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Do Soaring Global Oil Prices Heat up the Housing Market? Evidence from Malaysia

Thai-Ha Le

Abstract
This study analyses the effects of oil price and macroeconomic shocks on the Malaysian housing market using a SVAR framework. The specification of the baseline model is based on standard economic theory. The Gregory-Hansen (GH) cointegration test reveals that there is no cointegration among the variables of interest. The results obtained from the Toda-Yamamoto (TY) non-Granger causality test show that oil price, labor force and inflation are the leading factors responsible for changes in the Malaysian housing prices. The findings from estimating generalized impulse response functions (IRFs) and variance decompositions (VDCs) indicate that oil price and labor force shocks are responsible for substantial fluctuations in the price of housing in Malaysia.

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Keywords Housing market fluctuations; oil price shocks; macroeconomic shocks; Malaysia

Authors
Thai-Ha Le, ✉ RMIT University, Vietnam, ha.lethai@rmit.edu.vn

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1 Introduction

The housing industry plays an eminent role in the economy in terms of employment, capital market, consumption and financial wealth and thus, improved housing market performance stimulates the business cycle. On the other hand, developments in the housing market can have a critical impact on financial stability. In the event of prolonged increases in house price, the local economy could be vulnerable to an economic slowdown and increasingly prone to financial instability and imbalance. Further, since housing is generally the single largest investment of households in most countries, volatilities in housing price might also imply considerable changes in wealth, and thus bring about significant household wealth effects. These are the reasons why the public and policymakers should closely monitor changes in house prices.

Many oil exporting countries have seen rocketing house prices over the past decade. This study examines the short-run and long-run impacts of oil price fluctuations on the housing market in such an economy. Malaysia is chosen as the case study for this research as this country has been a major net oil exporter of the region and has also rapidly emerged as one of the most prominent real estate investment spots in Southeast Asia over the past decade. Malaysia's house price has steadily increased by 8% in 2014 alone, and a huge 77% since 2004 (during an oil price boom). In the recently released Global House Price Index in mid-2014, Malaysia was ranked 11th in the top 20 mainstream residential markets in the world. This prolonged growth in Malaysia's house prices seem to indicate that the "housing bubble" that has devastated so many markets around the world has not affected this country.

The research has multiple practical implications in both macro and micro aspects. From a macro perspective, this study could benefit the Malaysian policy makers, being a simplified case study isolating the effects of each factor (i.e., oil prices and macroeconomic and financial indicators) to the economy's real estate performance. Based on this study, policy makers can deduce the extent of correlation or causal relationship between variables of interest, as well as the patterns of reaction of the Malaysian housing prices to shocks in oil prices and key macroeconomic variables. From a micro perspective, forecasts of oil prices (and selected macroeconomic indicators) in the future could be used to predict the behavior of the local real estate industry. Based on the findings of this research, investors can determine the best time to buy or sell real estate. Furthermore, by studying the case of Malaysia, this study aims to provide an empirical model to answer the question of whether oil price shocks and major macroeconomic shocks can explain a significant portion of fluctuations in the housing sector of an emerging or developing oil-exporting country.

Section 2 reviews the related academic literature and gives an overview of the Malaysian housing market. Section 3 describes the data and variables while Section 4 explains the testing framework. Section 5 presents and discusses the empirical results and section 6 concludes with a summary.

2 Background Information

2.1 Literature Review

A body of literature has investigated the connection between the housing sector and the macroeconomy. Most of them focused on the role of housing channels in the monetary transmission mechanism and the role of wealth effects in asset markets in determining the divergence of house prices from their fundamental values (e.g., Maclenman et al., 1998; Tan and Voss, 2003; Himmelberg et al., 2005). Several studies used a structural vector autoregressive (SVAR) approach to model the housing sector and its interconnection with the macroeconomy. For example, Lastrapes (2002), Aoki et al. (2002) and Elbourne (2008) mainly focused on examining the impact of monetary shocks on the housing sector.

In the Malaysian context, property market modelling is a relatively new area with a relatively few number of studies carried out (e.g., Ng, 2006; Tan, 2008; Hui, 2009; Tan, 2010; Doling and Omar, 2012; Hui, 2013; Lean and Smyth, 2013). Tan (2010) investigated the increasing trend in residential property construction using the pooled EGLS model (Cross Section Seemingly Unrelated Regression). The purpose was to analyze the influence of lending rate and housing price on the trading volume of residential housing activities. The results show that base lending rate is the key determinant of residential housing activities in most states in Malaysia during the 2000–2005 period.

Using quarterly data spanning from 1991 to mid-2006, Hui (2013) found that the housing price in Malaysia is pro-cyclical with respect to the real and financial sectors but counter-cyclical with respect to the real exchange rate. Notably, the correlations between house price and the real sector are stronger than that between house price and the financial sector. The Granger causality test results imply that house price cycles influence cycles in the macroeconomy, while cycles in the credit market and real exchange rates impact house price cycles.

Similar to other property market modelling, modelling of the Malaysian property market suffers from several technical and theoretical problems. One emerging issue is the possible omission of an important variable. Research shows that house price movements are influenced by economic fundamentals. It was suggested that indicators of the economy measured by gross domestic product (GDP), labor force, income level and population exhibit a direct relationship with the construction of the office development (Kamarudin et al., 2014). For Malaysia, however, there is another important variable that might also matter but has not been included in any prior study, it is the oil price.

As a result of its location on the Sunda shelf – the world's biggest continental shelf – which is of great interest to oil companies, Malaysia's oil reserves are currently ranked as the 27th largest in the world and the third largest in the Asia-Pacific region, after China and India. According to the 2011 BP Statistical Energy Survey, Malaysia had proven oil reserves of 5.8 billion barrels at the end of 2010, or 0.4% of the world's reserves. Malaysia's future growth trajectory in oil and gas is expected to be sustainable, thanks to a range of government initiatives and incentives, together with significant private sector investments in the oil and gas sectors and subsectors.

This study aims to examine whether oil price is a critical factor driving the trend in the Malaysian house price. The model includes four endogenous variables besides house price namely: (i) the consumer price index (CPI), which is the only nominal variable in the system; (ii) the average commercial bank lending rate, which is the cost of housing mortgage loan and payback capacity; (iii) the labor force, which is a proxy for households, adding to existing housing demand; and (iv) the oil price, which affects the country's investment, propensity and wealth.

