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

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**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 tests reveal that there is no cointegration among the variables of interest. Results from performing Toda-Yamamoto (TY) non-Granger causality tests show that oil price, labor force and inflation are the leading factors causing movements in the Malaysian housing prices in the long run. The findings from estimating generalized impulse response functions (IRFs) and variance decompositions (VDCs) indicate that oil price and labor force shocks explain a substantial portion of housing market price fluctuations in Malaysia.

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

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## **1. Introduction**

Housing industry plays an eminent role to economy in terms of employment, capital market, consumption and financial wealth and thus improved housing market performance stimulates the business cycle. Housing is not just consumption good. 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 households' single largest investment in most countries, volatilities in housing price might also imply considerable movements in wealth, and thus bring significant household wealth effects. These justify why public and policymakers should monitor house price developments closely.

The last decade has witnessed booms in housing markets in many oil exporting countries. 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 the country's property market has experienced a steady increase in prices over the past decade.

The research has multiple practical implications in both macro and micro aspects. From a macro perspective, this study could benefit Malaysian policy makers as being a simplified case study in 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 are able to deduce the extent of correlation or causal relationship between the 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. Investors can base on the findings of this research to determine the best time to buy and to sell real estate.

The rest of this study is structured as follows. Section 2 reviews the related academic literature and gives an overview of the Malaysian housing market. Section 3 describes the data and variables. Section 4 explains the testing framework. Section 5 presents and discusses the empirical results. Section 6 concludes with a summary.

## **2. Background information**

### *2.1. Literature review*

In literature, many studies have investigated the connection between the housing sector and the macroeconomy. Most of them focus 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., Tan and Voss, 2003; MacLenman et al., 1998; Himmelberg et al., 2005). Several studies use a structural vector autoregressive (SVAR) approach to model the housing sector and its interconnection with the macroeconomy. For example, Lastrapes (2001), Aoki, Proudman and Vlieghe (2002) and Elbourne (2008) particularly concentrate on assessing the effect of monetary shocks on the housing sector.

Property market modelling in the Malaysian context has been a relatively new area in literature. A few studies have conducted research on the housing market in Malaysia (e.g., Tan, 2010; Tan, 2008; Doling and Omar, 2012; Hui, 2013; Lean and Smyth, 2013; Hui, 2009; Ng, 2006). Tan

(2010) examines empirically whether the increasing trend in residential property construction is related to changes in base lending rate and house prices. Pooled EGLS model (Cross Section Seemingly Unrelated Regression) is used to analyze the influence of lending rate and housing price upon the trading volume of residential housing activities. The results show that base lending rate is the key determinant of residential housing activities in most of states in Malaysia for the year 2000-2005.

Using quarterly data measured in real terms spanning from the first quarter of 1991 through the second quarter of 2006, Hui (2013) finds that the housing price in Malaysia is pro-cyclical with respect to the real and financial sectors but counter-cyclical with respect to real exchange rate. Notably, the correlations between the house price and the real sector are stronger than that between the house price and the financial sector. Meanwhile, the results from Granger causality tests imply that house price cycles influence cycles in the macroeconomy, while cycles in credit market and real exchange rates impact house price cycles.

In search for the explanation on the dynamics of the property market, different types of models are utilized to analyse the nature and the forces that drive the market. Similar to other property market modelling, modelling of the Malaysian property market suffers from several problems including both technical and theoretical ones. One emerging issue is the possible omission of an important variable. Research shows that house price movements are influenced by economic fundamentals. It is suggested that indicators of the economy measured by gross domestic product (GDP), labor force, income level and population exhibit direct relationship with the construction of the office development (Copper et al. 1995). For Malaysia, however, there is another important variable that might also matter and has not been included in any prior study, which is the oil price.

This study aims to examine whether oil price is a critical factor driving trend in the Malaysian house price. The model includes four endogenous variables besides house price growth: (i) the inflation rate, 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 growth rate of labor force, which is a proxy for growth rate of households, adding to existing demand; (iv) the growth rate of oil price, which affects the country's investment, propensity and wealth.

