointegrating residuals. Prior to estimating the VECM, following the Johansen and Juselius (1990) procedure we employ the Trace Test ($\lambda_{\text{trace}}$) and Maximum-Eigenvalue Test ($\lambda_{\text{max}}$) in selecting an appropriate model and lags to be used for VECM. The results for model selection (see Table 5.2) are shown in Table 6.5.

<table>
<thead>
<tr>
<th>Model</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Trend:</td>
<td>None</td>
<td>None</td>
<td>Linear</td>
<td>Linear</td>
<td>Quadratic</td>
</tr>
<tr>
<td>Test Type</td>
<td>No intercept</td>
<td>Intercept</td>
<td>Intercept</td>
<td>Intercept</td>
<td>Intercept</td>
</tr>
<tr>
<td>Trace</td>
<td>No trend</td>
<td>No trend</td>
<td>No trend</td>
<td>Trend</td>
<td>Trend</td>
</tr>
<tr>
<td>Max-Eig</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

** Critical value based on Osterwald-Lenum (1992)

Based on the results, we can see that Model (1) and Model (5) are not considered realistic because no deterministic trend is imposed on the cointegration data (Model 1) and a quadratic trend is imposed on the level (Model 5). Neither model is reliable for testing financial and economic time-series data which contain both deterministic
trends (intercept and trend) and stochastic trends (Harris, 1995). Therefore, Model (4), which has both the intercept and trend (deterministic component) in the equation, was selected. Thereafter, the speed of adjustment of the VECM is computed to determine any deviation of house prices from actual market values (see Figure 6.5). As shown in Model 4, there is one (1) cointegration vector. This implies the presence of a single cointegrating vector with 1 lag to be use in estimating the VECM.

If, according to the cointegration test criteria, there is no cointegration amongst the series, then the Vector AutoRegression (VAR) model is indicated. In the present case, however, the selection of Model 4 suggests that the VAR model is not appropriate for our data.

Theoretically, bubbles exist in house prices when the housing market is not efficient and there is a deviation in the house prices from their long-run fundamentals. However, in the real estate market efficiency theory, house prices will adjust to the economic shock quite quickly when it is an efficient market. Hence, the estimation of the VECM should produce a value of 1 for the $\gamma$ and 0 for the $\alpha$ if the housing market in Malaysia is perfectly efficient. Thus, the value of $\alpha$ for our study is -3%, which is not equal to 0. This indicates that the Malaysian housing market is not efficient and there is a deviation in house prices from its long-run fundamentals values, possibly resulting in house price bubbles.

A further test was conducted on the VECM model by restricting the error correction parameters to test for the weak exogeneity income, interest rates and inflation. That is we test the weak exogeneity (with respect to the long-run equilibrium parameter) by imposing restriction adjustment parameters for the income, interest rate and inflation adjustment equations, then these restrictions jointly against the unrestricted VECM model with a $\chi^2$ test statistic. Non rejection of these restrictions indicates that the VECM model can be reduced to a single-equation error correction model for housing price, conditional on the other 3 explanatory variables.
Table 6.6 reports the result of the restricted model of the VECM obtained from the Eviews 6.0 software (see Appendix 1). The test statistic has a value of $\chi^2 = 8.056$ with a p-value of 0.0449 which would indicate rejection of the null hypothesis of weak exogeneity. However, the null is only just rejected, and the restricted long run equilibrium parameters are estimated much more efficiently, so we retain the restricted model. Table 6.6 is the scalar form of the restricted VECM.

**Figure 6.6 Long-run equilibrium coefficients for VECM**

\[
H_{sg, t} = -20.746 + 5.238 Inc_t - 39.585 Intr_t + 154.16 Inf_t - 7.313 T \\
(-1.823) (3.718) (-2.4669)
\]

Values in ( ) represent t-stat

Based on the restricted VECM result, the magnitude of the signs and the estimated long-run coefficients of income, interest rates and inflation displayed consistency with other findings in the housing market studies (see Ashworth & Parker, 1997; Muellbauer & Murphy, 1997).

The inflation coefficient, which displays a positive relationship with MHPI, proves to be a highly influential macroeconomic fundamental variable in the Malaysian housing market. This result is consistent with the findings of Dougherty and Van Order (1982), and Poterba (1984) which suggest that inflation increases the demand for owner-occupied houses. The authors suggest that inflation reduces the after-tax user cost of homeownership which in turn increases the demand for owner-occupied houses. According to their conclusions, inflation stimulates housing demand since it reduces the effective cost of homeownership and raises the tax subsidy to owner occupation. Higher inflation rates not only raise the homeowner’s mortgage payments by increasing the nominal interest rates but also result in higher nominal capital gains on houses.

In Malaysia, due to larger number of homeowners, people are more concerned about a future increase in house prices which could affect their purchasing power, increase their credit risk and depress their consumption. This emphasis on the inflation
variable and knowledge of the significant impact caused by the increase of inflation in the economy imply that Malaysians process information about the housing market in a rational manner. This result also indicates that the inflation variable is a reliable factor to use in monitoring Malaysian expectations about future increase in house prices. The estimated coefficient for income variable (GDP) is positive (+5.238) and statistically significant. This coefficient is the smallest value among other macroeconomic fundamental variables used in this study. This result is consistent with other studies which showed income to be positively related to house price in the long-run (see Chen & Patel, 1998; Giussani et al., 2005). The smallest coefficient of income implies that it has the least amount of influence on the movement of Malaysian house prices. People have been less willing to upgrade their houses and larger residential assets have become less affordable particularly after the 1997 Asian financial crisis. Factors such as easy credit (Quigley, 1999) and high affordability ratio (Cruz, 2008) may possibly cause Malaysian people with lower income to have access to mortgage financing without the need of increased in the income. This result suggests that the income variable tend to be less important in determining house prices in Malaysia. A similar result of a positive and significant coefficient for income was also reported in Malpezzi and Mayo (1997) study on the Malaysian housing market and tax effect on homeowners.

The estimated interest rate coefficient is statistically significant (39.585) and negatively related to the Malaysian house price. This result implies that housing demand in Malaysia is affected by the interest rate (mortgage rate) offered by financial institution and banks in Malaysia. Prior to the 1997 Asian financial crisis, the base lending mortgage rate in Malaysia was 6.83% (in 1994) which was one of the lowest rates after Singapore (5.34% in 1993) and Hong Kong (6.5%). A report by Bank Negara Malaysia also shows a significant decrease in the base lending rate from 11% in 1998 to 5.98% in 2004. When the interest rate decreased, housing demand in Malaysia increased due to the lower cost of mortgage financing. This contributed to higher number of loans distributed to the property market in Malaysia (see Figure 2.5).
6.2.3 a) Elasticity

This study also employs the above results to discuss on the ‘efficiency’ in the Malaysian housing market. The calculated efficiency of housing price in relation to income, interest rate and inflation uses the coefficient estimation from the VECM (see equation 5.2.8a). Table 6.5 shows the results of the elasticities computed at the mean values of the variables. Analysis of price elasticity indicates a different dynamic pattern of adjustments displayed by the macroeconomic fundamental variables with regard to the Malaysian house price.

Table 6.5 Elasticities of the Malaysian house price in relation to mean income, interest rates and inflation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Calculation of elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income (Gdp)</td>
<td>$5.238 \times (85.31/90.444) = 4.9406$</td>
</tr>
<tr>
<td>Interest rates</td>
<td>$-39.585 \times (5.599/90.444) = -2.45$</td>
</tr>
<tr>
<td>Inflation</td>
<td>$154.16 \times (0.728/90.444) = 1.24$</td>
</tr>
</tbody>
</table>

The price elasticity between Malaysian house price and income implies that a 1% increase in the Malaysian household income can cause an increase of 4.94% in the Malaysian house price. This result shows that houses in Malaysia are becoming less affordable for most households which may be a result of higher housing construction costs. For example in the urban areas in Malaysia such as Damansara, residential property is reported to valued between RM500,000 (terraced houses) and RM1 million (semi-detached and bungalows). In addition, the higher price elasticity of house price relative to income may be caused by the increased number of houses bought by Malaysians. In an earlier discussion (see Chapter 2), Malaysia is reported to have high homeownership and one-third of Malaysian household incomes are use to pay the home mortgage (Mar Iman, 2002). These factors possibly contribute to the high sensitivity of the Malaysian house prices in response to the changes in income variable.

Previous studies of housing price-income elasticity can be found in Mayo, 1981; Ingram, 1984; Malpezzi and Mayo, 1985. In the US housing market (a developed country), the housing price-income elasticity is estimated to be between 0.55 to 1.63
(Mayo, 1981). Hence, the differences in housing price-income elasticity in Malaysia (4.94%) compared to the US may be due to high homeownership in the Malaysian housing market.

The elasticity between interest rate and MHPI is -2.45. This result implies that a 1% increase in the 3-month interest rates caused the MHPI to decrease by 2.45 index points. This result suggests that the short-term interest rate is quite elastic in response to changes in the Malaysian housing price. The low interest rate caused a decrease in the mortgage-financing cost leads to an increase in house price due to the higher demand for houses (Thomsett & Kahr, 2007). This is consistent with previous studies, which found that interest rate contributes to a significant impact on the movement of house prices in the US (Hendershott, 1991) and Paris (Roehner, 1999).

The elasticity of housing price to inflation shows that inflation is the least elastic macroeconomic variable to respond to the changes in Malaysian house prices. For example, a 1% increase in price level (inflation) only caused the MHPI to increase by 1.186 index points (see table 6.5). As mentioned previously, housing is considered a necessity and the majority of the Malaysian people buy houses to live in not for speculative purposes. Furthermore, Dougherty and Van Order (1982) and Poterba (1984) found that inflation stimulates demand for housing due the decrease cost of homeownership. Therefore, the increase in house prices through inflation does not prevent people in Malaysia from purchasing houses.

**6.2.3b) Efficiency in the Housing Market**

According to DiPasquale and Wheaton (1994, 1995), the housing market takes several years to completely incorporate changes in the market. However, in the stock market, the adjustment process occurs immediately. Case and Shiller (1989) explain that the inefficiency of the housing market is due to the illiquidity characteristic caused by high transaction cost.

In this study, the efficiency of the Malaysian housing market is analysed by observing the speed of adjustment factors obtained from the VECM estimation result (see Appendix 1). The coefficient value of \( \alpha \), which determined the speed of adjustment,
is 0.014. This implies that, for each quarter, the Malaysian house price is adjusting slowly to the equilibrium price by 1.4%. Therefore, it can be concluded that the estimated parameter of $\alpha$ result implies that the Malaysian housing market is not an efficient market due to the slow adjustment towards market equilibrium price. The result of this slow adjustment in Malaysian house prices is consistent with the illiquid characteristic of the housing market which causes a slow reaction to economic shocks (see Case & Schiller, 1989; DiPasquale & Wheaton, 1994, 1995). The rate of $\alpha$ adjustment in house price also differs depending on whether the expectation of future economic condition changes (Warnock & Warnock, 2008). The Malaysian housing market, which mostly consists of homeowners, is inefficient since house prices respond slowly to changes in economic conditions such as expansion or recession.

Other possible factors that contribute to the slow adjustment of Malaysian house prices to real economic conditions is the inexperience of buyers and sellers which tends to follow the market trend without having knowledge about the real condition of the Malaysian housing market. In addition, the increase in house price, caused by bubbles (inflated) is offset by an increase in the opportunity cost of housing. As a result, homeowners in Malaysia cannot sell their houses as suggested in Paiella (2007) study. According to Chen and Patel (1998), the changes in prices caused by economic shocks do not encourage homeowners to sell off their houses because of the high acquisition cost involved. Furthermore, other researchers (see Campbell & Cocco, 2004; Sinai & Soules, 2005) state that the fluctuations in house price will not affect homeowners who expect to stay in their current houses (Attanasio et al., 2005).