The selection of these variables was made based on an array of published studies on the determinants of house prices in both developing and developed economies (e.g., Johnes and Hyclack, 1999; Piazzesi and Schneider, 2009; Adams and Fuss, 2010; Glindro et al., 2011). Note that the purpose of this study is to model the Malaysian residential house price. Therefore, business-related factors such as the number of business establishments (which are often used in modelling commercial-industrial property prices) were excluded.

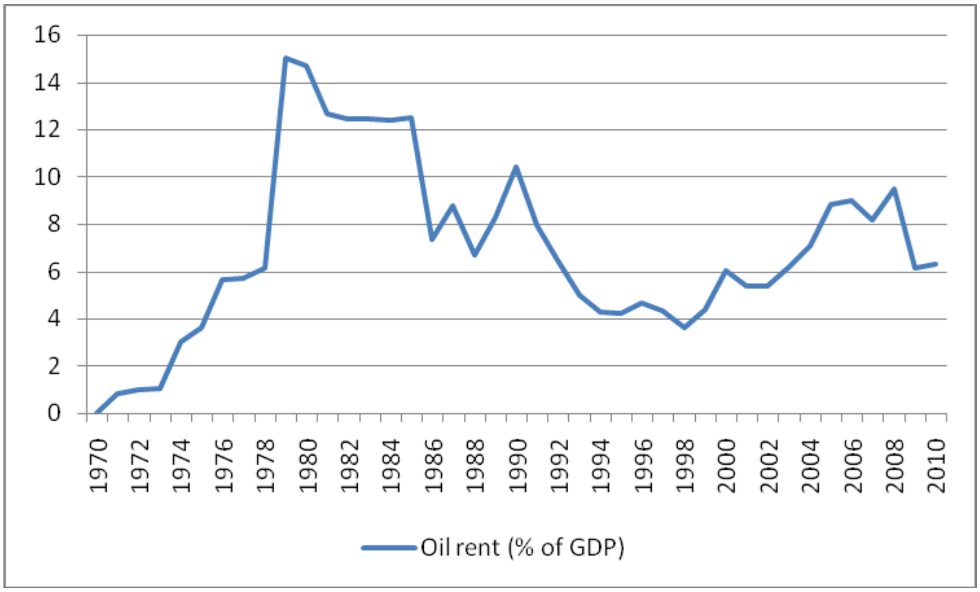
While the economic motivation for including most of these variables is fairly clear from existing literature, what merits further discussion is the exclusion of a few other factors that arguably affect house prices and the inclusion of oil price as an explanatory variable. As to the former matter, this study experimented with the inclusion of GDP growth rate. Tsatsaronis and Zhu (2004) found that GDP growth summarizes the information contained in other more direct measures of household income, such as unemployment rate and wages. However, when GDP was included, insignificant coefficients were attained. This could be explained as due to the multicollinearity problem between GDP growth and other independent variables. For instance, oil prices and GDP are expected to be highly correlated, given that higher oil prices might boost investment and consumption in an oil-exporting country.

In addition, this study also experimented with including equity market returns, a competing asset in household portfolios, which is proxied by the Kuala Lumpur Composite Index (KLCI). In theory, stock price affects household's wealth and investment alternatives and thus, is expected to influence housing prices. When included, however, this did not yield any significant coefficient. It was interpreted as an indication that, in normal times, the co-movement between equity and housing prices is driven by their mutual link to business cycle dynamics and the yield curve. The regularities in the relationship between the peaks in these two markets, as obtained by Borio and McGuire (2004), relate to particular phases in their respective price cycles, which are quite distinct.

Regarding the inclusion of oil price in the model, over the years, crude oil has contributed to the country's development in its own ways and superseded other resources in becoming the major fuel of Malaysia's economic growth. As the major oil producer and exporter of the region, it is no doubt that Malaysia could benefit from the rising oil price. Higher oil prices would increase the national income and the government's revenue. Specifically, Petronas (the national oil company) is Malaysia's largest single taxpayer and biggest source of revenue, covering nearly 45% of the government's budget. The company paid the government a total of RM806 billion (approximately USD230 billion) between 1974 and 2013. In addition, oil rents (% of GDP) in Malaysia, defined as the difference between the value of crude oil production at world prices and total costs of production, were 6.30 as of 2010. Its highest value over the past 40 years was 15.02 in 1979, while its lowest value was 0.00 in 1970 (Figure 1).

Oil prices theoretically affect housing prices in a net oil exporting country in two ways. First, higher oil prices raise real estate prices. This is primarily because an increase in real oil prices results in profit growth for oil companies, which attracts more investments to the country. This creates more jobs, which might increase migration into the city and thus, effectively push up the demand for housing and vice versa. Further, a rise in oil prices would also generate propensity and wealth for a net oil exporter. This enhances the consumer's ability to buy housing or upgrade their current house. However, higher oil prices may also negatively impact the oil-intensive sectors, including manufacturing and transportation, due to an increase in production costs, which might slow economic activity. High oil prices can also dampen consumer confidence and reduce spending. If consumers need to pay more for gasoline, heating oil and

Figure 1: Contribution of Oil Rents to GDP



Source: indexmundi.com. Estimates based on sources and methods described in "The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium" (World Bank, 2011).

transportation services, they would have less money to spend on other purchases including housing.

Although several studies have examined the effect of oil price shocks on the economy in oil-exporting countries, much fewer studies have attempted to quantify the importance of oil price shocks on the economy and particularly on the housing sector. This study aims to fill this gap by answering the question of whether oil price shocks and other macroeconomic shocks can explain a major part of fluctuations in the housing price of an emerging oil-exporting country. The Malaysian housing market provides a particularly interesting case study. This is because there have been large-scale increases in Malaysia's housing prices in recent years which occurred during a period of rising oil prices.

2.2 Overview of Malaysia's Housing Market

A critical contribution to the modelling of Malaysian property market is the establishment of the Malaysia House Price Index (MHPI) (VPSD, 1997) which serves as a benchmark for the performance of the Malaysian housing market. The MHPI was first initiated in 1993 by the Valuation and Property Services Department and finally came into force in 1997. This index represents the overall housing market in Malaysia, including thirteen states and two federal territories. It aims to establish a national price index to monitor the movement of house prices in Malaysia. This index indicates how much the house price changes over time, holding other attributes constant. It is the official source of reference to assess the performance of the housing market in Malaysia. The index may be used to formulate national economic policy with respect to housing and property development.

