Measuring the Effects of World Oil Price Change on Economic Growth and Energy Demand in Malaysia: An ARDL Bound Testing Approach

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Abstract—**This paper investigates the effects of world oil price change on economic growth and energy demand in Malaysia by using an ARDL bounds testing co-integration approach. The results revealed that changes in world oil price benefitted the Malaysia's real GDP in the short term. Interestingly, the estimated results showed that energy demand is found to be an oil price inelastic and income elastic of demand, consistently in the short and long run. In addition to that, there was a bidirectional causality effect between energy demand and GDP, which would have important implications for energy policy, where the energy policy may be implemented without convey adverse effects to both energy sector and economy performance. Given the dominant effects of oil price on energy demand and economic growth, this study suggests that policy planner should confer prompt response and choose the right mechanism of energy conservation and fiscal policy, especially to keep environmental friendly with sound macroeconomic balances. Also, in order to retard the fuel import growth, inter fuel substitution towards indigenous resources, mainly green energy resources would be required critically.**

Index Terms—**ARDL, economic growth, energy demand and oil price.**

I. Introduction

The Malaysia economy has been growing steadily in the last several decades. With an annual average growth projected at 4.8%, the demand for energy demand will inevitably increase. During the 8th Malaysia Plan, several strategies were formulated to meet the challenge including the promotion of renewable energy and efficient utilization of resources. Meanwhile in the next Malaysian Plan,the development of the energy sector focuses on the diversification of fuel sources especially nonfossil fuel to reducing the dependency on fossil fuel products. Owing to the importance of the energy sector to the Malaysian economy, the National Depletion Policy has been formulated to preserve the Malaysian economy's energy resources, particularly oil and gas resources. The Four-Fuel Policy was introduced to reduce the economy's overdependence on oil and later was expanded to incorporate renewable energy as the fifth fuel after oil, gas, coal and hydroelectric.

Economic growth is a key determinant of energy sector growth. Although there is not a one-to one relationship between GDP growth rates and energy demand growth rates, there is a strong positive correlation between energy demand and economic growth in Malaysia from 1966 to 2006 (from First to Tenth Malaysian Plan) where the average annual growth rate of energy demand and real GDP are at 6.67 and 6.4 per cent, respectively. [1]. This means that energy demand typically increases with consistent with increasing in GDP growth. Thus, it is no doubt that energy infrastructure growth has been regarded as indispensable to economic development, and is now the driver and stimulus for greater economic growth in Malaysia.

It was witnessed that rising oil prices especially in 2007 and 2008 had substantially increased government subsidies as the gap between world market prices and the price caps on electricity and petroleum products widened. In fact, Malaysia has had a cap on the price of electricity and petroleum products for almost 10 years. Specifically, Malaysia has been subsidizing its liquefied natural gas (LNG) since January 1990, diesel since October 1999, and petrol since June 2005 [2]. Since then, it has been running a fiscal deficit which has been growing progressively from RM5 billion in 1998 to RM 36.5 and RM48 billion for 2008 and 2009, respectively. Evidently, the fuel subsidy has made a hole in the country's budget, contributing to the fiscal deficit, which stood at 4 per cent of GDP in 2008 and increase to 4.7% in 2009, putting pressure on the budget and prompting the Malaysian government to review their subsidy policies. In addition, as a proportion of GDP, Malaysia is one of the world's highest subsidized countries in terms of GDP compared to Indonesia 2.7%, Philippines 0.2% and OECD countries at 1.5% on average in year 2009 [3].

In line with this, recently, under the new Economic Transformation Programs (ETP) Model, a Road Map of Malaysia towards Vision 2020 realizations, the Malaysian government has put great endeavor to rationalize the subsidy reform framework. This is done by resoluting the subsidy reform framework under their one of the 12 National Key Economic Areas (NKEAs). Subsequently, in July 2010 subsidies for petroleum products as well as sugar, have been reduced as the first step in a gradual subsidy rationalization program.