In conclusion, the application of Johansen and Juselius’s (1990) cointegration test helps to determine the cointegration relationship between MHPI, income, interest rate and inflation. In addition, the results of the VECM show that the MHPI is positively related to income (GDP) and inflation and negatively related to interest rates. A similar finding is reported in terms of elasticities (see Table 6.5). The Malaysian housing market is also found to be inefficient as the result of the slow adjustment of house prices to the changes in economic conditions in Malaysia. In this study, the adjustment of MHPI, which is represented in the error correction term, shows a negative coefficient. This implies that the short-run increase in house prices could not improved investment spending (Warnock & Warnock, 2008).
6.2.3c) House Price Equilibrium (Evidence of Housing Bubble)

Gui (2009) explains that many researchers attempt to examine house price bubbles by addressing the difference (gap) between the real house price and its fundamental values. The gap between these two factors can be used to indicate whether house prices are above or below their equilibrium values. The most common method used to examine the short-run dynamics of house price in adjusting to the long-run equilibrium price is the Vector Error Correction model (VECM). Furthermore, the VECM can also be used to examine the adjustment process (time taken) for house price to adjust to equilibrium price.

The solid line in Figure 6.8 is the equilibrium price based on fundamental variables such as income, interest rates and inflation, whereas the dotted line represents the actual or real house prices in Malaysia (MHPI). The deviation of real estate prices from fundamental values can be either positive or negative (Tse, 1997). As discussed previously, the amount of deviation of MHPI from equilibrium price by more than 30% is an indication that a house price bubble has formed. In Figure 6.8, the boom periods in the Malaysian housing market are identified by increasing house prices which typically consist of a negative deviation (see Table 6.6).

According to Figure 6.8, the difference between real house prices in Malaysia and the equilibrium house price is in the fluctuation or volatility of the series. The equilibrium house price is more volatile throughout the study period. This may be due to the
significant changes in macroeconomic fundamental variables as they react to the different economic conditions of boom and burst.

Thomsett and Kahr (2007) explain that the larger gap between the house price and its equilibrium long-run fundamentals signal the possible existence of a bubble. According to Thomsett and Kahr (2007), the price of bubble asset is above its fundamental value due to the expectation of future increase in asset price. This implies that bubbles can be associated with the Ponzi type behaviour. Minsky (1982) describes Ponzi behaviour as people or agents, engages in transaction with large amount of debt in expectation for higher profit to repay the debt when they are due.

There are several features in Figure 6.8 which capture the existence of house price bubbles in the Malaysian housing market. Table 6.6 summarizes the results based on the movement between real house prices in Malaysia and the equilibrium house price as illustrated in Figure 6.8.

**Table 6.6 Comparison between real house prices and long-run equilibrium house price in Malaysian housing market from 1990:Q1 to 2004:Q4**

<table>
<thead>
<tr>
<th>Period</th>
<th>Malaysian housing market condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990:Q1 to 1993:Q2</td>
<td>Hsg <strong>lower</strong> than $H_{sg_e}$ **</td>
</tr>
<tr>
<td>1992:Q3 to 1993:Q2</td>
<td>Hsg <strong>higher</strong> than $H_{sg_e}$ ***</td>
</tr>
<tr>
<td>1993:Q3 to 1996:Q1</td>
<td>Hsg <strong>lower</strong> than $H_{sg_e}$ **</td>
</tr>
<tr>
<td>1996:Q2 to 1999:Q2</td>
<td>Hsg <strong>higher</strong> than $H_{sg_e}$ *** (Existence of house price bubble)</td>
</tr>
<tr>
<td>1999:Q3 to 2000:Q1</td>
<td>Hsg <strong>lower</strong> than $H_{sg_e}$ **</td>
</tr>
<tr>
<td>2000:Q2</td>
<td>Hsg <strong>higher</strong> than $H_{sg_e}$ ***</td>
</tr>
<tr>
<td>2000:Q3 to 2001:Q1</td>
<td>Hsg <strong>lower</strong> than $H_{sg_e}$ **</td>
</tr>
<tr>
<td>2001:Q2</td>
<td>Hsg <strong>higher</strong> than $H_{sg_e}$ ***</td>
</tr>
<tr>
<td>2001:Q3 to 2004:Q4</td>
<td>Hsg <strong>lower</strong> than $H_{sg_e}$ **</td>
</tr>
</tbody>
</table>

* Hsg is real house prices in Malaysia and $H_{sg_e}$ is the long-run equilibrium house price
** House prices in Malaysia are undervalue
*** House prices in Malaysia are overvalue
The boom periods are identified by episodes in which the real house price in Malaysia, (proxy by MHPI) is below the long-run equilibrium price in five sub-periods (see Table 6.6 and Figure 6.10). During these periods, the Malaysian housing market is booming due to the relaxation of mortgage financing. This is evident from the increased in mortgage loans distributed during these periods (see Figure 2.4). Furthermore, during these periods, houses are considered to be affordable (undervalue) because of the oversupply of houses by developers. For example in Penang, an oversupply of condominiums of more than 600% is recorded between 1995 and 1996 (Gen, 2000). This suggests that more residential stock is supplied and available during the boom of the Malaysian housing market.

**Figure 6.8 Evidence of house price bubbles in the Malaysian housing market**

![Figure 6.8](image)

Figure 6.6 shows the long–run movement of Malaysian house prices from market value using equation (5.4.9). In the long-run, the oversupply of housing in Malaysia caused house prices to decrease in the subsequent periods (see Table 6.7). As a result, a boom and burst process exists in the Malaysian property cycles. The booming of the Malaysian property market starts in the early 1990s. In Figure 6.10, the excess price over the zero line shows possible signs of bubbles in the Malaysian housing market. The plot of excess price in the long-run appears to be in the increasing trend during the boom period of 1990 to 1993. From 1997 to 1998, the significant excess in house price from its long run equilibrium supports the existence of house price
bubbles in the Malaysian housing market (see Figure 6.4 and Table 6.11). In 1997:Q1, the house price in Malaysia exceeded its long run equilibrium price by 50.68% and the size of deviation increased to 92.46% in 1998:Q2. The deviations from this long-run relationship occur in the short-run as Malaysia house prices started to revert slowly to their equilibrium price in the aftermath of the 1997 Asian Financial crisis (see Figure 6.3 and Table 6.7).

From 1997:Q1 to 1998:Q2, the Malaysian economy was unstable as a result of the 1997 Asian financial crisis. The similar movement of the Malaysian property cycles (boom and burst) with economic cycles (expansion and recession) in Malaysia is consistent with other studies which have found an interrelationship between property cycles and economic cycles (see Davis & Zhu, 2009; Herring & Wachter, 2004).

As discussed earlier, house price bubbles in Malaysia exist when the deviation of the real house price is more than 30% from its long-run equilibrium price. Therefore, the evidence for the existence house price bubbles in the Malaysian housing market is captured in 1997:Q1 and 1998:Q2.

Prior to the 1997 Asian financial crisis, house prices in Malaysia were undervalued for an average of two years. In the post-crisis period, house price were undervalued for shorter period of three to nine months (see Table 6.6). This demonstrates the possible impact of the 1997 Asian financial crisis, which increased the adjustment process of Malaysian house prices towards the long-run equilibrium price. In addition, the less noise-trading (speculators) and the successful steps and policies taken by the Malaysian government in stabilizing house prices after the 1997 Asian financial crisis may have resulted in a shorter period of adjustment in the Malaysian housing market. The policies taken by the Malaysian government include capital control in 1994 and 1998, a homeownership campaign (12th December 1998 to 12th January 1999), the introduction of CAGAMAS and Danaharta and relaxation of several policies which governed the Malaysian housing market (see section 2.6).

Table 6.7 summarizes the periods of overvalued and undervalued for the Malaysian house price from its long run equilibrium price with 56 numbers of observations. Apparently, there are two periods which indicate possible existence of housing
bubble; 1997:Q1 (50.68%) and 1998:Q2 (92.46%). This result implies that during these two periods, the house prices in Malaysia do not reflect the underlying values (market value). Therefore, any buying decision made based on the distorted house price will be inefficient. This is because bubbles can cause ‘capital overhang’ and excess consumption due to inefficient investment in the overvalued assets (Thomsett and Kahr, 2007).
Table 6.7 Percentage deviation of the Malaysian house price from its' long-run equilibrium price

<table>
<thead>
<tr>
<th>Period</th>
<th>% of deviation</th>
<th>Period</th>
<th>% of deviation</th>
<th>Period</th>
<th>% of deviation</th>
<th>Period</th>
<th>% of deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990:Q3</td>
<td>-2.54</td>
<td>1994:Q4</td>
<td>-1.80</td>
<td>1999:Q1</td>
<td>27.28</td>
<td>2003:Q2</td>
<td>-60.00</td>
</tr>
<tr>
<td>1990:Q4</td>
<td>-2.34</td>
<td>1995:Q1</td>
<td>-0.94</td>
<td>1999:Q2</td>
<td>-12.95</td>
<td>2003:Q3</td>
<td>-77.09</td>
</tr>
<tr>
<td>1991:Q1</td>
<td>-1.94</td>
<td>1995:Q2</td>
<td>-1.38</td>
<td>1999:Q3</td>
<td>-13.02</td>
<td>2003:Q4</td>
<td>-0.84</td>
</tr>
<tr>
<td>1991:Q2</td>
<td>-1.76</td>
<td>1995:Q3</td>
<td>-1.05</td>
<td>1999:Q4</td>
<td>-12.31</td>
<td>2004:Q1</td>
<td>-0.65</td>
</tr>
<tr>
<td>1991:Q3</td>
<td>-1.45</td>
<td>1995:Q4</td>
<td>-0.83</td>
<td>2000:Q1</td>
<td>-0.67</td>
<td>2004:Q2</td>
<td>-0.80</td>
</tr>
<tr>
<td>1991:Q4</td>
<td>-1.42</td>
<td>1996:Q1</td>
<td>-0.62</td>
<td>2000:Q2</td>
<td>-0.98</td>
<td>2004:Q3</td>
<td>-0.93</td>
</tr>
<tr>
<td>1992:Q1</td>
<td>-1.42</td>
<td>1996:Q2</td>
<td>-0.39</td>
<td>2000:Q3</td>
<td>-1.07</td>
<td>2004:Q3</td>
<td>-0.91</td>
</tr>
<tr>
<td>1992:Q2</td>
<td>-0.85</td>
<td>1996:Q3</td>
<td>-0.54</td>
<td>2000:Q4</td>
<td>-0.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992:Q3</td>
<td>-1.01</td>
<td>1996:Q4</td>
<td>-0.45</td>
<td>2001:Q1</td>
<td>-0.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992:Q4</td>
<td>-0.88</td>
<td>1997:Q1</td>
<td><strong>50.68</strong></td>
<td>2001:Q2</td>
<td>-0.70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993:Q1</td>
<td>-0.33</td>
<td>1997:Q2</td>
<td>-33.35</td>
<td>2001:Q3</td>
<td>-0.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993:Q2</td>
<td>-1.02</td>
<td>1997:Q3</td>
<td>-52.26</td>
<td>2001:Q4</td>
<td>-0.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1993:Q3</td>
<td>-1.49</td>
<td>1997:Q4</td>
<td>-30.94</td>
<td>2002:Q1</td>
<td>-0.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994:Q1</td>
<td>-1.84</td>
<td>1998:Q2</td>
<td><strong>92.46</strong></td>
<td>2002:Q3</td>
<td>-91.95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The results from the non-switching model indicate some bubble patterns in several periods in Malaysian house price (see Figures 6.3 and 6.4 and Table 6.6). These results suggest that house price bubbles exist in linear ways, without considering the impact of changes in economic conditions from boom to burst (nonlinear ways) on Malaysian house prices. The VECM result only captured the cointegration relationship between house prices and fundamental variables in a linear way by assuming no changes in economic conditions will affect these variables. Therefore, understanding changes in the Malaysian house price in different economic states is of important.