Malaysia is regarded as one of the most attractive real estate investment spots in Southeast Asia. Based on the data calculated by the Global Property Guide, a research house and website, the housing market in Malaysia still has relatively low property prices and price per square foot as compared with many Western countries and neighbors. Further, Malaysia offers the lowest average price per square foot for house, compared with Asian neighboring countries (except for Indonesia). This makes the cost of buying an apartment or a house in Malaysia relatively low, as compared with the money that can be earned by renting it out. Thanks to recent reforms in government policies that aim to encourage foreign investment in the country's housing market, many worldwide investors consider Malaysia as an attractive place for property investment (Ong and Chang, 2013).

In recent years, rapid economic development has resulted in an increasing demand for residential housing in Malaysia. Thus, house prices have appreciated dramatically throughout the country, whether in major cities or smaller towns. Particularly during the years 2009–2012, Malaysia had been through a period of dramatic run-ups in housing prices. According to the Malaysia Deputy Finance Minister (2011), the average housing prices in Malaysia increased up to 20% per year after 2007. This is a worrying trend for lenders and it presents a number of major issues. Such high annual jumps in housing prices are arguably not in line with annual income growths in the general population. Most people are afraid that such high property prices would present a real affordability issue. In fact, the real factors behind the illogical skyrocketing house prices are still controversial. With a strong economic and domestic demand, the housing value is likely to see a considerable growth over the coming years. In understanding the determinants of house price in Malaysia, it is critical to relate to the macroeconomic factors that affect housing prices in general. These factors can help relevant parties to handle the situation and stabilize housing prices before the condition becomes worse. It is argued that the current situation of the housing environment reflects economic distortion, instead of an economic take-off by the real economic growth. Therefore, the property market could face chaos if it continues to grow the same way (Ong and Chang, 2013).

3 Model and Data

This study employs a SVAR framework, using quarterly data over the period spanning from March 1999 to September 2012, to examine the determinants of housing prices in Malaysia, with a focus on the impact of oil price shocks. The choice of the investigation period and the frequency of the data are due to the availability of all the required data sets. As discussed in the previous section, the baseline model consists of five variables: oil price (*oilp*), housing price (*housep*), labor force (*labor*), consumer price index (*cpi*) and lending rate (*lendr*). $y_t = (oilp_t, housep_t, labor_t, cpi_t, lendr_t)$. All the variables are in natural logarithm except for lending rates.

The reduced form VAR is given by:

$$y_t = c + \sum_{i=1}^{p} A_i y_{t-i} + u_t \qquad (1)$$

where c is a vector of constants, p denotes the lag length, A_i are the 5×5 parameter coefficient matrices, and u_t is a vector of error terms.

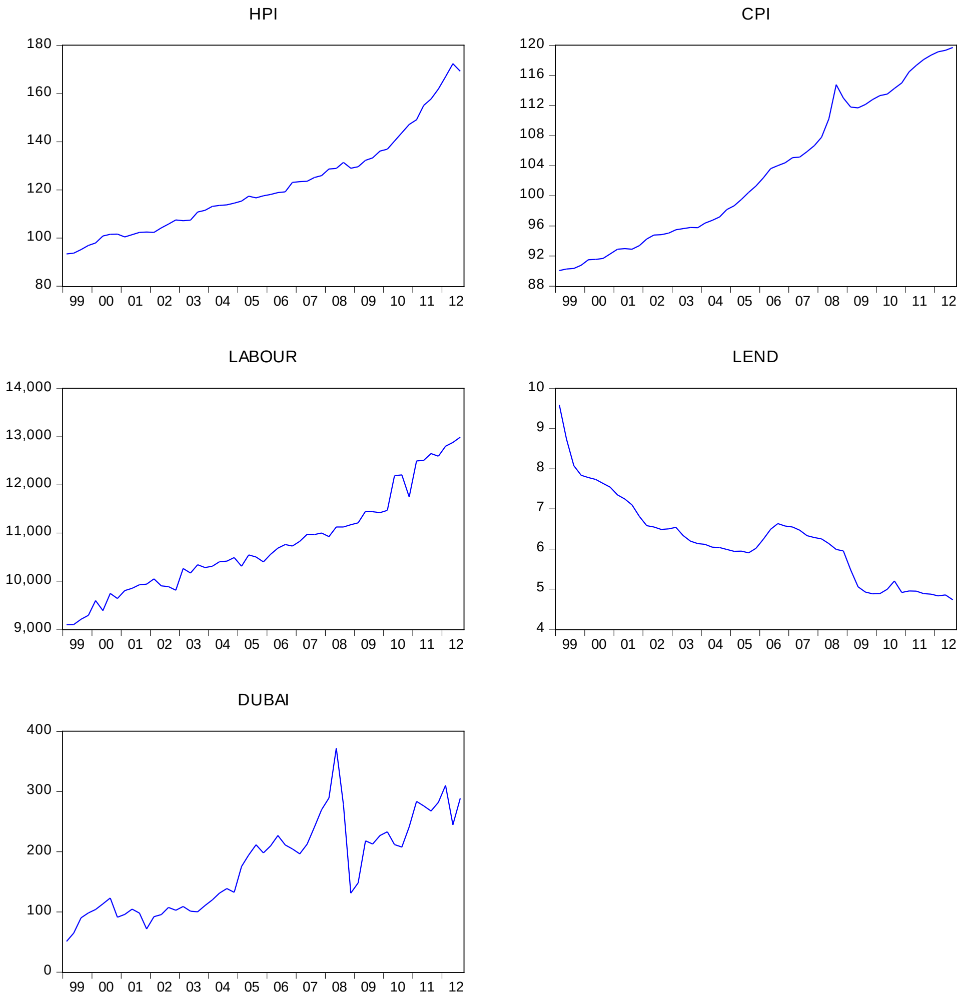
The Dubai crude oil price quoted in US dollars was chosen as representative of the world oil price. The Dubai crude is the main benchmark used for pricing crude oil exports to East Asia and a major impetus when key OPEC countries abandoned the administered pricing system in 1988 and started pricing their crude exports to Asia, on the basis of the Dubai crude (Fattouh, 2011). The Dubai market became known as the “Brent of the East” (Horsnell and Mabro, 1993). The data on Dubai crude oil is from the World Bank’s Commodity Price Data.Data on the housing price index of Malaysia was acquired from the Valuation and Property Services Department, Malaysia’s Ministry of Finance. Data on other macroeconomic indicators of the country including labor force, lending rate and CPI were acquired from IMF’s International Financial Statistics. The oil price is defined in real terms by transforming to value in nominal Malaysian Ringgit (MYR), and then deflating by the country’s CPI. Except for the lending rate, the rest of the data were taken as natural logarithm to stabilize data variability. The summary statistics of the data series are provided in Table 1 and their plots are presented in Figure 2. The preliminary observations show that most of the variables including house price, oil