However, the impact of high oil prices on Malaysia's overall economic performance would also depend on the exposure of the Malaysian economy to oil, and the extent of the spillover effect of the increase in costs on other products and services. At the first glance as an oil exporting country, high oil prices would benefit the Malaysian economy as the

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positive gains from higher oil prices would offset any negative impact on the economy.

In this context, this paper attempts to explore the effects of oil price changes on energy demand and economic growth in Malaysia. These tests are useful in assessing the interdependence of energy demand to real income and the world oil price for Malaysian economy. In order to accomplish the empirical analysis, this research will apply the bounds testing (or autoregressive distributed lag, ARDL) co-integration procedure, developed by M. Pesaran and Shin (1997) [4] and further extended by Pesaran *et al* [5] by using time series data (1980 – 2005). The rest of the paper is structured as follows. Section 2 presents the past studies. Section 3 presents data sources and research methodology. Section 4 describes the empirical results and findings. Section 5 discusses the Policy Implications and finally Section 6 includes several conclusions and further study's recommendations.

II. Past Studies

The relationship between oil price, energy demand and economic growth is now well established in the literature as the direction of causality has significant policy implications. Generally, there are three groups of causality directions findings can be found. First, a large number of studies found unidirectional causality running from energy demand to GDP. For instance, Abosedra and Baghestani (1989) argued that the direct Granger test should be used to determine the direction of this causality. They concluded that for all sample periods tested (1947–1972, 1947–1974, 1947–1979, and 1947–1987); there was a unidirectional causality between GNP and energy demand. [6]. Kraft and Kraft (1978) supported the unidirectional causality from GNP growth in energy demand in the United States of America for the period of 1947-1974.[7].

Secondly, a group of studies that found bi-directional causality. Yang (2000) for example found bidirectional causality between aggregate energy demand and GDP in Taiwan. However, he observed different directions of causality when energy demand was disaggregated into different kinds, including coal, oil, natural gas and electricity. His results implied the importance of analyzing the relationship between different sources of energy demand and GDP [8]. Empirically, the direction of causality between energy demand and economic activities in the developing as well as in the developed countries had been searched by employing the Granger or Sims techniques.

Also in another study, Ebohon (1996) found a simultaneous causal relationship between energy demand and economic growth in Tanzania and Nigeria [9]. The last group comprises of studies that found no causal linkages between energy, or even electricity, consumption and economic growth for instance, Yu and Chai (1988) [10]. Stern (1993) also found the absence of any causality in the United States was also revealed as a part of a larger study including other countries. They tested data for six industrialized countries, and found no significant causal relationship between energy demand and GDP growth and, energy and employment [11]. Erol and Yu (1987) found no relationship between energy and GNP [12].

However, most of these studies had focused primarily on developing economies. The unidirectional causality between energy demand and economic growth seems to be more consistent for these countries. So, the conclusion is that a reliable increasing energy supply is required to meet growing energy demand, and as a result to sustain paths of economic growth. Therefore, a further implication is that energy conservation policies may come into conflict with economic growth. In assessing the oil price effects to energy demand and macroeconomic performance, many researchers have concluded that there is a negative correlation between increases in oil prices and the subsequent economic downturns in the United States. Knut (1989) found an asymmetry between the responses of the GDP and oil-price increases and decreases, concluding that the decreases were not statistically significant. Thus, his results confirmed that the negative correlation between GDP and increases in oil-price was persistent when data from 1985 onwards were included [13]. Most of the studies mentioned above incorporated bivariate models which contain energy and an economic variable for co-integrating relationships and use error correction models to test for granger causality.