Higher volatilities of the Malaysian house price (see Figure 5.1) particularly prior and during the 1997 Asian financial crisis has caused higher deviation of MHPI from its’ long-run equilibrium price (see Figure 6.8). This shows that MHPI moves in non-linear ways. Similar findings about the non-linearities of the boom and burst in housing price is found in Muellbauer and Murphy (1997) and Herring and Wachter (1999) studies. This suggests that nonlinearity may play an important role in influencing the behaviour of the Malaysian house prices during different economic states.

The possibility of Malaysian house prices being influenced by market fundamental variables in a non-linear way was examined using the switching model. A Markov-Switching model and GARCH model (MS-GARCH) were used to ascertain whether Malaysian house prices change between economic expansion (boom) and recession (burst) states. Failure to examine the changes in the movement of house prices and macroeconomic fundamental variables because of the switching economic states may result in biasness and insignificant results.
6.3 Results of switching model

6.3.1 Empirical Results of Modeling Switching-State in the Mean (level) and Variance (volatility) of MHPI.

The effect of economic cycle and the lag between housing demand growth and housing supply causes volatility in the real estate market (Mueller, 2002). Many researchers have examined this variation in house prices and its impact on changes in economic conditions, particularly in developed countries such as in the US housing market (see Capozza et al., 2007; DiPasquale & Wheaton, 1994; Englund & Ioannides, 1997; Meese & Wallace, 2003). According to Fei (2009), the largest personal economic risk faced by individuals is the fluctuation in house price. Therefore, understanding the movement of house price in different economic conditions for a developing country such as Malaysia will provide accurate information in forecasting and managing house price bubbles in the future.

This section discusses the results of the switching technique of Markov-Switching (MS) for the mean and variance of MHPI. The MS technique is employed in two different approaches. The first approach uses the MS technique to test for changes in the mean of MHPI conditioned upon macroeconomic fundamental variables such as income, interest rate and inflation through periods of boom and burst. The second approach combines the MS technique with the GARCH model to test for the movement of the variance, which captures the volatility of the MHPI (excluding the macroeconomic fundamental variables), in two different states (boom and burst).

6.3.1a) Switching in the Mean (level) of the MHPI

Table 6.12 presents the result of Hamilton’s (1986) switching-regime model using equation (5.2.9c). This model analyses the movement in level for all parameters (lag of house price, income, interest rates and inflation) using the algorithm of BFGS. The BFGS algorithm achieved convergence in the RATS software after 87 iterations using the starting values of 0.001 (see Appendix). The MS results based on the mean model of MHPI is carried out by examining at the difference in parameter values of MHPI, income, interest rate, inflation and the significance of probabilities shifting from state 1 (boom) to state 2 (burst).
In this model, the posterior means are estimated by the average of samples drawn from conditional distribution. By allowing the parameters to switch between states, the model captures the movement of the variables, which were governed by the first order Markov process (equation 5.2.9c). As noted in Table 6.8, each of the two states provides a different economic interpretation of the Malaysian housing market. State-1 (S1) is described as a boom phase or bull market with a more persistent and higher increase in house prices. State-2 (S2) shows a decrease in Malaysian house prices from the previous state (S1) due to the bursting of the house price bubbles. The condition in State-2 also suggests the occurrence of recession in the Malaysian housing market.

In State-1, all fundamental variables, except for interest rates, proved to be statistically significant. The interest rate is not significant in both states (S1 and S2), which suggests that short-term interest rates do not have a nonlinear effect on housing prices in Malaysia. In addition, the lack of statistical significance for the interest rate variable may be due to psychological factors (Brunnermeier & Julliard, 2008). According to Brunnermeier and Julliard (2009), households are unable to differentiate between the changes in real and nominal interest rates, and make wrong investment decisions in consequence. Therefore, this result suggests that households in Malaysia purchase a house during lower nominal interest rate and that no expectations about future house price increases are factored into the purchase decision. Another possible explanation for the insignificance of the interest rate is due to the capital control policy implemented in 1994 by the Malaysian government to stabilize the increase in interest rates and inflation. Malpezzi (1997) also suggests that the Malaysian government uses interest rates to control and stabilize the conditions of the Malaysian property market. This stabilization process leads to an increase in inflation since people purchase more houses due to the lowering of interest rate. The insignificant interest rate also implies that for Malaysia, the demand for housing is insensitive to the cost of housing finance.

The most significant variable in State-1 is inflation with a t-statistic of 3.347. This implies that during the inflated housing price bubbles in the Malaysian housing market, the changes in the level of inflation seems to be moving empirically from boom state (S1) to burst state (S2). Income variable, which shows a negative posterior
mean of -0.442, implies that during the booming of the Malaysian housing market, the sudden increase in house prices leads to an increase in the affordability ratio (house price/income). As a result, income levels display a negative relationship with house prices during this economic state as evidenced by the volatility and uptrend movement of income (see Figure 5.2), compared to MHPI (see Figure 5.1).

In State-2, income (GDP) is the most significant variable with a t- statistic value of 5.946. The posterior mean for income changes from a negative value of -0.442 in State-1 to a positive value of 0.131 in State-2. This result implies that the increase in income of Malaysian households led to only a small gradual increase of expenses allocate to housing. Therefore, the significance income coefficient implies that in State-2, the houses in Malaysia are still highly demanded by households with higher income as houses are relatively cheaper during the economic recession.

The difference in the estimated probabilities of moving from a booming state to a bursting state, which is denoted by P1 to P2, is not statistically significant. Table 6.8 reports a t-value of 0.8255. This result suggests that the mean model of switching regimes is less efficient in capturing the persistence of the conditional mean switching between regimes.

According to Lecat and Mosonnier (2005), it is difficult to capture changes in economic condition using the switching regime technique because of the growing trade, financial deregulation and integration of the Malaysian economy, with East Asian countries contributing to the increased in crisis transmission between countries. Therefore, to further provide a robust result in modeling the MHPI using the switching regime technique of MS, the changes in variances of MHPI are also examined. Consequently, the estimation result changes tremendously when the switching regime is estimated in terms of volatility (variance) (see Table 6.9).
Table 6.8 Results of the Multivariate switching model in the mean (level) equation of MHPI (condition on incomem interest rate and inflation)

State 1 (S1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$\alpha$</th>
<th>$hsg_{t-1}$</th>
<th>Income</th>
<th>Interest rate</th>
<th>Inflation</th>
<th>$\sigma$</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior Mean</td>
<td>22.68</td>
<td>1.180</td>
<td>-0.442</td>
<td>-0.395</td>
<td>2.717</td>
<td>0.469</td>
<td>0.083</td>
</tr>
<tr>
<td>Posterior Standard error</td>
<td>2.347</td>
<td>0.149</td>
<td>0.334</td>
<td>1.688</td>
<td>0.812</td>
<td>0.354</td>
<td>0.074</td>
</tr>
<tr>
<td>T-statistic</td>
<td>9.661</td>
<td>7.897</td>
<td>-1.321*</td>
<td>-0.233</td>
<td>3.347*</td>
<td>1.325</td>
<td>1.127</td>
</tr>
</tbody>
</table>

State 2 (S2)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$\alpha$</th>
<th>$hsg_{t-1}$</th>
<th>Income</th>
<th>Interest rate</th>
<th>Inflation</th>
<th>$\sigma$</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior Mean</td>
<td>9.483</td>
<td>0.788</td>
<td>0.131</td>
<td>-0.068</td>
<td>-1.247</td>
<td>0.571</td>
<td>0.021</td>
</tr>
<tr>
<td>Posterior Standard error</td>
<td>1.208</td>
<td>0.0188</td>
<td>0.022</td>
<td>0.183</td>
<td>1.027</td>
<td>0.070</td>
<td>0.010</td>
</tr>
<tr>
<td>T-statistic</td>
<td>7.845</td>
<td>41.86</td>
<td>5.946*</td>
<td>-0.373</td>
<td>-1.214*</td>
<td>8.082</td>
<td>2.118</td>
</tr>
</tbody>
</table>

Difference between states

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$\alpha$</th>
<th>$hsg_{t-1}$</th>
<th>Income</th>
<th>Interest rate</th>
<th>Inflation</th>
<th>$\sigma$</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior Mean</td>
<td>13.2</td>
<td>0.932</td>
<td>-0.573</td>
<td>-0.326</td>
<td>3.964</td>
<td>-0.102</td>
<td>0.061</td>
</tr>
<tr>
<td>Posterior Standard error</td>
<td>1.139</td>
<td>0.130</td>
<td>0.312</td>
<td>1.504</td>
<td>-0.215</td>
<td>0.283</td>
<td>0.0639</td>
</tr>
<tr>
<td>T-statistic</td>
<td>4.996</td>
<td>2.604</td>
<td>-1.711*</td>
<td>-0.1911</td>
<td>3.029*</td>
<td>-0.284</td>
<td>0.8255</td>
</tr>
</tbody>
</table>

* significant,

State- 1 (S1) - boom (bubble inflated) of housing market
State- 2 (S2) - busting of housing price bubbles
6.3.2 Regime-Switching in Variance (volatility) using Markov-switching GARCH model

To further expand the use of switching technique of the MS model in the Malaysian housing market, this study combines the Markov-Switching technique with the GARCH process (MS-GARCH) as illustrated in equations 5.2.9d and 5.2.9e. The result in Table 6.9 shows that the model is well suited to account for the volatility of house prices which change during the boom (bubble inflated) and burst (bubble burst) state. Assuming that the changes in the volatility of house prices followed a GARCH process (as established in Section 6.1) the changes of house prices in variance are allowed to shift between states (S1 to S2) through the mean equation model. As documented in Sinai and Souleles (2005), the variance in house price is associated with an increase in the number of homeowners and higher house prices. Therefore, the modeling of the variance’s house price is significantly important because of the high number of homeowners in the Malaysian housing market.

As illustrated in the equations (5.2.9d and 5.2.9e), the variables of income, interest rates and inflation were excluded from the equation specification of MS-GARCH in order to focus the analysis on the conditional variance process.

\[ Y_t = \beta_0 + d h \sqrt{h_t} + \varepsilon_t, \]

is the mean equation and by including the conditional variance equation of

\[ h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2; \quad \varepsilon_t \sim N(0, \sigma_2), \]

the two equations comprise the GARCH in mean model.

Barrot and Takala (1998) explain that the most unpredictable component in house prices, which varies based on economic shock, comes from the volatility of demand conditions in the housing market. By examining the switching of time-varying volatility between states, any possible differences in the variance across the two states may possibly indicate the existence of house price bubbles.
Table 6.9 Results for the regime-switching in the volatility (variance) of the house price in Malaysia

<table>
<thead>
<tr>
<th>Parameter</th>
<th>State 1 (S1)</th>
<th>State 2 (S2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$dh_1$</td>
<td>$P_1$</td>
</tr>
<tr>
<td>Posterior Mean</td>
<td>5.51835</td>
<td>1.3196</td>
</tr>
<tr>
<td>Posterior Standard Error</td>
<td>0.02903</td>
<td>0.01566</td>
</tr>
<tr>
<td>T-statistic</td>
<td>188.3*</td>
<td>84.25*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>44.95*</td>
</tr>
</tbody>
</table>

Difference between states

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$dh_{1-2}$</th>
<th>$P_{12}$ to $P_{21}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior Mean</td>
<td>4.198</td>
<td>-0.01865</td>
</tr>
<tr>
<td>Posterior Std Error</td>
<td>0.144</td>
<td>0.00000</td>
</tr>
<tr>
<td>T-statistics</td>
<td>126.36*</td>
<td>-14.005 *</td>
</tr>
</tbody>
</table>

* significant at 5%

Table 6.9 reports the results for posterior mean and posterior standard error using the switching–regimes model in variance. The results of MS-GARCH show that all parameters seem to display large different values especially in terms of posterior mean for both states. The estimation of parameter $dh$, which is the GARCH in mean parameter, changes from 5.518 in State-1 to 1.3196 in State-2. The large changes in this parameter were expected and statistically significant in State-1 (188.3), State-2 (84.25) and the difference between states (126.36). This result suggests that the variance in house prices which move from State-1 to State-2, behaves in a nonlinear ways with more volatility recorded during the booming (State-1) of the Malaysian housing market. The increased volatility in house prices during the booming of the housing market is due to higher buying and selling transactions in State-1. Furthermore, the result suggests that the variance of MHPI is heteroscedastic.