Table 1: Summary Statistics of the Variables

	House price index (2000=100)	CPI (2005=100)	Labor force (thousand)	Lending rate (%)	Dubai (MYR/barrel)
Mean	121.698	103.044	10754.29	6.238	176.860
Median	117.500	101.320	10542.00	6.193	194.649
Maximum	172.400	119.730	12991.00	9.593	372.379
Minimum	93.400	90.064	9093.900	4.730	50.968
Std. Dev.	20.492	9.675	1038.345	1.068	77.058
Skewness	0.795	0.299	0.553	0.712	0.323
Observations	55	55	55	55	55

Source: Authors’ calculations.

Figure 2: Plots of the Data Series



Source: Data plots using Eviews 8. HPI, CPI, LABOR, LEND and DUBAI respectively stand for Malaysia's housing price index, consumer price index, labor force, lending rate and oil price.

price, consumer price index and labor force in Malaysia exhibit an upward trend while the lending rate time series reveals a downward trend over the investigation period.

4 Empirical Framework

This section highlights the econometric framework used to investigate the cointegrating relationships between the variables of interest, as well as to examine the causality from global oil price shocks to housing prices in Malaysia and their short-run impacts.

4.1 Unit Root Tests

The Toda-Yamamoto (TY) (1995) procedure requires determining the maximum order of integration of the series. As such, this study first examined the time series properties of the variables in the models, using the Phillips-Perron (PP) test and the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test. The null hypothesis of KPSS, namely stationarity, differs from the null hypothesis of PP, which is non-stationarity. Hence, it provides a good cross-check at conventional significance levels.

A break in the deterministic trend affects the outcome of unit root tests. Several studies have found that the conventional unit root tests, fail to reject the unit root hypothesis for series that are actually trend stationary with a structural break. The work by Zivot and Andrews (ZA) (1992) provides methods that treat the occurrence of the break date as unknown. Hence, the ZA test (with allowing for a single break in both intercept and trend) was employed to take into account an endogenous structural break in the data series.

4.2 The Gregory-Hansen (1996) Cointegration Analysis

Different methodological alternatives have been proposed in econometric literature to empirically analyze the long-run relationships and dynamics of interactions between time-series variables. The two-step procedure of Engle and Granger (1987) and the full information maximum likelihood-based approach of Johansen (1988) and Johansen and Juselius (1990) are the most widely used methods. However, the cointegration frameworks in these studies have limitations when dealing with data, since major economic events may affect the data generating process. In the presence of structural breaks, the tests for the null hypothesis of cointegration are severely oversized and tend to reject the null hypothesis, despite one with stable cointegrating parameters. The presence of structural breaks in turn leads to inefficient estimation and lower testing power (Gregory et al., 1996). The sensitivity of the outcome of the tests to structural breaks has been documented in literature (e.g., Lau and Baharumshah, 2003). As such, this study employed the Gregory and Hansen (GH) (1996) tests for cointegration, taking into account the possible presence of a structural break.

The GH (1996) tests for cointegration explicitly incorporate a break in the cointegrating relationship. The GH statistics can be seen as a multivariate extension of the endogenous break univariate approach and enables the test for cointegration by taking into account, a breaking cointegrated relationship under the alternative. The cointegration procedure consists of two steps. First, as suggested by Gregory and Hansen (1996), the Hansen's (1992) linearity (instability) tests were performed to determine whether the cointegrating relationship is subject to a structural change. The L_C test was employed to verify whether the long-run relationship between oil price shocks and housing prices in Malaysia, with controlling for a number of the country's macroeconomic factors, is subject to a break. Regarding the second step, cointegration tests were conducted by allowing a break in the long-run equation, following the approach suggested by Gregory and Hansen (1996). The advantage of this test is the ability to treat the issue of a break (which can be determined endogenously) and cointegration altogether.

The GH (1996) test is used to determine if cointegration amongst variables of interest held over the first period of time and then, in an a priori unknown period T_b (the timing of the change point), it shifted to another long run relationship.

This study employed three different models C, C/T and C/S corresponding to the three different assumptions concerning the nature of the shift in the cointegrating vector: the level shift model (C), the level shift with trend model (C/T) and the regime shift model (C/S). To model the structural change, the step dummy variable $D_t(T_b)$ is defined as: $D_t(T_b) = 1$ if $t > T_b$ where 1(.) denotes the indicator function, and $D_t(T_b) = 0$ otherwise. The three models: C, C/T and C/S representing the general long-run relationship are respectively defined as follows:

$$y_t = \mu + \theta D_t(T_b) + \alpha' x_t + u_t \quad (2)$$
$$y_t = \mu + \theta D_t(T_b) + \alpha' x_t + \beta t + u_t \quad (3)$$

$$y_t = \mu + \theta D_t(T_b) + \alpha' x_t + \delta' x_t D_t(T_b) + u_t \qquad (4)$$

where y_t is a scalar variable, x_t is an m-dimensional vector of explanatory variables (both x_t and y_t are supposed to be I(1)), u_t is the disturbance term, parameters μ and θ measure respectively, the intercept before the break in T_b and the shift that occurred after the break, while α is the parameter of the cointegrating vector, β is the trend slope before the shift, and δ is the change in the cointegrating vector after the shift.

The standard methods of testing the null hypothesis of no cointegration are residual-based. Ordinary Least Squares (OLS) were employed to estimate (2), (3), and (4), and a unit root test was then applied to the regression errors (Gregory and Hansen, 1996). The time break was treated as an unknown and estimated with a data dependent method. That is, it was computed for each break point in the interval [0.15*T*, 0.85*T*] where *T* denotes the sample size (Zivot and Andrews, 1992). The date of the structural break corresponded to the minimum of the unit root test statistics, computed on a trimmed sample.