Other studies also used bivariate models, for instance Nachane *et al* (1988) [14], Glasure *et al* (1997) [15], and Cheng and T.W. Lai (1997) [16]. Aside from the bivariate models there were a few studies that utilized multivariate models that allow for more than two variables in the co-integrating relationships, (see example Mehrara (2007) [17] and Mahadevan and Adjaye (2007) [18]. The most common variables used were total primary energy demand and real GDP, but many studies also looked at specific sectors and energy forms (e.g. industrial, residential and transportation sector or coal, oil, gas and electricity consumption). Only a few studies included energy prices (including oil prices) as a third variable, but most of them used the consumer price index as a proxy, for instance Masih and Masih (1996) [19] and Adjayae (2000) [20].

III. Data Sources and Research Methodology

A. Data

This study uses annual data from the year (1980 to 2010) period to examine both short run and long run relationships between real growth domestic product (LRGDP), energy demand (LEND), oil prices (LOILP) and employment (LEMP) for Malaysia. Yearly data on real GDP was measured in constant price (2000 as a base year), denominated in US Dollars and energy demand was measured in kt of oil equivalent (ktoe).

Real GDP and energy demand were taken from the World Bank database (www.worldbank.com). Meanwhile, Employment of millions of people and world oil prices dominated in US Dollars in constant price (2000 as base year), were taken from Economic Planning Unit Malaysia (www.epu.gov.my). All data series were transformed into a logarithm form in order to standardize the different units of measurement.

B. Research Instrument

The models in this study have been estimated by using the bounds testing (or autoregressive distributed lag, ARDL) co-integration procedure. Basically, the ARDL method of co-integration analysis is unbiased and efficient. This is because it performs well in small sample size which is also the case in this study (30 observations).

It is also applicable irrespective of whether the underlying variables are integrated of *I* (1) or *I* (0). We can also estimate the long run and short run components of the model simultaneously. The ARDL method can distinguish dependent and explanatory variables. The data analysis will be conducted by using Microfit 5 software.

C. Methodology

The first step of this analysis is to treat the model as a system of first-difference equations, then the variables must be tested for stationary processes. The ARDL bounds testing procedure can be applied irrespective of whether the variables are I (0) or I (1). In this study, the stationary test of Augmented Dickey and Fuller (ADF) test will be used to test whether α =0, therefore the null and alternative hypothesis of unit root tests can be written as follows:

Ho: $\alpha = 0$ (Y_t is non-stationary)

Ha: $\alpha < 0$ (Y_t is stationary or non unit root)

The unit root hypothesis using the ADF test can be rejected if the calculated pseudo-t value (ADF statistics) lie to the left of the relevant critical value or alternate hypothesis is that α is less than zero (α< 0), meaning that the variable to be estimated is stationary. However, normally after taking first differences, the variable will be stationary [21].

The next step is to test for the presence of the long run relationship through the bounds testing approach to estimate the long run relationship between LRGDP, LEND, LOILP and LEMP in equation (1) and equation (2). The last step is to estimate the association of ARDL error correction models.

TABLE I: HYPHOTHESIS

H_0 (No long run relationship)	H_1 (A long run relationship)
$n_{11}= n_{12}= n_{13}= n_{14}=0$	at least one $n_{ij} \neq 0$
$n_{21}= n_{22}= n_{23}= n_{24}=0$	at least one $n_{ij} \neq 0$

D. Model Specification

In this study we focus only in two models which are *Energy Demand Model* (LEND) and *Real GDP Growth Model* (LRGP) in order to assess the impact of world oil price change in energy demand and income for short run and long run effects. The error correction model representation of the ARDL model can be written as follows:

$$\Delta \ln END_t = \beta_0 + \sum_{j=1}^{k} \beta_{11} \Delta \ln END_{t-j} + \sum_{j=0}^{k} \beta_{12} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \beta_{13} \Delta \ln OILP_{t-j} + \sum_{j=0}^{K} \beta_{14} \Delta \ln EMP_{t-j} + n_{11} \ln END_{t-1} + n_{12} \ln RGDP_{t-1} + n_{13} \ln OILP_{t-1} + n_{14} \ln EMP + \xi_t \quad (1)$$