The selection of these variables is made based on an array of published studies on the determinants of house prices in developing and developed economies (e.g., Piazzesi and Schneider, 2009; Glindro et al., 2011; Adams and Fuss, 2010; Johnes and Hyclack, 1999). Note that the aim of this study is to model the Malaysian residential house price, therefore business-related factors, such as the number of business establishment (which are often used in models to explain commercial-industrial property prices) are 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 the 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 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 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. This is 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 the 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 a 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 raise the national income and the government's revenue. Specifically, Petronas (the national oil company) paid the government a total of RM403.3 billion between 1974 and 2008. 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.

[Please place Figure 1 here]

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 in 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 in a net oil exporter. This enhances the consumer's ability to buy housing or upgrade their current house.

Whereas several authors have studied the effect of oil price shocks on the economy in developing oil-exporting countries, much fewer studies have been done 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 along with credit shocks can explain for 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 the price of owner occupied dwellings in recent years and these rises have occurred during a period of an oil price boom.

## *2.2. Overview of Malaysia's housing market*

A critical contribution to the Malaysian property market modelling is the establishment of the Malaysia House Price Index (hereafter MHPI) (VPSD 1997) that acts as a benchmark on 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, as a result of inflation, holding other attributes constant. Despite having shortcomings, 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.

As compared with those in many Western countries and its neighbors, the housing market in Malaysia still has relatively low property prices and price per square foot. Further, Malaysia offers the lowest average price per square foot for house if compared directly with Asian neighboring countries (except for Indonesia). Due to recent reforms in its government policies that aim to encourage foreign investment in the country's housing market, many worldwide investors has considered Malaysia as an attractive place for their property investment (Ong and Chang, 2013).

Housing market in Malaysia has experienced significant price expansions over the past fifteen years. Particularly during the years 2009-2012, Malaysia had been through a period of dramatic run-ups in housing prices. According to 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 economy and domestic demand, the housing value is likely to see a considerable growth over the coming years. In understanding the determinants of the 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 the housing prices before the condition becomes worse. It is argued that the current situation of the housing environment is reflecting the economic distortion, instead of an economic take-off by the real economic growth. Therefore, the property market could lead to chaos if it continues to grow like the way it has been (Ong and Chang, 2013).



### 3. Data description

This study examines the determinants of housing prices in Malaysia over the period spanning from March 1999 to September 2012, with a focus on the impact of oil price shocks. As discussed in the previous section, the baseline model consists of oil price and housing price, and other variables including labor force, consumer price index (CPI) and lending rate, that may influence the interactive relationship between oil price and housing price. The choice of investigation period is due to the availability of all the required quarterly data sets.

The Dubai crude oil spot price quoted in US dollars is chosen as the 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).

Data on housing price index of Malaysia is acquired from Valuation and Property Services Department, Ministry of Finance. Data on other macroeconomic indicators of the country including labor force, lending rate and CPI are acquired from IMF’s International Financial Statistics. The oil price is defined in real terms by transforming to value in nominal MYR and hence deflating by the country’s CPI. The obtained data are then taken natural logarithm to stabilize the data variability. As lending rates are in percentage, their logarithm are defined as  $\ln(1 + \text{rate}(\text{in percentage})/100)$ , which is a common transformation in literature.

## 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 long-run causality from global oil price shocks to housing prices in Malaysia and their short-run impacts.

### *4.1. Unit root tests*

The Toda-Yamamoto (1995) (TY) 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 by 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 hereafter) (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) is 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 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, tests for the null hypothesis of cointegration are severely oversized in which they 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 hereafter) (1996) tests for cointegration to take 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 enable to test for cointegration by taking into account for a breaking cointegrated relationship under the alternative. The cointegration procedure consists of two steps. First, as suggested by Gregory and Hansen (1996), the Hansen (1992)'s linearity (instability) tests are performed to determine whether the cointegrating relationship has been subject to a structural change. The  $L_c$  test is 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. As to the second step, cointegration tests are 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.

#### 4.3. *The Toda-Yamamoto (1995) approach*

Following GH test, this study employed the Toda-Yamamoto (TY hereafter) methodology to do causality test. The most common way to test for causal relationships between two variables is 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 is 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. Thereby, 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 Schwarz Bayesian Information Criteria (SIC) and the VAR is made sure to be well-specified by, for instance, ensuring that there is no serial correlation in the

residuals. If need be, the lag length is increased until any autocorrelation issues are 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 long-run Granger causality tests but it 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 literature use the sum of the coefficients to indicate the sign of the causality but it may produce misleading results as there are all of the 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 hereafter) does.