4.3 The Toda-Yamamoto (1995) Approach

Following the GH test, this study employed the Toda-Yamamoto (TY) (1995) methodology to conduct causality test. The most common way to test for causal relationships between two variables is by the Granger causality proposed by Granger (1969) but it has probable shortcomings of specification bias and spurious regression (Gujarati, 1995). In order to avoid these shortcomings, the TY procedure was adopted to improve the power of the Granger-causality test. The procedure is a methodology of statistical inference, which makes parameter estimation valid even when the VAR system is not co-integrated. One advantage of the TY procedure is that it makes Granger-causality test much easier, as researchers do not have to test for cointegration or transform VAR into ECM. This procedure requires the estimation of an augmented VAR that guarantees the asymptotic distribution of the Wald statistic, since the testing procedure is robust to the integration and cointegration properties of the process. In other words, this technique is applicable irrespective of the integration and cointegration properties of the system, and fitting a standard VAR in the levels of the variables rather than first differences like the case with the Granger causality test. Therefore, the risks associated with possibly wrongly identifying the orders of integration of the series, or the presence of cointegration are minimized and so are the distortion of the tests' sizes, as a result of pre-testing (Mavrotas and Kelly, 2001).

The method involves using a Modified Wald statistic for testing the significance of the parameters of a VAR(p) model, where p is the optimal lag length in the system. The estimation of a VAR(p+d_{max}) guarantees the asymptotic $\chi 2$ distribution of the Wald statistic, where d_{max} is the maximum order of integration in the model. In this study, the lag lengths in the causal models were selected based on the Akaike Information Criteria (AIC) and the VAR was well-specified by, for instance, ensuring that there is no serial correlation in the residuals. If need be, the lag length was increased until any autocorrelation issues were resolved. Needless to say, the system must satisfy the stability conditions and the common assumptions to yield valid inferences. The null of "no Granger causality" is rejected if the test statistic is statistically significant. Rejection of the null implies a rejection of Granger non-causality. That is, a rejection supports the presence of Granger causality.

4.4 Generalized Impulse Response and Variance Decomposition Analysis

The TY procedure provides a powerful means for Granger causality tests but does not tell how the series respond, when there is a shock in one of the variables within the system. A number of prior studies in the literature used the sum of the coefficients to indicate the sign of the causality but it may produce misleading results, as there are dynamic effects between the equations that have to be taken into account. If the response function is positive for all periods, fading away to zero, it can be interpreted that the sign of the causality is positive. If it is positive, then negative, and then dampens down, it may not be interpreted that there is a clear-cut sign of causality. Instead, it could be said that the sign depends on the time horizon. That is precisely what an impulse response function (IFR) does.

To identify the sign of causality, this study employed a generalized impulse response analysis developed by Koop et al. (1996) and Pesaran and Shin (1998). Their generalized forecast error variance decomposition (VDC) analysis was used to determine the relative importance of oil price shocks and selected macroeconomic variables in explaining the volatility of the house price. The generalized approach is superior to the traditional approach, as it is not subject to the orthogonality critique. In the traditional impulse response analysis, the results are sensitive to the order of the variables in the system. The generalized approach does not have this shortcoming. The generalized approach is common in recent literature; therefore, the specifics are not discussed here to conserve space.

5 Results and Implications

5.1 Empirical Results

The results of unit root tests with and without accounting for a structural break are respectively reported in Table 2a and 2b. The finding is mixed in a few cases but the common suggestion of the unit root tests is that in level, all the series are nonstationary while in the first difference, all the variables are stationary. This finding led to the conclusion that the maximum order of integration for all groups of variables is 1.

Following the modeling approach described earlier, this study tested for the stability of the long run relationship between oil prices and housing price indices with the inclusion of three control variables: labor force, CPI and lending rate. The test statistics L_C is reported in Table 3. The results show that there is not enough evidence to reject the null of stability in the long-run equation, since the test statistic is insignificant at all conventional significance levels. The next step, as presented earlier, is conducting the cointegration tests by Gregory and Hansen (1996). They provide an alternative approach with tests that are based on the notion of regime change and are a generalization of the usual residual-based cointegration test. These tests allow for an endogenous structural break in the cointegration. Since all the variables are $I(1)$, this study investigated the presence of a cointegrating relationship under a structural shift between oil prices and housing prices, with the inclusion of labor force, lending rate and CPI, and computed modified versions of the cointegration ADF tests of Engle and Granger (1987), as well as modified Z_t and Z_α tests of Phillips and Ouliaris (1990):[1]

[1] The details of how these tests are modified in the Gregory and Hansen (1996) cointegration test are provided in pages 104–106 in Gregory and Hansen (1996). To conserve space, they are not presented here.

Table 2a: PP and KPSS Unit Root Test Results

	With intercept		With intercept and trend	
	PP	KPSS	PP	KPSS
Variables in log level				
House price index	1.828	0.884***	–0.286	0.185**
Dubai	–2.238	0.947***	–3.643**	0.126
Lending rate	–3.452**	0.889***	–4.109**	0.121*
CPI	0.624	0.884***	–2.355	0.182**
Labor force	0.569	0.880***	–2.772	0.176**
Variables in first log difference				
House price index	–6.710***	0.399*	–6.988***	0.119*
Dubai	–9.047***	0.200	–9.468***	0.096
Lending rate	–5.314***	0.352*	–5.025***	0.156**
CPI	–5.703***	0.178	–5.732***	0.110
Labor force	–13.124***	0.500**	–13.400***	0.500***

Note: Critical values of PP and KPSS: Without trend: –3.557 and 0.739 (1% significance level), –2.917 and 0.463 (5% significance level), –2.596 and 0.347 (10% significance level). With trend: –4.137 and 0.216 (1% significance level), –3.495 and 0.146 (5% significance level), –3.177 and 0.119 (10% significance level). *, ** and *** denotes significance at 10%, 5% and 1% significance respectively. Note: Dubai (in nominal US$) are converted into real terms by transforming to value in nominal MYR and hence deflating by CPI of Malaysia. Source: Authors' calculations.