The estimation of P1 and P2 in the MS-GARCH-M model indicates the probability of house price moving from State-1 (P1) to State-2 (P2). However, in theory the change of MHPI from State-1 (boom) to State-2 (burst) only happens in one direction with no probability of its occurring from State-2 (burst) to State-1 (boom). Therefore, it is unnecessary to analyse the results of P1 and P2 in detail.
The significant t-statistic for probability (P) of shifting between states (-14.005) suggests that the occurrence of house bubbles is somehow unpredictable unforeseen and difficult to capture. The use of Gibbs sampling in Bayesian technique shows some evidence of nonlinear movement in house price in different economic states. As pointed out by Flood and Hodrick (1986), the unobservable characteristics of bubbles mean that their existence is uncertain. Therefore, because the shift from State-1 to State-2 could happen randomly and statistically, the MS-GARCH model has less estimation power to capture and analyze it.

In conclusion, Table 6.9 shows that the estimated difference in variances for the posterior mean between states is sizable and very significant, while the difference of shifting (P1 and P2) between states is substantially smaller. The application of the switching model approach of the GARCH-in-mean process (MS-GARCH-M) explains much of the volatile movement in Malaysian house prices for both states of bubble inflated (boom) and bubble burst. This observation leads to the conclusion that the MS-GARCH-M model is able to capture the different movement of MHPI’s variance particularly during booming economic conditions (see Table 6.9).

### 6.4 Summary of the Findings

The findings of this study are divided into two parts; a non-switching model and a switching model. In the non-switching model, the occurrence of house price bubbles is detected in 1997:Q1 and 1998:Q2 with 50.68 % and 92.46 % of the real house price deviating from its long-run fundamental price respectively (see Table 6.8). The results of the non-switching model also show that the Malaysian housing market is not efficient and that the past information and trends influence the future movement of house prices (adaptive expectation hypothesis) possibly through the presence of the ARCH effect (see Table 6.2 and Figure 6.2). In addition, the results in all of the econometric models (OLS, ARCH(1), VECM) show that inflation is the most significant variable influencing the movement of Malaysian house prices.

In the switching model, the results imply that the Malaysian house price (MHPI) moves in a nonlinear ways by using the Markov-Switching technique of Hamilton (1991). The MS technique is applied to two different components of housing price; the mean and variance model. In the mean model, the results imply that inflation and income are statistically significant in State-1 (boom) and State-2 (burst) respectively. The results of changes between
different states show that inflation is highly significant. The estimations of $dh$, which is the GARCH in mean parameter, show a statistical significant values (see Table 6.9).

In conclusion, the results of this study support the existence of house price bubbles in the Malaysian housing market in 1997:Q1 and 1998:Q2. By combining the non-switching and switching models, this study takes into consideration the linearity and nonlinearity movement of the house prices in Malaysia with respect to the changes in economic conditions from 1990:Q1 to 2004:Q4. The most interesting finding of this study is that the bubbles in the Malaysian house prices seems to have inflated or formed slowly in the early 1990s and the bursting of the housing bubbles occurred during and after the 1997 Asian financial crisis.
Chapter 7

Discussion, Recommendation and Conclusion

.....the housing market is a large sector of the economy and it is highly possible that the housing market and the economy interact. Although the feedback mechanism is possible, it is not very clear. It is not only important to determine a timing relationship, but also a direction relationship between house price and its aggregate determinant series.

(Maclennans, D 1994)

7.0 Introduction

This chapter presents a summary of the thesis findings, including discussion of the empirical results as well as other issues that have emerged. Section 7.1 presents the results of the study. Section 7.2 discusses the implications of the research. Section 7.3 discusses the research limitations and Section 7.4 offers suggestions for future research on house price bubbles. The concluding remarks for the study are presented in section 7.5.

7.1 Summary of the Findings and Discussion

From 1990 to 1996, Malaysia underwent unprecedented economic growth with an average GDP growth rate of 8.7% (see Table 5.1) (Malpezzi & Mayo, 1997). The expansion of the Malaysian economy was evidenced by the increased in residential property transactions during this period (Ng, 2006). For example, in 1996 the Malaysian real estate debt, as a percentage of GNP, was 58% (Renauld et al., 1998) and bank lending to residential mortgages was 40% relative to the GDP growth (Barth et al., 1998). Moreover, the residential market in Malaysia (evidenced by the high percentage of homeownership (85%) in 1991) constituted the greatest proportion of the total property market (see Table 2.1). House price bubbles were believed to cause instability in the Malaysian economy leading, in turn, to crises in the banking and economic sectors.

The expansion of the Malaysian economy was interrupted by the Asian financial crisis in mid 1997. According to Meen (1998) and Quigley (1999), it was ‘over-investment’ and the boom in the real estate sectors in most the East-Asian countries contributed to the 1997 Asian
financial crisis. In addition, the dynamic growth of the real estate market in East Asian countries was due to excessive lending to the property market by financial institutions (see Table 1.1). As a result of easy credit and a lending boom, the house price indexes in most of East-Asian countries were increased significantly (see Figure 1.1) raising significant concern about the possibility of ‘bubbles’ in house prices.

The main objective of this study was to identify whether a bubble existed in the Malaysian housing market by using three macroeconomic fundamentals (income, interest rates and inflation). This study also investigated the efficiency of the Malaysian housing market and suggested a new technique for modelling housing price bubbles. Several alternative ways to monitor and manage house price bubbles in the Malaysian housing market were also discussed.

To answer research objectives one, two and three, a house price bubble model adopted from a vector error correction model (VECM) and a reduced housing demand equation was utilized with the time-series data covering the period of 1990:Q1 to 2004:Q4. Furthermore, the extended house price bubble model used in this study combined non-switching and switching models to ascertain the existence of bubbles in the Malaysian housing market.

In Malaysia, the residential market is the largest contributor to the property market providing more than 60% of the total transactions (RAM, 2007). Furthermore, the Malaysian housing market is characterized by a higher percentage of homeowners (85% in 1991- four million households), preferring a terrace type of house with a mortgage repayment period of between 25 and 30 years. The Malaysian housing market is different from the European and the US market in that houses in Malaysia are purchased and occupied primarily by the homeowners (85% in 1991) rather for rental or investment. In addition, the common tradition of the Malaysian people is to pass down their houses to their children or the next generation. This ‘traditional practice’ helps stabilize the Malaysian housing market and protect it from price speculation, with the results that there are lower demands for houses for investment and capital gains purposes.

A survey of the housing market literature on house price bubbles was discussed briefly in Chapter 3. Several related housing bubble theories such as Rational Expectation Hypothesis (REH), Adaptive Expectation Hypothesis (AEH) and Exogenous Expectation Hypothesis
(EEH), the Supply Side Theory, the Keynesian and Shiller Theory and the Austrian School were discussed in detail.

The variables employed in this study were quarterly time series data which included the Malaysian house price index (MHPI), income (proxy by GDP), interest rates and inflation, covered the period 1990:Q1 to 2004:Q4. Table 7.1 presents a summary of the estimated coefficients of income, interest rate and inflation for both the non-switching and switching models.

Table 7-0.1 Summary results for income, interest rate and inflation which affect the MHPI (non-switching and switching models)

<table>
<thead>
<tr>
<th>Model</th>
<th>Income</th>
<th>Interest rate</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-switching</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OLS</td>
<td>(-)</td>
<td>OLS</td>
<td>(-)</td>
</tr>
<tr>
<td>GARCH</td>
<td>(+)</td>
<td>GARCH</td>
<td>(-)</td>
</tr>
<tr>
<td>ARCH</td>
<td>(+)</td>
<td>ARCH</td>
<td>(-)</td>
</tr>
<tr>
<td>VECM</td>
<td>(+)</td>
<td>VECM</td>
<td>(-)</td>
</tr>
<tr>
<td>Switching</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Markov-switching in mean model)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State-1 (boom)</td>
<td>(-)</td>
<td>(-)</td>
<td>(+)</td>
</tr>
<tr>
<td>State-2 (burst)</td>
<td>(+)</td>
<td>(-)</td>
<td>(-)</td>
</tr>
</tbody>
</table>

The income coefficient was positive in several tests; GARCH, ARCH and VECM indicating that higher incomes increased house prices in Malaysia. Since most of the econometric techniques used in this study were consistent with a positive sign for income, it can be concluded that the GDP variables captured the movement of real income behavior in Malaysia from 1990:Q1 to 2004:Q4. In the switching model, the results were mixed, with the income variable showing negative and positive signs in the booming state (S1) and bursting state (S2) respectively.

The estimated interest rate coefficient was negative for all models (i.e. non-switching and switching models) and statistically not significant in the switching model. This implied that
the cost of housing, which was a proxy for the interest rate, was negatively related to Malaysian house prices. Furthermore, the non-significant result of the interest rate in the switching model (mean model) implied that the volatility of house prices during different economic conditions (boom and burst) were not significantly influenced by the movement of interest rates.

In conclusion, the results from the non-switching and switching models supported the existence of house price bubbles in the Malaysian housing market. In addition, several issues concerning the Malaysian housing market, such as efficiency and the movement of house prices prior, during and after the 1997 Asian financial crisis were addressed. The main findings are as follows:

- Based on the empirical results from the non-switching model, there was a strong evidence to support the argument that house price bubbles existed in the Malaysian housing market. This study used a 30% deviation from long-run equilibrium price as an indicator for bubble existence. In 1997:Q1 and 1998:Q2, the MHPI showed signs of a bubble, with 50.65% and 92.46% deviations from its long-run equilibrium prices, respectively.

- Due to the stability of the Malaysian housing market compared to those of neighboring countries such as Thailand and Indonesia, it is possible to characterize the existence of bubbles in the Malaysian housing market as semi-rational bubbles. Apparently, the contributing factors such as the efficiency of the Malaysian government, favorable financing conditions, the improved condition of macroeconomic fundamentals (such as income, interest rate and inflation) and the relative absence of speculative elements in the Malaysian housing market caused the Malaysian housing market to be less affected by the bursting of housing bubbles.

- The estimated result of the VECM also revealed that the Malaysian housing market was not an efficient market. This was due to the slow adjustment (1.4% per quarter) of the real house prices in Malaysia towards the long-run equilibrium price. The rejection of the efficient market hypothesis was due to the adaptive expectation hypothesis (AEH) formed by Malaysian people in regard to the future movement of house prices. This was based on the results of the Breusch-Godfrey (BG) and Breusch-Pagan-Godfrey tests (see Table 6.2) which rejected the null hypotheses of no autocorrelation
and no heteroscedasticity. As discussed earlier, the house price in the AEH depended on past information and trends.

- This study used a non-switching (linear) model and a switching (non-linear) model to determine the existence of bubbles in the Malaysian housing market. In both models, there was significant evidence to support the existence of house price bubbles in the Malaysian housing market.

- The results of this study indicated that Malaysian house prices did not always move in accordance with the movement of fundamental values such as income, interest rates and inflation. Throughout the study period, it was believed that large volatilities in Malaysian house prices were caused by the process of financial liberalization (in early 1993), which resulted in the expansion of credit and an increase in demand for houses.