To identify the sign of causality, this study employs a generalized impulse response analysis developed by Koop et al. (1996) and Pesaran and Shin (1998). Their generalized forecast error variance decomposition (VDC hereafter) analysis, which is an analysis tool to determine the relative importance of oil price shocks and selected macroeconomic variables in explaining the volatility of the house price, is also used. 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, however, does not have this shortcoming. The generalized approach has been common in the recent literature, and therefore the specifics are not discussed here, to conserve space.

## 5. Results and implications

The results of unit root tests without and with accounting for a structural break are respectively reported in Table 1a and 1b. The finding is mixed in a few cases but the common suggestion of the unit root tests is that in level, most of the series are nonstationary while in first difference, most of the variables are stationary. The only exceptional case is the lending rate which is found to be stationary in log level. This finding leads to conclude that the maximum order of integration for all groups of variables is 1.

[Please place Table 1a and 1b here]

Following the modeling approach described earlier, this study tests 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 2. 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.

[Please place Table 2 here]

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 the lending rate variable is stationary in log level, this study investigates the presence of a cointegrating relationship under a structural shift between oil prices and housing prices, with the inclusion of labor force and CPI, and compute modified versions of the cointegration ADF tests of Engle and Granger (1987), as well as modified  $Z_t$  and  $Z_\alpha$  tests of Phillips and Ouliaris (1990), i.e.

$$ADF^* = \inf_{T_b} ADF(T_b) \quad [\text{Eq.1}]$$

$$Z_t^* = \inf_{T_b} Z_t(T_b) \quad [\text{Eq.2}]$$

$$Z_\alpha^* = \inf_{T_b} Z_\alpha(T_b) \quad [\text{Eq.3}]$$

All the three statistics obtained from different model specifications (C, C/T and C/S) are reported for comparison, where the 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 3. The common suggestion indicates that there is not enough evidence to reject the null of no cointegration at 1% significance level. As such, it might be concluded that there is no cointegration relationship among the variables of interest, allowing for structural change in the cointegration relation.

[Please place Table 3 here]

Next, the possible causality between these variables is 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 are determined to include in the VAR models using the SIC. The lag length, if needed, is increased until there is no serial correlation in the residuals. The estimated VAR system is stable. The TY test is employed to specifically investigate if there is causality running

from oil price and selected macroeconomic variables to housing price. Table 4 presents the results.

[Please place Table 4 here]

The results reveal that, at 1% significance level, the oil price appears to Granger-cause the housing price in Malaysia. This is expected as crude oil has, over the years, contributed to the country's development in its own ways and superseded other resources in becoming the major fuel of Malaysia's 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 a 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 buy housing or upgrade their current house.

The results also show that, at 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 existing demand. According to the 2010 Census by the Department of Statistics Malaysia, 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 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 exists relative to the pool of households trading down, which push up the house price (Hui, 2009).



Further, the results indicate the causation from inflation to housing price in Malaysia at 5% significance level. This could be explained due to 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 relation between lending rate and housing price, the results show that lending rate does not Granger-cause housing price in Malaysia. This is consistent with the finding from Brissimis and Vlassopoulos (2008) that in the long run 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 of states in Malaysia during the period from 2000 to 2005. This could be explained due to the inclusion of more recent data in the study.

The long-run causality analysis fails to establish causal linkages from lending rate to housing price but there may still be short-run temporary effects. As such, this study estimates 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 2 illustrates the plots of the estimated IRFs. Before interpreting the IRFs, it is important to note here that the variables are found 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.

[Please place Figure 2 here]

As regards to the plots presented in Figure 2, the results show that the contemporaneous feedback between oil price shocks and Malaysia's housing price index is positive and statistically significant at its peak which is attained two months 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 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 5 indicate that, two months after the shocks, all of the factors are able to explain some variations in housing prices. Specifically, the monthly oil price change accounts for approximately 24.41% of the variation in the 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 the house price is followed by those of Malaysia's labor force and lending rate with 8.11% and 0.49% respectively. The general price level proxied by CPI is the least important determinant when accounting for only 0.21% of housing price variation. This finding appears to be consistent with the finding by Khiabani (2010) that oil price shocks explain a substantial portion of housing market fluctuations.