$$\Delta \ln RGDP_t = \beta_0 + \sum_{j=1}^{k} \beta_{21} \Delta \ln RGDP_{t-j} + \sum_{j=0}^{k} \beta_{22} \Delta \ln END_{t-j} + \sum_{j=0}^{k} \beta_{23} \Delta \ln OILP_{t-j} + \sum_{j=0}^{K} \beta_{24} \Delta \ln EMP_{t-j} + n_{21} \ln RGDP_{t-1} + n_{22} \ln END_{t-1} + n_{23} \ln OILP_{t-1} + n_{24} \ln EMP + \xi_t \quad (2)$$

The terms with the summation signs in the above equations represents the error correction dynamics while the second part (terms with η_{ijs}) corresponds to the long run relationship; Δ denotes a first difference operator; *ln* represents a natural logarithmic; β_0 is an intercept and ξ_t is a white noise. In other hand, the *F-test* or Wald test is used to test for the existence of long run relationship. If the computed F-test is higher than the upper bound, the null hypothesis of no co-integration is rejected. If the *F-test* is lower than the lower bound than the null hypothesis cannot be rejected. Meanwhile, if the F-test lies between the lower and the upper bounds, conclusive decision inference cannot be made. Once the co-integration is confirmed, the further two step procedure in ARDL is taken to estimate the models.

IV. Empirical Results and Findings

We have estimated the short run and long run relationships between oil price, energy demand, real GDP and employment. These estimations are presented step by step as follows:

A. Unit-Root Tests

Table II shows that all variables have a unit root in their level, since the *p*-value for all series are not significant at all levels. Based on these estimated result we failed to reject the null hypothesis of unit roots even at the 10% significance. However, when we perform the unit root test at first difference, I (*1*), the results indicate that all variables are I (*1*) since the *P*-value is significant at 1% and 5%. This means that after we have taken the first difference of all variables, there is no evidence of the existence of unit roots. Interestingly, however, first differences of all the variables show stationary under this test.

TABLE II: RESULTS OF ADF TESTS

ADF		
Variables	Level	1st Diff
LRGDP	-2.385441	-5.064396***
LEND	-2.958903	-6.677150***
LOILP	0.735199	-4.120358***
LEMP	-2.577672	-5.880473***

Note: *,**,*** denotes sig. level of 10%, 5%, 1%, respectively

B. ARDL Bounds Test for Long Run Analysis

The results of the ARDL bounds test in regard to Malaysia are reported in Table 3. In the LEND and LRGDP model, with LEND and LRGDP as dependent variables, we note that the computed F-statistics for Malaysia is above the upper bound critical values provided by Narayan (2005) [22]. Hence, we have strong evidence to reject the null hypothesis of no co-integration at 1%, 5% and 10% significance level, respectively. It shows that there was a long run relationship between LRGDP, LEND, LOILP and LEMP for LRGDP and LEND Model.

TABLE III: BOUNDS TEST RESULTS

F-statistics	LEND Model	LRGDP Model
	4.4608**	9.2718***
1% I(0)	4.614	4.614
I(1)	5.966	5.966
5% I(0)	3.272	3.272
I(1)	4.306	4.306
10% I(0)	2.676	2.676
I(1)	3.586	3.586

Notes: *,** and *** indicate 10%, 5% and 1% level of significance, respectively.

We estimated two separate models for the period of 1980 to 2010. We used the $\bar{R}^2$ criterion to find the coefficient of the level variables. The results for Malaysia indicated that there is existence of long run co-integrating relationships among the variables. Based on the Johansen and Juselius Co-integration test, there is one co-integrating relationship among the variables in LEND Model and LRGDP Model. We estimated two separate models for the period of 1980 to 2010.