Table 2b: Zivot–Andrews Unit Root Test Results

	Lag	t-stat	Break point
Variables in log level			
House price index	0	–5.294**	2008Q4
Dubai	2	–4.196	2005Q1
Lending rate	1	–2.793	2001Q4
CPI	1	–4.000	2005Q2
Labor force	3	–4.416	2010Q2
Variables in first log difference			
House price index	0	–7.711***	2009Q2
Dubai	1	–7.973***	2008Q3
Lending rate	0	–5.036***	2006Q1
CPI	1	–7.089***	2008Q4
Labor force	2	–8.423***	2010Q2

Note: Lags are automatically determined by AIC. The critical values for Zivot and Andrews test are: Without trend (only intercept): –5.34, –4.80 and –4.58 at 1%, 5% and 10% significance levels, respectively. With intercept and trend: –5.57, –5.08 and –4.82 at 1%, 5% and 10% significance levels, respectively. Source: Authors' calculations.

Table 3: Linearity (Stability) Test Results

Lc statistic	Stochastic Trends (m)	Deterministic Trends (k)	Excluded Trends (p2)	Prob.*
0.046	4	1	0	> 0.2

Note: Null hypothesis: Series are cointegrated. Significance implies rejection of the null hypothesis of stability at conventional levels. Lc tests are performed by Eviews 8. C and @TREND are used as deterministic regressors, and lags are automatically determined by AIC. Source: Authors' calculations.

$$ADF^* = inf_{T_b} ADF(T_b) \tag{5}$$

$$Z_t^* = inf_{T_b} Z_t(T_b) \tag{6}$$

$$Z_\alpha^* = inf_{T_b} Z_\alpha(T_b) \tag{7}$$

The three statistics obtained from different model specifications (C, C/T and C/S) are reported for comparison, where lag *k* was set as in Perron (1997), following a general to specific procedure. The results of the GH cointegration tests are presented in Table 4. The common suggestion indicates that there is not enough evidence to reject the null of no cointegration at the 1% and 5% significance levels. As such, it might be concluded that there is no cointegration relationship among the variables of interest, allowing for structural change in the cointegration relationship.

Next, the possible causality between these variables was explored by conducting the TY procedure. As mentioned in the previous section, to set the stage for the TY test, the order of integration of the variables was initially determined using the results from the unit root tests. The appropriate lag structures were determined to include the VAR models, using the Akaike Information Criterion (AIC). The lag length, if needed, was increased until there was no serial correlation in the residuals. The estimated VAR system is stable. The TY test was employed to specifically investigate if there is causality running from oil price and selected macroeconomic variables to housing price. Table 5 presents the results.

The results reveal that, at the 1% significance level, the oil price appears to Granger-cause the housing price in Malaysia. This is so because in recent times, crude oil has superseded other resources in becoming the major fuel of Malaysia's

Table 4: Gregory–Hansen Cointegration Test Results

	Level shift C	Level shift with trend C/T	Regime shift C/S
ADF*	–6.11*** 2005Q4	–5.92 2007Q4	–6.19* 2005Q4
Z_α^*	–46.09 2005Q4	–44.49 2007Q4	–46.23* 2005Q4
Z_t^*	–6.16*** 2005Q4	–5.98 2007Q4	–6.24 2005Q4

Note: VAR consists of *oilp, housep, labor, cpi* and *lendr* (m=4).*, ** and *** denote significance, i.e. rejection of the null hypothesis of no cointegration at 10%, 5% and 1% levels, respectively. Numbers in (.) are lag orders to include in equations. Time breaks are in [.] Critical values are taken from Table 1, page 109, Gregory and Hansen, 1996, Residual-based tests for cointegration in models with regime shifts, Journal of Econometrics, 70, p. 99–126. Approximate asymptotic critical values for C, C/T and C/S respectively: –6.05, –5.56, –5.31 for ADF* and Z_t^* and –70.18, –59.40, –54.38 for Z_α^* (at 1%, 5% and 10% level, respectively); –7.31, –6.84, –6.58 for ADF* and Z_t^* and –100.69, –88.47, –82.30 for Z_α^* (at 1%, 5% and 10% level, respectively); –6.92, –6.41, –6.17 for ADF* and Z_t^* and –90.35, –78.52, –75.56 for Z_α^* (at 1%, 5% and 10% level, respectively). Source: Authors' calculations.

Table *5:* Toda-Yamamoto Non-Granger Causality Test Results

Null hypothesis	Lag	Wald statistic	p-value
Dubai → House Price	2	14.035***	0.000
Labor force→ House Price	2	5.972**	0.050
Lending rate → House Price	2	1.330	0.514
CPI→ House Price	2	5.151*	0.076

Note: VAR consists of *oilp, housep, labor, cpi* and *lendr* (satisfy stability condition). The maximum order of integration among the variables of interest is 1. Lag lengths were determined based on AIC. *, ** and *** denote significance, i.e. rejection of the null hypothesis of no causality at 10%, 5% and 1% levels, respectively. Source: Authors' calculations.

economic growth. The oil and gas sector accounts for 30% of the economy's manufacturing income and about 8% of the annual GDP. Since Malaysia is the major oil producer and exporter of the region, the country certainly benefits from the higher oil price, as a rise in oil prices would also generate propensity and wealth. This enhances the households' ability to pay for housing or upgrade their current house.

The results also show that, at the 5% significance level, the country's labor force Granger-causes the housing price. This is not surprising as well, since an increasing number of younger Malaysians enter the job market implies more are likely to begin acquiring their first property at an early age, adding to the existing demand. According to the 2010 Census by Malaysia's Department of Statistics, the working age population (15 to 64 years old) increased from 62.8% in 2000 to 67.3% in 2010. Further, this finding is attributable to the demographic statistics from Ng (2006) that population in Malaysia, consists of a much larger number of working adults than retirees. Over 60% of the population is in the age group of 15-64 while less than 5% of the population is over 65. This implies that a bigger pool of first-time buyers and up-graders exist relative to the pool of households trading down, resulting in an increase in house price (Hui, 2009).