[Please place Table 5 here]

The relative contributions of the variables in the system in accounting for variations in housing prices immediately after the shocks fluctuate dramatically for the periods following the shocks. This study may thus conclude that the impacts of aggregate shocks on the housing market are non-transitory. Specifically, thirteen months after the shock, the oil price change explains 26.06% of the variation in the housing price whilst the CPI, labor force and lending rate explain 5.03%, 8.41% and 2.66%, respectively. The results thus indicate that the contribution of oil price shocks to variability in housing prices is still the greatest compared to those of the other variables and this is maintained over time throughout the 20-month horizon.

Finally, this study conducts robustness checks by using a different oil price series. Specifically the domestic oil price of Malaysia is used instead of the Dubai crude oil price. The objective of the robustness checks is to find if there is any significant difference in results. Since the results in all cases are not significantly different, the use of Dubai crude oil price in US dollars is retained in the analysis of this study<sup>1</sup>. Last but not least, it is well-known that causality results are often quite sensitive to changes in the model specification so that the TY approach is carried out for a new model specification by including an additional potential explanatory variable. The country's exchange rate with the US dollar is added as another controlling variable to the baseline model specification. The results obtained by performing the TY-procedure are basically the same to the original ones. Thus, it may be concluded that those causality results are robust to reasonable changes of the baseline VAR model.

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<sup>1</sup> As space is limited, detailed results on robustness checks will be provided upon request.

## **6. Concluding remarks**

This study examines 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, an innovation in 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 the related studies on the subject.

A SVAR model with five variables is set up, which, apart from housing price and oil price, consists of labor force, general price level and lending rate. These economic factors are included as they may influence the interactive relationship between oil price and housing price. The prior information for model identification is derived based on economic theory proposed in the housing, money, foreign asset and goods markets. The Gregory-Hansen cointegration tests reveal that there is no cointegration among the variables of interest, allowing for structural change in the cointegration relation. Results from performing Toda-Yamamoto non-Granger causality tests show that oil price, labor force and general price level are the factors causing movements in Malaysian housing prices in the long run. The findings from estimating generalized impulse response functions and variance decompositions 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 rising faster while its domestic oil production has been falling. As Malaysia increases its oil

consumption, its 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. In the case of Malaysia, its annual domestic oil demand continues to grow at 4% whereas the country's oil and gas production remains at 2.7% per year. There is a possibility that the country would become a net oil importer within the next 10 years. The governments of major oil exporters should carry out fiscal adjustments so as to ensure long-term stability of its finances. For instance, the government could seek other sources of revenue through diversification and to focus on increasing its 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 to 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.

## Appendix

**Table 1a: Unit root tests – PP and KPSS tests (with trend and intercept)**

	With intercept		With intercept and trend	
	PP	KPSS	PP	KPSS
<b>Variables in log level</b>				
House price index	1.828	0.884***	-0.286	0.185**
Dubai	-2.238	0.947***	-3.643**	0.126
Lending rate	-3.377**	0.890***	-4.032**	0.119*
CPI	0.624	0.884***	-2.355	0.182**
Labor force	0.569	0.880***	-2.772	0.176**
<b>Variables in first log difference</b>				
House price index	-6.710***	0.399*	-6.988***	0.119*
Dubai	-9.047***	0.200	-9.468***	0.096
Lending rate	-5.253***	0.344	-4.975***	0.154**
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.

**Table 1b: Unit root tests – Zivot-Andrews test (Intercept and trend)**

	Lag	t-stat	Break point
<b>Variables in log level</b>			
House price index	0	-5.294**	2008Q4
Dubai	2	-4.196	2005Q1
Lending rate	1	-4.007	2005Q4
CPI	1	-4.000	2005Q2
Labor force	3	-4.416	2010Q2
<b>Variables in first log difference</b>			
House price index	0	-7.711***	2009Q2
Dubai	1	-7.973***	2008Q3
Lending rate	8	-2.643	2008Q2
CPI	1	-7.089***	2008Q4
Labor force	2	-8.423***	2010Q2

Note: 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.

**Table 2: Linearity (stability) test**

Lc statistic	Stochastic Trends (m)	Deterministic Trends (k)	Excluded Trends (p2)	Prob.*
0.62	5	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 7. C and @TREND are used as deterministic regressors, and lags are automatically determined by AIC.