TABLE IV: LONG-RUN ESTIMATION RESULTS

Energy Demand Model (1)				
$LEND_t$ =	-15.408^{***}	$+ 0.8623\Delta lnRGDP_t^{**}$	$- 0.0260\Delta lnOILP_t$	$+ 0.4945\Delta lnEMP_t$
SE:	(0.5639)	(0.1055)	(0.0160)	(0.2314)
t :	(-27.325)	**(8.177)**	(-1.6285)	**(2.1369)**
Real GDP Model (2)				
$LRGDP_t$ =	14.609^{***}	$+ 0.8128\Delta lnEND_t^{**}$	$+ 0.0206\Delta lnOILP_t$	$+ 0.2048\Delta lnEMP_t$
SE:	(2.924)	(0.2693)	(0.0291)	(0.6352)
t :	(4.995)	**(3.018)**	(0.7055)	(0.3225)

The presence of co-integration among these variables also had been found by other researchers. For instance,Maamor and Sahlan (2005) found that there is presence a co-integration relationship between economic growth, energy demand and employment in the long run for Malaysia during the period of 1975-2000 [23]. Pedroni (2004) also, indicated at least one co-integrating relation for the panel of 19 European countries, which confirmed the presence of the long run relationship between the energy demand, economic growth and energy price [24]. The results for Malaysia indicated that there is existence long run co-integrating relationships among the variables. The details of the models are discussed below.

*Model 1*shows that in the long run the real GDP and level of employment have emerged as a significant determinant of energy demand function, with *a t*-value (8.177 and 2.14), respectively, but the average world oil price was not significant. The value of income elasticity of demand for energy is near to 1 (0.86). These results are in line with the Goldstein-Khan values [1.0, 2.0] for typical income elasticity [25]. Equation in *Model 2* shows that there is positive relationship between energy demand and economic growth. However, the employment growth and average oil price were not significant in this model. This result seems to support our expected findings which suggested that when energy demand growth increases, there will be an increase in economic growth.

C. Error Correction Models for Short Run Analysis

Short run estimation results in the error correction representations of LEND model and LRGDP models are provided in Table 5. The error correction terms (EC_{t-1}) of the LRGDP model and LEND model are statistically significant at the 1% level with appropriate sign (negative), verifying the established co-integrating relationships among the variables. The coefficients of EC_{t-1} measures the speed of adjustment back to the long run equilibrium after a short run shock. The absolute value of the coefficients of EC_{t-1} in LRGDP model is moderate, indicating the fairly moderate speed adjustment to the long run equilibrium following short run shocks. For example, the coefficient of EC_{t-1} is 0.445 in the case of LRGDP Model. This implies that, nearly 45% of the disequilibria in this model of the previous year's shock adjust back to the long run equilibrium in the current year.

Equation 1 (Energy Demand Model) shows that in the short run the real GDP, the level of employment and average world oil price have emerged as a significant determinant of energy demand model. The aggregate energy demand is found to be *an oil price inelastic of demand (α < 1)*. The coefficient estimates of Equation 1 (-0.18) indicates that, in the short run when oil price increases by 1% then the energy demand would decrease by 0.18%. The negative causality result running from oil price of energy demand would then support our expected findings.

On the other hand, the positive value of *income elasticity of demand* is greater than unity for *Equation 1 (1.18)*, indicates that, in the short run when national income increases by 1%, the energy demand would increase by 1.18%. Also, the significant value of real income in the energy demand function indicates that in the short run there is positive unidirectional causality running from real income to energy demand. This result was captured by *the T*-value was 0.002 and significant at the 1% level which inferred that the growth rate of national income would lead to more demand for energy.

Equation 2 (Real GDP Model) shows that the energy demand and average world oil price have emerged as a significant determinant of the real GDP model. The significant value of the energy demand and average oil price in real income function would indicate that in the short run there is positive unidirectional causality running both from oil price and energy demand to real income.