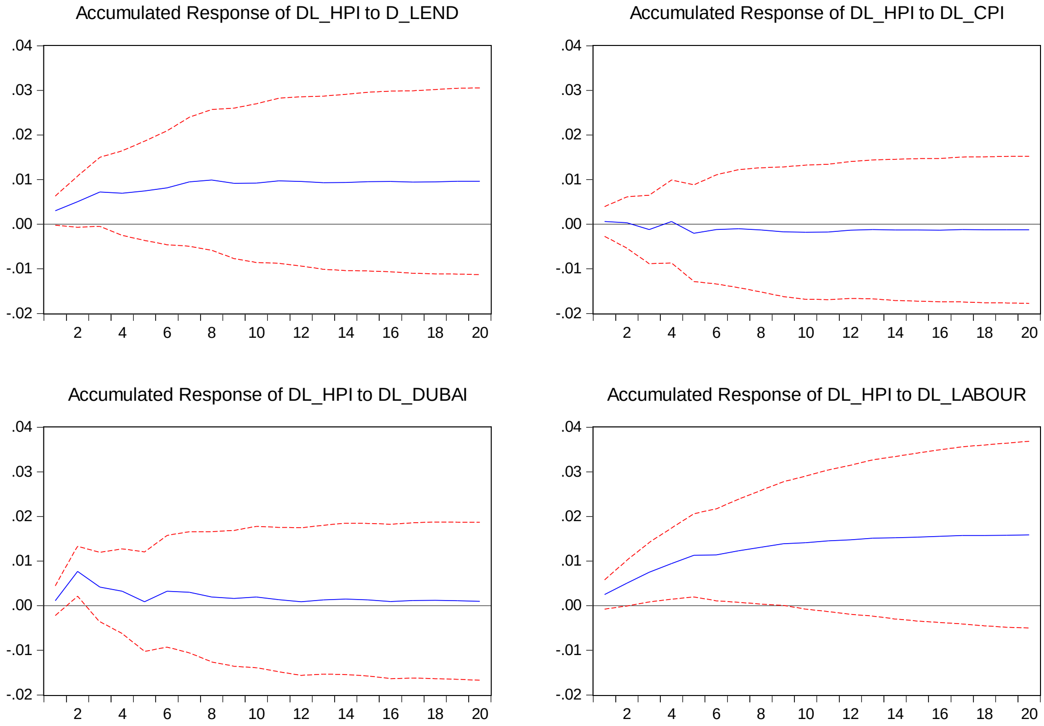
Further, the results indicate the causation from inflation to housing price in Malaysia at the 10% significance level. This could be explained by the direct impact of inflation on house prices through two channels. The first is via higher input cost – as prices for construction materials, land prices and labor wages increase, newer houses become more expensive than older ones. The second relates to rental yields – increases in consumer prices and related inflation expectations are typically factored into higher rents, which in turn translate into higher house prices. Inflation also has an indirect impact by increasing the attractiveness of houses, as a hedge against inflation. This has been exacerbated by the search for higher yield, given lower or more volatile returns on other forms of investments, such as deposits and equities.

More interestingly, despite the seemingly direct relationship between lending rate and housing price, the results show that lending rate does not Granger-cause housing price in Malaysia. This could be explained that buyers and speculators in the housing market might not care much about the interest rate charged by financial banks in making house purchase decision, particularly during a good economy. Instead, they make the decision based on their confidence and optimism about the housing market. This finding is consistent with the finding from Brissimis and Vlassopoulos (2009) that the causation does not run from lending rate to house prices. This finding, however, shows a contradiction to findings from Tan (2010) that the base lending rate is the key determinant of residential housing activities in most Malaysian states, during the period from 2000 to 2005. This could be explained due to the inclusion of more recent data in the study.

The causality analysis failed to establish causal linkages from lending rate to housing price but there may still be short-run temporary effects. As such, this study estimated the generalized IRFs of housing price based on a one-standard deviation shock to the oil price, labor force, lending rate and general price level (CPI) for the case of Malaysia. Figure 3 illustrates the plots of the estimated IRFs. Before interpreting the IRFs, it is important to note that the variables were not cointegrated from the previous section, so that this study estimated the generalized IRFs based on the unrestricted VAR model of the variables, in their first differences. The roots of the characteristic polynomial of all models satisfy the stability condition, in that they are all in the unit circle.

The estimated IRFs presented in Figure 3 show that the contemporaneous feedback between oil price shocks and Malaysia's housing price index is positive and statistically significant at its peak, which was attained two quarters after the shock. This finding suggests that Malaysia's rising housing prices are associated with increases in oil prices. The results also indicate that housing prices in Malaysia respond positively to shocks in the labor force of the country. The positive response is persistent and statistically significant immediately after the shock. The positive responses of Malaysia's housing prices to oil price shocks and labor force growth are consistent with what is expected in theory. The results from estimating generalized VDC reported in Table 6 indicate that, one quarter after the shocks, all the factors could explain some variations in housing prices. Specifically, the oil price change accounts for approximately 25.31% of the variation in house price. Of all the variables, the role played by the real oil price in explaining volatilities in the housing price, appears to be the most significant. The greatest contribution of oil price shocks to variability in house price, is followed by Malaysia's labor force and lending rate at 9.97% and 1.56%, respectively. The general price level proxied by CPI is the least important determinant when accounting for only 1.50% of housing price variation. This finding appears to be consistent with the finding of Khiabani (2010) that oil price shocks are responsible for a substantial portion of housing market fluctuations. The relative contributions of the variables in the system, in accounting for variations in housing prices, fluctuate dramatically immediately after the shocks. This study may thus conclude that the impacts of aggregate shocks on the housing market are non-transitory. Specifically, ten quarters after the shock, the oil price change explained 21.59% of the variation in the housing price whilst the CPI, labor force and lending rate explained 9.23%, 12.87% and 2.97%, respectively. The results thus indicate that the contribution of oil price shocks to variability in housing prices is still the greatest, compared to other variables. This has been the case over time, throughout the 20-quarter horizon.

Figure 3: Accumulated Response to Generalized One S.D. Inovations ± 2 S.E.



Source: Data plots using Eviews 8. DL_HPI, DL_CPI, DL_LABOUR, DL_DUBAI respectively stand for the log-first-diffference forms of Malaysia's housing price index, consumer price index, labor force and real Dubai crude. D_LEND is the first difference of Malaysia's lending rate.