**Table 3: Gregory-Hansen cointegration test**

	Level shift C	Level shift with trend C/T	Regime shift C/S
ADF*	-5.098 (0)	-5.544 (0)*	-6.437 (0)**
	2000Q3	2000Q3	2007Q4
$Z_{\alpha}^*$	-46.018	-40.876	-48.375
	2000Q3	2000Q3	2007Q4
$Z_t^*$	-5.155	-5.565*	-6.498**
	2000Q3	2000Q3	2007Q4

Note: VAR consists of hpi, dubai, labour, cpi (m=3).\*, \*\* 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: m=3: -5.77, -6.05, -6.51 for ADF\* and  $Z_t^*$  and -63.64, -70.27, -80.15 for  $Z_{\alpha}^*$  (at 1% level); -5.28, -5.57, -6.00 for ADF\* and  $Z_t^*$  and -53.58, -59.76, -68.94 for  $Z_{\alpha}^*$  (at 5% level); -5.02, -5.33, -5.75 for ADF\* and  $Z_t^*$  and -48.65, -54.94, -63.42 for  $Z_{\alpha}^*$  (at 10% level).

**Table 4: Toda-Yamamoto non-Granger causality test**

Null hypothesis	Lag	Wald statistic	p-value
Dubai → House price	4	19.211***	0.000
Labor → House price	4	9.476**	0.050
Lending rate → House price	4	2.272	0.686
CPI → House price	4	10.398**	0.034

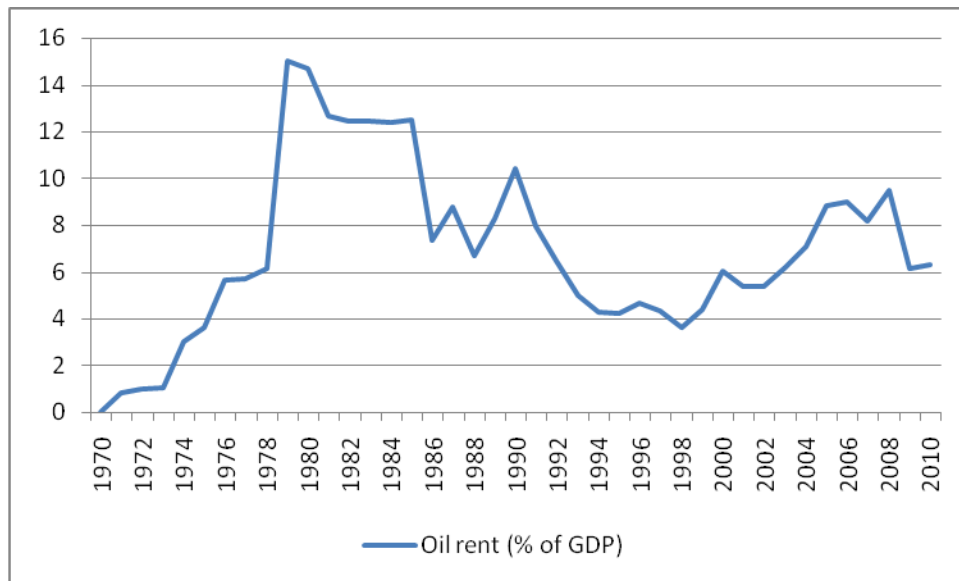
Note: VAR consists of hpi, dubai, labour, cpi, lending (satisfy stability condition). The maximum order of integration among the variables of interest is 1. Lag lengths were determined based on Schwarz Information Criterion (SIC). \*, \*\* and \*\*\* denote significance, i.e. rejection of the null hypothesis of no causality at 10%, 5% and 1% levels, respectively.