- Housing in Malaysia can still be considered stable based on the overall results in both the non-switching and switching models. Homeowners in Malaysia appeared to delay selling their houses during the bursting of the housing bubble until the demand for houses strengthened. The weak demand for housing in Malaysia was shown mostly as a decline in the number of transactions (i.e., buying and selling) rather than as a decrease in nominal house prices. This condition was reflected in the gradual movements of MHPI (see Figure 6.5) after the 1997 Asian financial crisis. Furthermore, the actions taken by the Malaysian Government and Bank Negara Malaysia in stabilizing and promoting homeownership after the 1997 financial turmoil seemed to have been effective (see Section 2.6).

### 7.2 Implications of the Research Findings

The bursting of house price bubbles can be hazardous to the overall economy if governments and the relevant institutions failed to realize the adverse impact of previous house price bubble crises (see US-subprime crisis 2008, Florida 1929 crisis and Japanese real estate crisis, 1989).

In terms of policy, there were different views on how the authorities should respond to house price bubble crises. Policymakers and economic analysts have used various techniques to manage house price bubbles. These techniques have included reacting only when the bubble burst in an economy (not before it burst), leaning against the bubble, including the house
price index in the monetary targets of the central bank and providing regulatory approaches should the bubble burst (Cecchetti, 2006). All these suggestions affect differently in different housing markets.

House price bubble crises can be managed through various risk management techniques. Risk management in real estate market is similar to the financial risk management in other assets which include identifying sources of risk, measuring and monitoring risk and devising approach to control the risk (Peyton & Bardzik, 2008). The illiquid risk in housing market (e.g transaction costs, time delay and varying availability of buyers) can be managed by establishing the asset-liability management and liquidity management in housing market by the Central bank of Malaysia (Bank Negara Malaysia). Furthermore, in managing mortgage or credit risk, the default borrowers could modify their mortgage loans according to the current government plans such as one-time emergency transaction which inject funds directly to federal and states governments to address the housing market crisis (Jafree, 2008). This is consistent with the suggested plan outlined in managing the US subprime crisis (Jafree, 2008).

The finding of this study showed that a house price bubble existed in the Malaysian housing market. Furthermore, the macroeconomic fundamental variables such as income, interest rate and inflation significantly captured the existence of the housing price bubble. These results were important to homebuyers, economists, policymakers and financial institutions in Malaysia.

For economist, the significant effect of inflation (in both the non-switching and switching models) on house prices suggested that the movement of house prices can be monitored and stabilized using the inflation variable. These included adding house prices to the consumer price index calculation, minimizing unfavorable news, which affected people’s expectation about house prices, and balancing the housing demand with housing supply.

The switching behavior of MHPI (in terms of mean and volatility) reported in this study suggested that the action plans and measurements taken by the Malaysian government and financial institutions in Malaysia should reflect the changes in economic conditions such as boom (expansion) and burst (recession). For example, during the expansion (boom) of the economy, the standard sign of bubbles (i.e. the deviation of house price from its long-run equilibrium) must be higher than during an economy recession. The different size of bubbles
under different economic conditions should reflect the correct sign of bubbles. For example, during an economic recession, a 20% deviation of house price from the equilibrium prices is showing a house price bubble, while during the boom of housing market, a 30% to 45% deviation is indicating house price bubble.

The result of the estimated equilibrium in house prices from the non-switching model (see Figure 6.3) can be used by policymakers in Malaysia in implementing appropriate fiscal or monetary policies during the pre and post bubble crisis period. This is because a bubble is triggered by an over heated or booming market which can lead to other types of crises such as a credit crisis, a financial crisis and exchange-rate crisis. Close monitoring on the movement of the house price index (MHPI) and its activities (i.e. buying and selling) by policymakers is necessary in order to prevent the housing bubble from spreading to other related sectors such as the banking, construction and economic sectors. In addition, policymakers can also implement new housing policies and regulations by considering factors which cause house prices to increase. For example, the volatility of house prices can be minimized by reducing uncertainty for future house prices. This can be done by increasing efficiency in the housing market.

The results from the VECM showed that the Malaysian housing market was not efficient due to the slow adjustment of 1.4% per quarter towards the long-run equilibrium price. For financial institutions and banks, the slow adjustment of the housing market can be improved by establishing a one-stop centre that would enable buyers and sellers to access current information about the Malaysian housing industry. In addition, financial institutions and banks can introduce electronic trading or an e-property trading system similar to the stock market which can improve liquidity and efficiency in housing transactions. For example, Crowston and Wigand (1999) stated that the real estate market have a promising prospect for electronic commerce due to the information-intensive and information driven caused by high value and asset specificity from many intermediaries (i.e. real estate agents, buyers, and sellers). The transaction cost of purchasing a house is also reduced by using the internet to list and search for a house, avoiding traditional real-estate agents (Fletcher, 1997c). In US, the online property transaction, known as ‘Electronic Closing Table’ is provided by the Property Network (PTN), a subsidiary of Finet Holding. The ‘Table’ is a secure website that supplies all transaction participants (i.e. real estate agents, insurance companies, buyers, and sellers).
For policymakers, the efficiency of the housing market can be improved by decreasing bureaucracy in the regulations and policies which govern the housing market. Consequently, the implementation of these initiatives would improve the financial stability in the financial market and increase transparency of information to real estate players and policymakers in Malaysia, which lead to higher efficiency in the housing market.

The non-significance of the short-term interest rate in capturing the different economic conditions (i.e. State-1 and State-2) suggested that the Malaysian homebuyers did not consider the movement of short-term interest rates in their purchasing decisions. The Malaysian government and the central bank of Malaysia should focus on the middle-term and long-term interest rates to stabilize the house prices in Malaysia during the bubble process. The lower significance of the short-term interest rates on house prices in the non-switching model also implied that homebuyers were using a medium-term to longer-term interest rates. Therefore, banks and financial institutions should use this information when designing attractive and efficient mortgage financing to homebuyers.

In this study, the macroeconomic fundamental variables such as income and inflation influenced the movement of Malaysian house prices. This result can be used by banks and financial institutions in understanding the expectations of potential homebuyers. To assess this behavioral factor (expectation), banks and financial institutions can add relevant factors which influence homebuyer’s expectation into the credit scores of the credit screening process. The credit screening process indirectly affected future increases in house prices by incorporating inflation and income issues into the credit screening process. Potential homebuyers should be informed about the impact of increasing house prices on the collateral values of houses and the impact of higher demand on house prices. This information could help homebuyers when making rational decisions about buying houses. For banks and financial institutions, the rational decisions of their customers could improve the banks and financial institution’s balance sheets that were over-exposed to the real estate sector (see Table 1.1). Furthermore, by reducing the number of uninformed people from participating in the housing market, speculation in the Malaysian housing market could be reduced.

The results of this study, which focused on the demand factor variables (i.e. income, interest rate and inflation), can be used by policymakers to address the problem of oversupply and overhang in housing. The occurrence of housing price bubbles can be minimized by
producing housing stocks (i.e. supply of houses) that were consistent with real housing demand.

The overall results of this study were based on the whole Malaysian housing market without dividing it into different states. However, the largest housing demand in Malaysia is mainly from larger cities such as the Federal Territory of Kuala Lumpur, Selangor, Johor Bahru and Penang. Therefore, the policymakers should be more concerned about the housing developments/projects in these areas when implementing housing policies.

The inefficiency of the Malaysian housing market reported in this study implies that the amount of information channeled into the market was less accurate or informative. This caused people to overreact to even to a small amount of information, as explained by psychological and behavioral finance theories (Case & Schiller, 2003). Controlling the amount of information available to people discouraged the efficient process of the housing market. Therefore, the policymakers should inform the Malaysian people about the true condition of the housing market through the appropriate channels, such as expert analysts, housing campaign bulletin and real estate agents. This could further help reduce the impact of panic due to the bursting of house price bubbles in Malaysia. The availability of information about the Malaysian housing market would also lead to greater stability where people can make informed financial decisions based on the information available rather than following others in a herd-like and speculative manner.

The short-term interest rate represents the cost of housing or mortgage rates offered by the banks and financial institutions in Malaysia. Indirectly, this showed that the banking and financial institutions in Malaysia were affected by the bursting of housing bubbles due to higher investment in mortgage financing (see Figure 2.6). According to Lecat and Missonnier (2005), banks and financial institutions underestimated the risk of exposure caused by the higher expectations of the increases in the collateral value (house prices), causing myopic behavior and a moral hazard issues. Therefore, the banks could manage house price bubbles by applying risk management techniques through mortgage financing. For example, insurance companies and other financial institutions in Malaysia could create a special insurance scheme to protect homebuyers from any difficulties in repaying loans caused by changes in adverse economic conditions such as economic crises, economic depression and other worst-case scenarios which may affect the values of home loans and the buyer’s repayment capabilities. The recent US subprime crisis showed the importance of having a protection
clause in the home mortgage agreement to insure the homebuyer from a rapid decrease in house value. The implementation of such risk management mechanism can improve the regulation of the Malaysian housing market in the long term. Banks can also prevent bubbles in the housing market by applying risk management strategies to their loan management. Using a restrictive screening mechanism to the potential homebuyer’s credit and limiting the bank’s portfolio from exposure to the property market can reduce the impact of decreases in the value of the house on the bank’s portfolio.

The result from the switching model implied that house prices reacted differently to different economic conditions such as boom or burst. Therefore, to capture the movements of house prices in different states in Malaysia, a house price index for each state could be created. This would enable a close monitoring of the 13 states house prices indexes by each state government.

7.3 Limitations of the Study

The limitations of the study are as follows:

- Only demand variables (income, interest rates and inflation) were included in the house price bubble model since the supply variables were assumed to have a less significant effect on the movement of house prices in Malaysia. Furthermore, due to the inelastic housing supply, it was often assumed that changes in the housing supply variable do not affect the long–run relationship of house prices (Oikarinen, 2009).

- Other types of properties such as commercial properties and industrial properties were not included in the study. The inclusion of other types of properties could show the different impact macroeconomic fundamental variables have in the bubbles process. For example, commercial properties are commonly found to be associated with price bubbles.

- The duration of this study from 1990 to 2004 (15 years), is not long enough to capture bubble changes in the complete real estate cycle, as suggested by the real estate cycle theory (see Mueller, 2002). However, due to the difficulty in obtaining reliable and consistent data on the housing market in Malaysia, this period can be considered appropriate. It is suggested that a more comprehensive and significant study could be made if the period were extended from 1960 to 2007.
• The house price bubble model did not consider the behavioral and psychological responses of households in Malaysia; this was not included due to the time constraints of this study. Furthermore, the empirical housing bubble model (through the switching technique) is only suitable to be used for fewer macroeconomic fundamental variables due to the convergence issue.

• Due to the inelastic supply of housing, the supply side factors such as developers or construction costs were not included in this study. This is because there are restrictive policies governing the supply of housing in Malaysia. For example, in each new housing project a certain proportion of houses must be built according to the housing policy guidelines implemented by each states government. This helps to reduce the problem of oversupply of housing.

• The changes in the policy implications such as the abolishment of stamp duty, and the freezing of real property gain tax (RPGT) were not analyzed in this study. These factors may show a larger impact on higher house prices in the larger cities such as Penang, Kuala Lumpur and Johor Bahru. However, the overall impact of these factors on the Malaysian house prices is less significant since the analysis in this study did not divide Malaysia into different states and regions.

• The investment of foreign investment in the Malaysian My Second Home Program was not included due to the limited and highly restrictive information. Moreover, foreigners purchase houses in larger cities such as Kuala Lumpur, Penang and Johor. Therefore the inclusion of this factor is consider inappropriate for this study since the analysis was carried out on Malaysia as a country. Furthermore, there are still tight restrictions in foreign ownership in Malaysia.