Table 6: Generalized Variance Decomposition of Housing Price in Malaysia (in percentage)

Horizon	Dubai	CPI	Lending	Labor
0	3.21	0.64	1.53	1.03
1	25.31	1.50	1.56	9.97
2	21.54	2.34	1.56	9.61
3	21.32	3.39	3.13	10.31
4	21.10	6.14	3.07	11.15
5	21.55	7.09	3.14	11.63
6	21.49	7.72	3.05	11.90
7	21.57	8.17	3.01	12.32
8	21.54	8.60	2.99	12.53
9	21.58	8.95	2.98	12.72
10	21.59	9.23	2.97	12.87
11	21.61	9.44	2.96	13.00
12	21.62	9.62	2.95	13.09
13	21.63	9.76	2.95	13.18
14	21.63	9.87	2.94	13.24
15	21.64	9.97	2.94	13.29
16	21.64	10.04	2.93	13.34
17	21.65	10.11	2.93	13.37
18	21.65	10.16	2.93	13.40
19	21.65	10.20	2.92	13.42
20	21.65	10.23	2.92	13.44

Source: Authors' calculations.

5.2 Robustness Checks

Finally, this study conducted a number of robustness checks. First, since the results in Table 3 indicate the stability in the long-run equation, this study also conducted the conventional cointegration test by Johansen (1988), which is more powerful compared to the univariate Engle-Granger cointegration test. Moreover, the Johansen framework is a useful setting for analyzing the housing market and macroeconomic activity. This is because it incorporates dynamic co-movements or simultaneous interactions, allowing study of the channels through which macroeconomic variables affect housing prices, as well as their relative importance. Johansen's (1988) methodology was used to estimate the number (or rank), r of cointegrating relationships as well as their long-run relationship. If the rank (r) equals zero, no cointegrating equilibrium exists, and the equations should be differenced. If r = 1, then the data support one long-run equilibrium among the variables.

Table 7 estimates the number of long-run relationships among housing prices and domestic macroeconomic variables, using Johansen's cointegration rank tests for vector x, where x = [oil price (*oilp*), housing price (*housep*), labor force (*labor*), consumer price index (*cpi*) and lending rate (*lendr*)]. Lag lengths were chosen based on Akaike Information Criterion (AIC). Both trace test and Max-eigen value test cannot reject the null hypothesis of no cointegrating equilibrium at the 5% level. This supports Gregory-Hansen's test results that there is no long-term relationship among oil price, housing price, labor force, consumer price index and lending rate in Malaysia.

Second, since there is no cointegration relationship among the variables, the study conducted robustness checks for causality results by performing conventional Granger causality test, using the first difference of the variables. The results in Table 8 indicate that the findings are qualitatively the same as the findings obtained from performing the Toda-Yamamoto test.

Thus, it may be concluded that the cointegration and causality test results are robust to the different econometric methods used.

Table 7: Johansen Cointegration Rank Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Max-Eigen Statistic	0.05 Critical Value
None	0.456	68.315	69.819	31.703	33.877
At most 1	0.343	36.612	47.856	21.864	27.584
At most 2	0.130	14.748	29.797	7.231	21.132
At most 3	0.084	7.518	15.495	4.550	14.265
At most 4	0.055	2.967	3.841	2.967	3.841

Note: Lag lengths are chosen based on Akaike Information Criterion (AIC). Both Trace test and Max-eigenvalue test indicate no cointegration at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values. Source: Authors' calculations.

Table 8: Granger Causality/Block Exogeneity Wald Test Results

Dependent variable: House Price			
Excluded	$\chi 2$	df	Prob.
Dubai	7.920***	1	0.005
Lending rate	0.680	1	0.409
Labor force	3.315**	1	0.025
CPI	2.964*	1	0.085
All	12.149	4	0.016

Note: Lag length is chosen based on Akaike Information Criterion (AIC). All the variables are in first log difference. *, ** and *** denote significance, i.e. rejection of the null hypothesis of no causality at 10%, 5% and 1% levels, respectively. Source: Authors' calculations.

6 Concluding Remarks

This study examined the behavior of the housing sector in response to oil price and macroeconomic shocks in Malaysia, a net oil-exporting country. Besides using advanced econometric techniques, a major contribution of this paper is the inclusion of the global oil price in the baseline model of house price dynamics in Malaysia, which has not been found before in any other related studies on the subject.

A SVAR model with five variables was set up, which, apart from housing price and oil price, consists of labor force, general price level and lending rate, as they may influence the interactive relationship between oil price and housing price. Quarterly data spanning from the first quarter of 1999 through the third quarter of 2012 was used. The GH cointegration tests revealed that there is no cointegration among the variables of interest. This finding is robust to the use of another conventional cointegration test. Results from performing the TY non-Granger causality test show that oil price, labor force and general price level are the leading factors causing movements in Malaysian housing prices. These results are also qualitatively robust to the use of conventional Granger causality test. The findings from estimating generalized IRFs and VDCs indicate that oil price and labor force shocks explain the most substantial portions of housing market fluctuations in Malaysia.

With the evidences above, it can be concluded that the house price index in Malaysia has witnessed significant growth in the past decade because of the increase in world oil price and the growth in the country's labor force. However, Malaysia's net oil export position has been changing recently. This change is due to the fact that its domestic oil consumption has been rapidly increasing while domestic oil production has been on a decrease. As Malaysia increases oil consumption, her vulnerability to changes in the price of oil will also increase. The combination of growing demand and depleting reserves may turn many net oil producers and exporters into oil importers, and Malaysia is not an exception. The country's annual domestic oil demand continued to grow at 4%, whereas oil and gas production remained at 2.7% per year. There is a possibility that Malaysia would become a net oil importer within the next 10 years. The Malaysian government should carry out fiscal adjustments, so as to ensure the long-term stability of her finances. For instance, the government could seek other sources of revenue through diversification and focus on increasing non-oil-based revenues, such as taxes. Among the potential initiatives are tax reforms and reinvestment of oil money in revenue-generating assets. Last but not least, the government should work closely with the oil industry to improve energy efficiency and accelerate the development of new, sustainable feedstock and technologies for the industry. These efforts will lower the industry's energy intensity and hence, the country's vulnerability to oil price fluctuations.

Further, the study discovers that the rising labor force is responsible for a significant portion of housing market price growths in Malaysia. As the labor force in Malaysia continues to increase, Malaysia needs to address this huge demand for housing by providing affordable and sustainable houses for this increasing labor force, especially for those with low and medium income. This task might be difficult to accomplish due to the conventional building system in Malaysia.

Hence, the former system must be replaced by the Industrialized Building System (IBS), which offers more advantages in terms of productivity, indoor quality, durability and cost, as well as short construction time and standard quality (Nawi et al, 2014).

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