**Table 5: Generalized variance decomposition of Housing price in Malaysia (in percentage)**

Horizon	Dubai	CPI	Labour	Lending
1	0.67	0.27	0.00	0.00
2	24.41	0.21	8.11	0.49
3	26.29	1.18	8.19	0.65
4	26.32	2.46	8.66	0.86
5	25.15	4.89	8.49	1.48
6	26.30	5.04	8.30	1.56
7	26.03	4.99	8.34	1.88
8	26.25	4.99	8.41	1.87
9	25.92	4.99	8.44	2.63
10	25.94	4.99	8.45	2.63
11	25.99	4.98	8.44	2.66
12	26.06	5.03	8.41	2.66
13	26.06	5.03	8.45	2.76
14	26.06	5.03	8.45	2.76
15	26.06	5.03	8.45	2.76
16	25.99	4.98	8.44	2.66
17	26.06	5.03	8.41	2.66
18	26.06	5.03	8.45	2.76
19	26.06	5.03	8.45	2.76
20	26.06	5.03	8.45	2.76



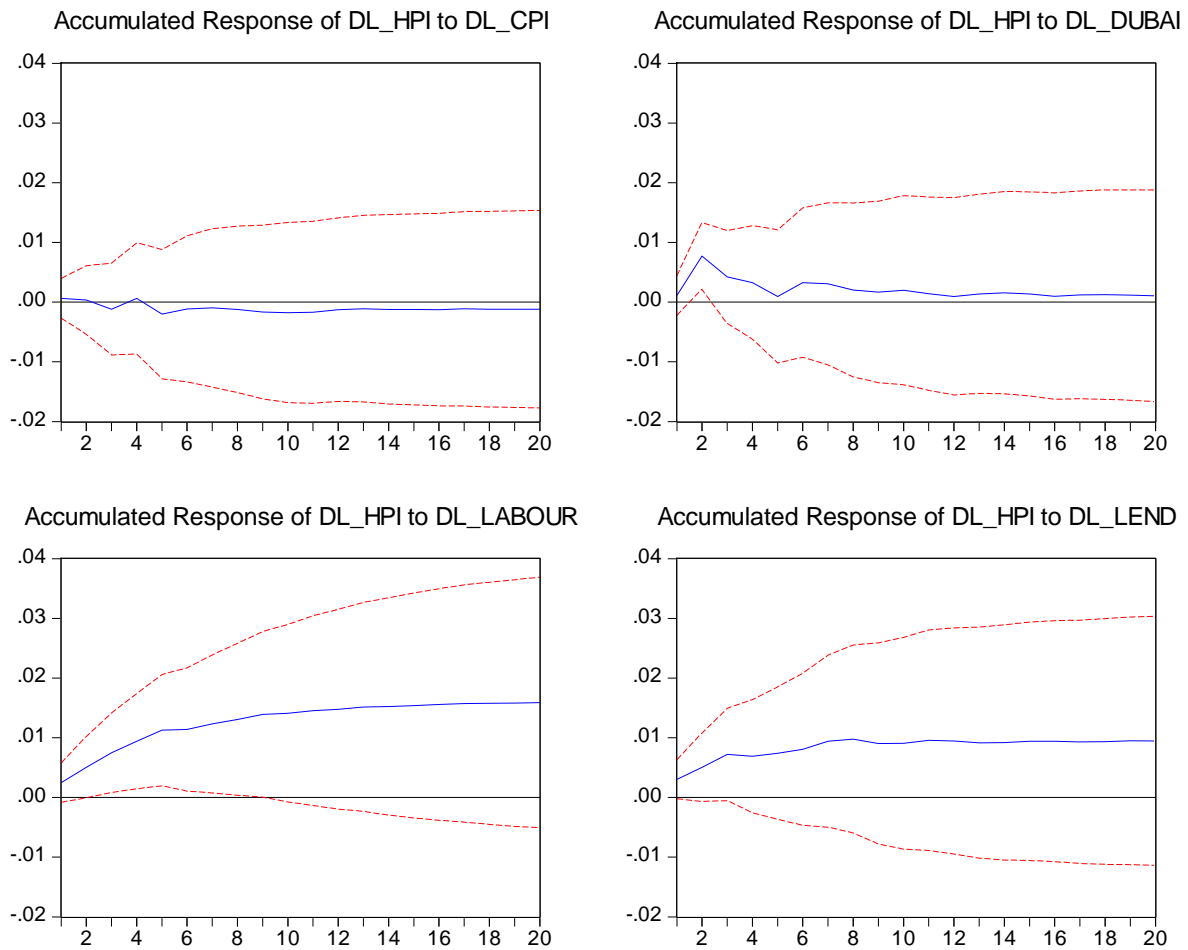
**Figure 1: Contribution of oil rents to GDP**



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).

**Figure 2:**

Accumulated Response to Generalized One S.D. Innovations  $\pm 2$  S.E.



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