• The overall results of this study do not differentiate various types of houses when analyzing the existence of house price bubbles. This is because of the difficulty in collecting reliable housing data in Malaysia for the study period. Furthermore, many housing market research did not differentiate the type of houses when analyzing the housing price bubble (see Case & Shiller, 2003; Abrahan and Hendershott, 1996).

• The analysis of this study was on housing market in Malaysia with no differentiation being made on the different types of housing holds by people in Malaysia. Some
people buy houses to occupy, while others buy houses for rental purposes (investment).

7.4 Future Direction in the Housing Price Bubble Research.

To further improve the research result in the housing price bubbles, a combination of qualitative and quantitative data should be used. The qualitative data should include behavioral and psychological aspects of homebuyers, focusing more on the future price expectation. This is due to the importance of price expectations which affect house prices causing bubbles.

Furthermore, it would be interesting to apply the method and framework used in this study to other housing markets, which share similar characteristics in terms of economies and housing market regulations - particularly markets in the neighboring countries such as Indonesia and Thailand. Cross-sectional research between these countries could further enhance our understanding of the behavior of house prices and bubbles.

Future studies could identify more macroeconomic fundamental variables that can be added to the house price bubble model. These include the short-term factors (i.e. interest rate, investment demand), institutional factors (i.e. deregulation and new policies) and long-term factors (i.e. demographic and economic growth) (Berry & Dalton, 2004).

The housing market consists of several sectors, which interact and play significant roles in the overall market development. To obtain comprehensive information about these interactions, further research should extend the research scope by estimating housing supply and mortgage markets. In addition, researchers can also include uncontrollable factors such as natural disasters (i.e. earthquake) and wars, which indirectly affect house prices.

The causes of house price bubbles are distinctive in different housing markets. Some countries encounter frequent bubbles compared to other countries. Future study on this issue should focus on establishing the real causes of house price bubbles in developed, developing and less developed countries. The findings from different types of countries will create a general picture about the contributing factors causing housing price bubbles.

In summary, as explained by Kritayanavaj (2008), the impact of a future bursting of housing bubbles will be more severe than in the past if no immediate steps were taken to prevent the
impact from spreading to other sectors of the economy. The importance of providing appropriate steps and action plans cannot be underestimated.

7.5 Conclusions

The strong growth in house prices in the housing markets of most countries has created concern about the possibility of house price bubbles. This issue is of concern to the public since the purchase of a house is generally the highest economic transaction made by most households. Hence, it is normal for people to have strong reactions to large movements in house prices compared to other goods and services (Kenny, 1998).

As discussed previously, the development of bubbles in the housing market led to an increase in uncertainty and economic risk. This study analyzed the Malaysian housing market by examining whether house price bubbles existed in the Malaysian housing market from 1990:Q1 to 2004:Q4. Analysis of the Malaysian house price index, income (GDP), short-term interest rates and inflation, confirmed that a moderate housing bubble existed in 1997:Q1 and 1998:Q2. The results of Markov-Switching regime technique show that the Malaysian housing market has undergone a switching state from a booming of bubbles (State-1) to the bursting of bubbles (State-2).

One important feature that distinguished this study from others is the combination of techniques used to examine the existence of housing bubbles, namely the non-switching and switching models. Experience has shown that each of the previous house bubble crises impacted on the economy differently depending on the factors (such as macroeconomic or macroeconomic variables) which triggered it. Nevertheless, the literature on asset pricing has shown that the presence of a bubble is difficult to confirm (Flood & Hodrick, 1990). According to Koh et al. (2006), even bubble theories fail to accurately capture the existence of a real estate bubble. The results of this study enhance our understanding about the methodology of non-switching and switching models that can be used to link bubble theory into practice. Nevertheless, there is still much room for further investigation.

To conclude, it is hoped that this study motivates other people to understand the concept of bubbles in house prices and the importance of information in managing such crises appropriately in the future.
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Appendices

Appendix 1 – Results of Non-Switching Model

Results of Ordinary Least Square Test (OLS) (equation 5.4.2)

Dependent Variable: HSG
Method: Least Squares
Date: 08/27/09   Time: 13:46
Sample (adjusted): 1990Q2 2004Q4
Included observations: 59 after adjustments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>10.52134</td>
<td>1.702444</td>
<td>6.6180140</td>
<td>0.0000</td>
</tr>
<tr>
<td>HSG(-1)</td>
<td>0.965346</td>
<td>0.037127</td>
<td>26.00085</td>
<td>0.0000</td>
</tr>
<tr>
<td>Income</td>
<td>-0.041333</td>
<td>0.040414</td>
<td>-1.035110</td>
<td>0.3052</td>
</tr>
<tr>
<td>Interest rate</td>
<td>-0.167463</td>
<td>0.196720</td>
<td>-0.851275</td>
<td>0.3984</td>
</tr>
<tr>
<td>Inflation</td>
<td>-2.288812</td>
<td>1.104795</td>
<td>-2.071708</td>
<td>0.0431</td>
</tr>
</tbody>
</table>

R-squared 0.994210  Mean dependent var 91.23739
Adjusted R-squared 0.993792  S.D. dependent var 17.86179
S.E. of regression 1.407296  Akaike info criterion 3.602155
Sum squared resid 106.9460  Schwarz criterion 3.778218

Breusch-Godfrey Serial Correlation LM Test:

<table>
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<tr>
<th></th>
<th></th>
<th></th>
<th>Prob. F(1,53)</th>
<th>Prob. Chi-Square(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-statistic</td>
<td>98.84312</td>
<td>Prob. F(1,53)</td>
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<td>Obs*R-squared</td>
<td>38.40638</td>
<td>Prob. Chi-Square(1)</td>
<td>0.0000</td>
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</table>

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/15/09   Time: 09:55
Sample: 1990Q2 2004Q4
Included observations: 59
Presample missing value lagged residuals set to zero.

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<th>Variable</th>
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<th>Std. Error</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
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<td>1.007017</td>
<td>0.492489</td>
<td>0.6244</td>
</tr>
<tr>
<td>HSG(-1)</td>
<td>-0.030397</td>
<td>0.022143</td>
<td>-1.372752</td>
<td>0.1756</td>
</tr>
<tr>
<td>GDP</td>
<td>0.026740</td>
<td>0.024025</td>
<td>1.113023</td>
<td>0.2707</td>
</tr>
<tr>
<td>INTR</td>
<td>-0.004121</td>
<td>0.116223</td>
<td>-0.035462</td>
<td>0.9718</td>
</tr>
<tr>
<td>INF</td>
<td>-0.017252</td>
<td>0.652715</td>
<td>-0.026431</td>
<td>0.9790</td>
</tr>
<tr>
<td>RESID(-1)</td>
<td>0.833461</td>
<td>0.083053</td>
<td>10.03534</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

R-squared 0.650956  Mean dependent var 6.77E-16
Adjusted R-squared 0.625100  S.D. dependent var 1.357902
S.E. of regression 0.831430  Akaike info criterion 2.585398
Sum squared resid 37.32891  Schwarz criterion 2.794773
Log likelihood -70.21318  Hannan-Quinn criter. 2.665971
F-statistic 20.14162  Durbin-Watson stat 2.353551
Prob(F-statistic) 0.000000
Results of ARCH effect

Heteroskedasticity Test: ARCH

<table>
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<th></th>
<th></th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
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<td>F-statistic</td>
<td>3.284704</td>
<td>0.0182</td>
</tr>
<tr>
<td>Obs*R-squared</td>
<td>11.44518</td>
<td>0.0220</td>
</tr>
</tbody>
</table>

General AutoRegression Conditional Heteroscedasticity (GARCH) Estimation Result.

Dependent Variable: HSG
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 06/12/09   Time: 11:07
Sample (adjusted): 1990Q2 2004Q4
Included observations: 59 after adjustments
Convergence achieved after 13 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(6) + C(7)*RESID(-1)^2 + C(8)*GARCH(-1)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
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<td>12.91304</td>
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<tr>
<td>HSG(-1)</td>
<td>0.836393</td>
<td>0.017088</td>
<td>48.94502</td>
<td>0.0000</td>
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<tr>
<td>GDP</td>
<td>0.074198</td>
<td>0.019003</td>
<td>3.904465</td>
<td>0.0001</td>
</tr>
<tr>
<td>INT</td>
<td>-0.035981</td>
<td>0.097236</td>
<td>-0.370038</td>
<td>0.7114</td>
</tr>
<tr>
<td>INF</td>
<td>-2.230168</td>
<td>0.599315</td>
<td>-3.721195</td>
<td>0.0002</td>
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</table>

Variance Equation

<table>
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<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.144639</td>
<td>0.134342</td>
<td>1.076642</td>
<td>0.2816</td>
</tr>
<tr>
<td>RESID(-1)^2</td>
<td>1.305005</td>
<td>0.484746</td>
<td>2.692142</td>
<td>0.0071</td>
</tr>
<tr>
<td>GARCH(-1)</td>
<td>-0.013281</td>
<td>0.162459</td>
<td>-0.081753</td>
<td>0.9348</td>
</tr>
</tbody>
</table>

R-squared    0.991211  Mean dependent var 91.23739
Adjusted R-squared 0.990560  S.D. dependent var 17.86197
S.E. of regression 1.735481  Akaike info criterion 2.941012
Sum squared resid 162.6422  Schwarz criterion 3.222712
F-statistic   -78.75985  Durbin-Watson stat 0.231749
Prob(F-statistic) 0.000000

Result of ARCH (1) model

Dependent Variable: HSG
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 08/27/09   Time: 13:53
Sample (adjusted): 1990Q2 2004Q4
Included observations: 59 after adjustments
Convergence achieved after 64 iterations
Presample variance: backcast (parameter = 0.7)
GARCH = C(6) + C(7)*RESID(-1)^2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
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<td>19.49528</td>
<td>0.0000</td>
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<tr>
<td>HSG(-1)</td>
<td>0.899623</td>
<td>0.016252</td>
<td>55.35588</td>
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<tr>
<td>GDP</td>
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<td>0.016351</td>
<td>1.112941</td>
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<tr>
<td>INF</td>
<td>-3.269762</td>
<td>0.434106</td>
<td>-7.532181</td>
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<tr>
<td>INTR</td>
<td>0.125404</td>
<td>0.062820</td>
<td>1.996230</td>
<td>0.0459</td>
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</table>
The Unrestricted VECM model from 1990:Q1 to 2004:Q4

Vector Error Correction Estimates
Date: 08/27/09   Time: 14:02
Sample (adjusted): 1990Q4 2004Q4
Included observations: 57 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq: CointEq1

<table>
<thead>
<tr>
<th>Variable</th>
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<th>Std. Error</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
</tr>
<tr>
<td>GDP(-1)</td>
<td>-3.955531</td>
<td>(0.89274)</td>
<td>[-4.43080]</td>
</tr>
<tr>
<td>INF(-1)</td>
<td>-83.24540</td>
<td>(19.4192)</td>
<td>[-4.28676]</td>
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<tr>
<td>INTR(-1)</td>
<td>12.32513</td>
<td>(3.29969)</td>
<td>[3.73524]</td>
</tr>
<tr>
<td>@_TREND(90Q1)</td>
<td>3.814076</td>
<td>(1.21020)</td>
<td>[3.15160]</td>
</tr>
<tr>
<td>C</td>
<td>120.9736</td>
<td></td>
<td></td>
</tr>
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</table>

Error Correction: D(HSG) D(GDP) D(INF) D(INTR)

<table>
<thead>
<tr>
<th>CointEq1</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>t-Statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.035104</td>
<td>0.085334</td>
<td>0.004708</td>
<td>-0.004105</td>
</tr>
<tr>
<td>(0.01231)</td>
<td>(0.03348)</td>
<td>(0.00266)</td>
<td>(0.00793)</td>
</tr>
<tr>
<td>[-2.85078]</td>
<td>[2.54898]</td>
<td>[1.76753]</td>
<td>[-0.51733]</td>
</tr>
</tbody>
</table>

The Restricted VECM of the Malaysian Housing Market

Vector Error Correction Estimates
Date: 11/06/09   Time: 10:27
Sample (adjusted): 1990Q4 2004Q4
Included observations: 57 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegration Restrictions:
B(1,1)=1,A(2,1)=0,A(3,1)=0,A(4,1)=0
Convergence achieved after 362 iterations. Restrictions identify all cointegrating vectors.

LR test for binding restrictions (rank = 1):
Chi-square(3) 8.056187 Probability 0.044865

<table>
<thead>
<tr>
<th>Cointegrating Eq:</th>
<th>CointEq1</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSG(-1)</td>
<td>1.000000</td>
</tr>
<tr>
<td>Income(-1)</td>
<td>-5.238853 (2.87277) [1.82362]</td>
</tr>
<tr>
<td>Interest rate (-1)</td>
<td>39.58548 (10.6447) [3.71880]</td>
</tr>
<tr>
<td>Inflation(-1)</td>
<td>-154.1667 (62.4938) [-2.46691]</td>
</tr>
<tr>
<td>@TREND(90Q1)</td>
<td>7.313859 (3.89929) [1.87569]</td>
</tr>
<tr>
<td>C</td>
<td>20.74614</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error Correction:</th>
<th>D(HSG)</th>
<th>D(GDP)</th>
<th>D(INTR)</th>
<th>D(INF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CointEq1</td>
<td>-0.014933 (0.00346) [-4.31964]</td>
<td>0.000000 (0.0000) [ NA]</td>
<td>0.000000 (0.0000) [ NA]</td>
<td>0.000000 (0.0000) [ NA]</td>
</tr>
</tbody>
</table>
Appendix 2 – Results of Switching Model

PART 1 Output Result taken from RATs programme of Modelling the Mean of House price model

* MS Regime model for the mean equation
open data Jan19.xls
data(for=xls,org=col) / hsg gdp intr inf
set y = hsg
nonlin p12 p21 a01 a02 b01 b02 b11 b21 b31 b12 b22 b32 sigma1 sigma2
frml reg1 = y(t)-a01-b01*y(t-1) -b11*gdp -b21*intr - b31*inf
frml reg2 = y(t)-a02-b02*y(t-1) -b12*gdp -b22*intr - b32*inf
compute p12 = 0.1
compute p21 = 0.2
linreg y
*linreg(noprint) y
#constant y{1} gdp intr inf

Linear Regression - Estimation by Least Squares
Dependent Variable Y
Usable Observations 59  Degrees of Freedom 54
Centered R**2 0.994221  R Bar **2 0.993792
Uncentered R**2 0.999790  T x R**2 58.988
Mean of Dependent Variable 91.237385165
Std Error of Dependent Variable 17.861785689
Sum of Squared Residuals 106.94600090
Regression F(4,54) 2322.3608
Significance Level of F 0.00000000
Log Likelihood -101.26358
Durbin-Watson Statistic 0.411895

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coeff</th>
<th>Std Error</th>
<th>T-Stat</th>
<th>Signif</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Constant</td>
<td>10.52134228</td>
<td>1.70244408</td>
<td>6.18014</td>
<td>0.00000009</td>
</tr>
<tr>
<td>2. Y{1}</td>
<td>0.96534578</td>
<td>0.03712747</td>
<td>26.00085</td>
<td>0.00000000</td>
</tr>
<tr>
<td>3. GDP</td>
<td>-0.04183264</td>
<td>0.04041373</td>
<td>-1.03511</td>
<td>0.30523109</td>
</tr>
<tr>
<td>4. INTR</td>
<td>-0.16746274</td>
<td>0.19671983</td>
<td>-0.85128</td>
<td>0.39837573</td>
</tr>
<tr>
<td>5. INF</td>
<td>2.28881204</td>
<td>1.10479488</td>
<td>-2.07171</td>
<td>0.04308355</td>
</tr>
</tbody>
</table>

* Starting values
compute a01 = %beta(1)+0.001
compute a02 = %beta(1)
compute b01 = %beta(2)+0.001
compute b02 = %beta(2)
compute b11 = %beta(3)+0.001
compute b12 = %beta(3)
compute b21 = %beta(4)+0.001
compute b22 = %beta(4)
compute b31 = %beta(5)+0.001
compute b32 = %beta(5)
compute sigma1 = sqrt(%seesq)+0.1
compute sigma2 = sqrt(%seesq)
set pstar 1 * = 0.5
frml markov =
f1 = %density(reg1{0}/sigma1)/sigma1,$
f2 = %density(reg2{0}/sigma2)/sigma2,$
rp1 = f1*(p21*(1-pstar{1})+(1-p12)*pstar{1}),'$
rp2 = f2*((1-p21)*(1-pstar{1})+p12*pstar{1})','$
pstar = rp1/(rp1+rp2),$
log(rp1+rp2)
*maximize(cvcrit=0.0001) markov 2 *

maximize(robust) markov 2 *

MAXIMIZE - Estimation by BFGS
Convergence in 87 Iterations. Final criterion was 0.0000000 <= 0.0000100
With Heteroscedasticity/Misspecification Adjusted Standard Errors
Usable Observations 59
Function Value -55.97601597

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coeff</th>
<th>Std Error</th>
<th>T-Stat</th>
<th>Signif</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. P12</td>
<td>0.08364222</td>
<td>0.07420270</td>
<td>1.12721</td>
<td>0.2596262 (probability)</td>
</tr>
<tr>
<td>2. P21</td>
<td>0.02180216</td>
<td>0.01029162</td>
<td>2.11844</td>
<td>0.03413796</td>
</tr>
<tr>
<td>3. A01</td>
<td>22.68124016</td>
<td>2.34769476</td>
<td>9.66107</td>
<td>0.00000000 (alpha)</td>
</tr>
<tr>
<td>4. A02</td>
<td>9.48351333</td>
<td>1.20878986</td>
<td>7.84546</td>
<td>0.00000000</td>
</tr>
<tr>
<td>5. B01</td>
<td>1.18041630</td>
<td>0.14947616</td>
<td>7.89702</td>
<td>0.00000000 (hsg) P1</td>
</tr>
<tr>
<td>6. B02</td>
<td>0.78815982</td>
<td>0.01882515</td>
<td>41.86739</td>
<td>0.00000000 (hsg) P2</td>
</tr>
<tr>
<td>7. B11</td>
<td>-0.44198976</td>
<td>0.33435886</td>
<td>-1.32190</td>
<td>0.18620067 (income)</td>
</tr>
<tr>
<td>8. B21</td>
<td>-0.39467963</td>
<td>1.68834498</td>
<td>-0.23377</td>
<td>0.81516574 (interest rate)</td>
</tr>
<tr>
<td>9. B31</td>
<td>2.71713448</td>
<td>0.81163247</td>
<td>3.34774</td>
<td>0.00081473 (inflation)</td>
</tr>
<tr>
<td>10. B12</td>
<td>0.13145659</td>
<td>0.02209647</td>
<td>5.94921</td>
<td>0.00000000 (income)</td>
</tr>
<tr>
<td>11. B22</td>
<td>-0.06871754</td>
<td>0.18381952</td>
<td>-0.37383</td>
<td>0.70852965 (interest rate)</td>
</tr>
<tr>
<td>12. B32</td>
<td>-1.24711570</td>
<td>1.02690478</td>
<td>-1.21444</td>
<td>0.22457921 (inflation)</td>
</tr>
<tr>
<td>13. SIGMA1</td>
<td>0.46903530</td>
<td>0.35393453</td>
<td>1.32520</td>
<td>0.18510364</td>
</tr>
<tr>
<td>14. SIGMA2</td>
<td>0.57143592</td>
<td>0.07070268</td>
<td>8.08224</td>
<td>0.00000000</td>
</tr>
</tbody>
</table>
PART 2: Output Result taken from RATs programme using the MS-GARCH in modelling the variance of House price

* Example 12.6 from pp 591-597
open data F:Jan19.xls
calendar(q) 1990
data(format=xls,org=columns) 1990:1 2004:4 hsg gdp intr inf
* Estimate GARCH-M model. Because this uses the square root of the variance (not
* the variance itself), it can't be done with the GARCH instruction.

*nonlin c a1 a2 b1 dh
nonlin c a1 b1 dh
dec series h u

frml uf = hsg-dh*sqrt(h)        ** Single-regime model
frml hf = c+a1*h{1}+b1*u{1}**2

*frml hf = c+a1*h{1}+a2*h{2}+b1*u{1}**2
*
linreg hsg
# constant hsg{1}

Linear Regression - Estimation by Least Squares
Dependent Variable HSG
Quarterly Data From 1990:02 To 2004:04
Usable Observations 59 Degrees of Freedom 57
Centered R**2 0.992337 R Bar **2 0.992203
Uncentered R**2 0.999722 T x R**2 58.984
Mean of Dependent Variable 91.237385165
Std Error of Dependent Variable 17.861785689
Standard Error of Estimate 1.577211543
Sum of Squared Residuals 141.79298642
Regression F(1,57) 7381.7138
Significance Level of F 0.00000000
Log Likelihood -109.58388
Durbin-Watson Statistic 0.435993

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coeff</th>
<th>Std Error</th>
<th>T-Stat</th>
<th>Signif</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>5.20515554712</td>
<td>1.0221786152</td>
<td>5.09222</td>
<td>0.00000416</td>
</tr>
<tr>
<td>HSG{1}</td>
<td>0.9556617557</td>
<td>0.0111230940</td>
<td>85.91690</td>
<td>0.00000000</td>
</tr>
</tbody>
</table>

set u = %resids
set h = %seesq
*compute c=%seesq/(1-.85),a1=a2=.4,b1=.05,dh=0.0

compute c=%seesq/(1-.9),a1=.5,b1=.05,dh=0.0
*compute c=%seesq/(1-.5),a1=.5,b1=.5,dh=0.0
*
frml garchm = h=hf,u=uf,%logdensity(h,u) **  
Hsg_t = dh*h  
maximize(cvcrit=0.001) garchm 3 *

MAXIMIZE - Estimation by BFGS  
Convergence in 42 Iterations. Final criterion was 0.0006559 <= 0.0010000  
Quarterly Data From 1990:03 To 2004:04  
Usable Observations 58  
Function Value -217.65627310

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>T-Stat</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. C (mean eq)</td>
<td>27.2240</td>
<td>6.22544</td>
<td>4.37302</td>
<td>0.00001225</td>
</tr>
<tr>
<td>2. A1 (var eq)</td>
<td>0.55843</td>
<td>0.01892</td>
<td>29.50332</td>
<td>0.0000000</td>
</tr>
<tr>
<td>3. B1 (var eq)</td>
<td>0.16702</td>
<td>0.034796</td>
<td>4.80004</td>
<td>0.00000159</td>
</tr>
<tr>
<td>4. DH</td>
<td>8.31087</td>
<td>0.898230</td>
<td>9.25249</td>
<td>0.0000000</td>
</tr>
</tbody>
</table>

** Starting regime-switching model **

* Initialize e's and draw a random sample for the s series based upon the transition probabilities.  
* compute e1=e2=.1  
set(first=%raninteger(1,2)) s = 1+(%uniform(0.0,1.0)>%if(s{1}==1,1-e1,e2))  
* 
* Prior for beta's  
* compute beta10=0.3,hbeta10=1.0/.09  
compute beta20=1.3,hbeta20=1.0/.09  
compute beta1=beta10,beta2=beta20  
* 
* Priors for alpha's  
* dec rect alpha(2,3)  
compute alpha(1,1)=1.0,alpha(1,2)=0.6,alpha(1,3)=0.2  
compute alpha(2,1)=2.0,alpha(2,2)=0.7,alpha(2,3)=0.1  
* 
* Formulas for the variances in the two branches  
* frml h1f = alpha(1,1)+alpha(1,2)*h{1}+alpha(1,3)*u{1}**2  
frml h2f = alpha(2,1)+alpha(2,2)*h{1}+alpha(2,3)*u{1}**2  
* 
* Set up the grids for the alpha parameters  
* compute ngrid=100  
dec rect[vect] agrid(2,3)  
compute agrid(1,1)=agrid(2,1)=%seqa(0.0,6.0/ngrid,ngrid)  
compute agrid(1,2)=agrid(2,2)=%seqa(0.0,1.0/ngrid,ngrid)  
compute agrid(1,3)=agrid(2,3)=%seqa(0.0,0.5/ngrid,ngrid)  
compute [vector] fgrid=%zeros(ngrid,1)
* Priors for e's
  compute gamma11=5,gamma12=95
  compute gamma21=5,gamma22=95
  *
  nburn is the number of draws in the burn-in period
  nkeep is the number of draws to keep
  *
  compute nburn=100,nkeep=400
  *
  We're keeping track of the full distribution on ten statistics
  (the beta's, alpha's and e's) and the time series for the states
  *
  dec vect[series] stats(10)
  do i=1,10
    (01.0041)    set stats(i) 1 nkeep = 0.0
    (01.0091) end do i
  *
  set shat 1 2004:4 = 0.0
  *
  dec real lastlogl
  *
  infobox(action=define,progress,lower=-(nburn-1),upper=nkeep) "Gibbs Sampling"
  do draws=-(nburn-1),nkeep
    (01.0051)    infobox(current=draws)
    (01.0067)    * Calculate the residuals given the current parameters
    (01.0067)    set u 3 * = h=%if(s==1,h1f,h2f),hsg-sqrt(h)*%if(s==1,beta1,beta2)
    (01.0189)    *
    (01.0189)    * Draw betas given states
    (01.0189)    *
    (01.0189)    do i=1,2
      (02.0559)       do j=1,3
        (03.0594)          do k=1,ngrid
          (04.0631)            compute alpha(i,j)=agrid(i,j)(k)
          (04.0672)            set u 3 * = h=%if(s==1,h1f,h2f),hsg-sqrt(h)*%if(s==1,beta1,beta2)
          (04.0794)            sstats(smpl=(s==i)) 3 * %logdensity(h,u)>>logl
          (04.0869)            compute fgrid(k)=logl
          (04.0892)            if (j==2.or.j==3).and.alpha(i,2)+alpha(i,3)>=1.0
          (05.0959)              break
          (04.0892)        end do k=1,ngrid
        (04.0672)      end do j=1,3
      (02.0559)    end do i=1,2
    (01.0524)  *
    (01.0524)  * Draw alphas
    (01.0524)  *
    (01.0524)  do i=1,2
    (02.0559)    do j=1,3
    (03.0594)      do k=1,ngrid
      (04.0631)        compute alpha(i,j)=agrid(i,j)(k)
      (04.0672)        set u 3 * = h=%if(s==1,h1f,h2f),hsg-sqrt(h)*%if(s==1,beta1,beta2)
      (04.0794)        sstats(smpl=(s==i)) 3 * %logdensity(h,u)>>logl
      (04.0869)        compute fgrid(k)=logl
      (04.0892)        if (j==2.or.j==3).and.alpha(i,2)+alpha(i,3)>=1.0
      (05.0959)          break
    (01.0524)  end do i=1,2
  (01.0051) end do draws=-(nburn-1),nkeep
* One detail in doing the draws from the grid is that you have to make sure
  that you don't either overflow or underflow when converting from log densities. The
  simplest way to do this is to subtract off the largest value. That way the
  "density" function will range between 0 and 1.

  compute biglogl=%maxvalue(%xsubvec(fgrid,1,nused))
 ewise fgrid(k)=%if(k<=nused,exp(fgrid(k)-biglogl),0.0)
  compute alpha(i,j)=%rangrid(%xsubvec(agrid(i,j),1,nused),%xsubvec(fgrid,1,nused))
  end do j
  end do i

* Draw e's

sstats(smpl=(s{1}==1)) 2 * s==2>>count
compute e1=%ranbeta(gamma11+count,gamma12+%nobs-count)
sstats(smpl=(s{1}==2)) 2 * s==1>>count
compute e2=%ranbeta(gamma21+count,gamma22+%nobs-count)

* Draw s's. Since the first and last data points have only one neighbor, they are
  covered by a different transition calculation. For each time period, we need to
  compute the function value twice, one for S=1, one for S=2. Since we end up keeping
  one of those two values, we've already done one of the calculations that we
  need

  do time=1,2004:4
  compute sold=s(time)
  if sold==1.and.time>1
    compute logl1=lastlogl
  else {
    compute s(time)=1
    set u 3 * = h=%if(s==1,h1f,h2f),hsg-sqrt(h)*%if(s==1,beta1,beta2)
    sstats 3 * %logdensity(h,u)>>logl1
  }
  if time==1
    compute p1g=%if(s(time+1)==1,1-e1,e1)
  else {
    if time==2004:4
      compute p1g=%if(s(time-1)==1,1-e1,e2)
    else
      compute p1g=%if(s(time-1)==1,1-e1,e2)*%if(s(time+1)==1,1-e1,e1)
  }
  if sold==2.and.time>1
  compute logl2=lastlogl
else {
    compute s(time)=2
}

set u 3 * = h=%if(s==1,h1f,h2f),hsg-sqrt(h)*%if(s==1,beta1,beta2)
sstats 3 * %logdensity(h,u)>>logl2
}

if time==1
    compute p2g=%if(s(time+1)==1,e2,1-e2)
else
    if time==2004:4
        compute p2g=%if(s(time-1)==1,e1,1-e2)
    else
        compute p2g=%if(s(time-1)==1,e1,1-e2)*%if(s(time+1)==1,e2,1-e2)
    *
    * Again, you have to be careful to avoid over/underflows in converting to densities.
    * Since the probability depends only upon the ratios of the densities, we can
    * subtract the two log densities before taking exp's
    *
    compute s(time)=%ranbranch(||p1g*exp(logl1-logl2),p2g||)

compute lastlogl=%if(s(time)==1,logl1,logl2)
end do time

if draws>0 {
    set shat 1 2004:4 = shat+s
    compute stats(1)(draws)=beta1
    compute stats(2)(draws)=beta2
    compute stats(3)(draws)=e1
    compute stats(4)(draws)=e2
    compute stats(5)(draws)=alpha(1,1)
    compute stats(6)(draws)=alpha(1,2)
    compute stats(7)(draws)=alpha(1,3)
    compute stats(8)(draws)=alpha(2,1)
    compute stats(9)(draws)=alpha(2,2)
    compute stats(10)(draws)=alpha(2,3)
}
end do draws

infobox(action=remove)

display alpha(1,1)
  5.92166

* The probability of state 2 is the average of shat (the state) - 1.0
*
set pprob 1 2004:4 = (shat/nkeep)-1.0
*
spgraph(vfields=2,footer="Markov Switching GARCH-M model")
* 
*graph(header="(a) Monthly log returns")
* # ge
graph(header="(a) Housing Price Index")
# hsg
graph(header="(b) Posterior Probability of state 2")
# pprob
spgraph(done)
*

dec vect[strings] vlabels(10)
compute
vlabels="l"beta1","beta2","e1","e2","alpha10","alpha11","alpha12","alpha20","alpha21","alpha22"ll

do i=1,10
(01.0041)  stats stats(i) 1 nkeep
(01.0080)  density(type=histogram,counts,maxgrid=12) stats(i) 1 nkeep xx fx
(01.0154)  scatter(style=bar,hlabel=vlabels(i))
(01.0177)  # xx fx
(01.0202)  end do i

Statistics on Series STATS(1) $\hat{\beta}_1 = d$ .......posterior mean in State-1
Quarterly Data From 1990:01 To 2089:04
Observations 400
Sample Mean 5.518355  Variance 0.337256
Standard Error 0.580738 of Sample Mean 0.029037
t-Statistic (Mean=0) 190.0464  Signif Level 0.000000
Skewness -2.498921  Signif Level (Sk=0) 0.000000
Kurtosis (excess) 6.124680  Signif Level (Ku=0) 0.000000
Jarque-Bera 1041.502217  Signif Level (JB=0) 0.000000

Statistics on Series STATS(2) $\hat{\beta}_2 = d$ .......posterior mean in State-2
Quarterly Data From 1990:01 To 2089:04
Observations 400
Sample Mean 1.319608  Variance 0.098136
Standard Error 0.313266 of Sample Mean 0.015663
 t-Statistic (Mean=0) 84.248321  Signif Level 0.000000
Skewness 0.005148  Signif Level (Sk=0) 0.966601
Kurtosis (excess) 0.292075  Signif Level (Ku=0) 0.237214
Jarque-Bera 1.423561  Signif Level (JB=0) 0.490769

Statistics on Series STATS(3) $e^1$ = Probability in regime 1
Quarterly Data From 1990:01 To 2089:04
Observations 400
Sample Mean 0.031560  Variance 0.000210
Standard Error 0.014499 of Sample Mean 0.000725
 t-Statistic (Mean=0) 43.534731  Signif Level 0.000000
Skewness 0.908542  Signif Level (Sk=0) 0.001192
Kurtosis (excess) 0.800848  Signif Level (Ku=0) 0.001192
Jarque-Bera 65.719255  Signif Level (JB=0) 0.000000

Statistics on Series STATS(4) $e^2$ = Probability in regime 2
Quarterly Data From 1990:01 To 2089:04
Observations 400
<table>
<thead>
<tr>
<th>Series</th>
<th>Sample Mean</th>
<th>Variance</th>
<th>Standard Error</th>
<th>t-Statistic (Mean=0)</th>
<th>Skewness</th>
<th>Kurtosis (excess)</th>
<th>Jarque-Bera</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATS(5)</td>
<td>0.050211</td>
<td>0.000499</td>
<td>0.022332</td>
<td>44.96879</td>
<td>1.119671</td>
<td>1.852198</td>
<td>140.754904</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STATS(6)</td>
<td>5.868089</td>
<td>0.021907</td>
<td>0.148011</td>
<td>792.9245</td>
<td>-10.772511</td>
<td>150.198733</td>
<td>383730.788492</td>
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<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>STATS(7)</td>
<td>0.973609</td>
<td>0.000047</td>
<td>0.006866</td>
<td>2836.2363</td>
<td>-0.188810</td>
<td>0.159582</td>
<td>2.801058</td>
</tr>
<tr>
<td></td>
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Statistics on Series STATS(5)
Quarterly Data From 1990:01 To 2089:04
Observations 400

Statistics on Series STATS(6)
Quarterly Data From 1990:01 To 2089:04
Observations 400

Statistics on Series STATS(7)
Quarterly Data From 1990:01 To 2089:04
Observations 400

Statistics on Series STATS(8)
Quarterly Data From 1990:01 To 2089:04
Observations 400
### Statistics on Series STATS(9)
#### Quarterly Data From 1990:01 To 2089:04

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<th>Variance</th>
<th>Standard Error</th>
<th>Variance of Sample Mean</th>
<th>t-Statistic (Mean=0)</th>
<th>Signif Level</th>
<th>Skewness</th>
<th>Signif Level (Sk=0)</th>
<th>Kurtosis (excess)</th>
<th>Signif Level (Ku=0)</th>
<th>Jarque-Bera</th>
<th>Signif Level (JB=0)</th>
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### Statistics on Series STATS(10)
#### Quarterly Data From 1990:01 To 2089:04

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<th>t-Statistic (Mean=0)</th>
<th>Signif Level</th>
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<th>Signif Level (Sk=0)</th>
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