TABLE V: THE ERROR CORRECTION REPRESENTATION OF THE SELECTED ARDL MODEL

***LEND* Model (1); (1, 0, 1, 1)**

$\Delta lnEND_t = -39.63^{***} + 1.187\Delta lnRGDP_t^{***} + 0.513\Delta lnRGDP_{t-1} - 0.614\Delta lnRGDP_{t-2} - 0.183\Delta lnOILP_t^{***} - 0.1065\Delta lnOILP_{t-1} - 0.054\Delta lnOILP_{t-2} + 0.057\Delta lnOILP_{t-3} - 0.057\Delta lnOILP_{t-3} - 1.387\Delta lnEMP_t - 2.495\Delta lnEMP_{t-1}^{**} - 1.998\Delta lnEMP_{t-2}^{**} - 2.572ECT_{t-1}^{***} + \xi_t$

$\bar{R}^2 = 0.7571$, F-stat. = 7.944, SSE = 0.033, $EC_{t-1} = -2.572$, DW = 2.187

$\chi^2_{sc} = 1.676$; $\chi^2_{ff} = 0.033$; $\chi^2_{nor} = 2.426$; $\chi^2_{het} = 1.906$

***LRGDP* Model (2); (3, 3, 4, 3)**

$\Delta lnRGDP_t = 6.495^{***} + 0.361\Delta lnEND_t^{***} + 0.0724\Delta lnOILP_t^{**} + 0.625\Delta lnEMP_t - 0.445ECT_{t-1}^{***} + \xi_t$

$\bar{R}^2 = 0.5252$, F-stat. = 9.2427, SSE = 0.028, $EC_{t-1} = -0.4446$, DW=1.9803

$\chi^2_{sc} = 0.558$; $\chi^2_{ff} = 2.109$; $\chi^2_{nor} = 0.5434$; $\chi^2_{het} = 0.0209$

The result was captured by the T-value was 0.002 and 0.015, respectively and significant at 1% and 5% level. These inferred that in the short term, higher oil price would lead to more income for the country.The positive causality means if the world oil price increase it would increase the real GDP in the same direction. However, employment emerge insignificant to the above model. The overall VEC causality results is summarized in Fig. 1.

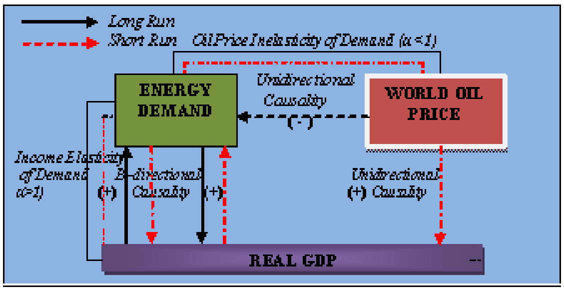

Fig. 1. Effects of World Oil Price Change on Economic Growth and Energy Demand

Fig. 1. shows that there is a *positive bidirectional* causality running from energy demand to real GDP and real GDP to energy demand, both for short run and long run. The ECM causality test indicated that there is the positive unidirectional causality effect of world oil price on real GDP and negative *unidirectional causality* effects of oil price to energy demand and the world oil price would become exogenous variables in the Malaysian economy.

In other words, the changes of world oil price give *a beneficial impact* to real GDP but *adverse* impact of the energy demand in the short run. Interestingly, the estimated results show that energy demand is found to be *an oil price inelastic* and *income elastic of demand*, consistently in the short run and long run, with their coefficient values are in line with the Goldstein-Khan results which lie between [-0.5, -1.0] for typical price elasticity and [1.0,2.0] for typical income elasticity.

V. Policy Implications

The direction of causality has significant policy implications. If, for example, there is unidirectional causality running from economic growth to energy demand, it may imply that energy policies may be implemented with little *adverse* or no effects on economic growth. On the other hand, if unidirectional causality runs from energy demand to income, reducing energy demand i.e. due to higher oil price could lead to income cut or vice versa. If there is 'no causality' in either direction, the co-called 'neutrality hypothesis' would imply that energy policies do not affect economic growth, as in [4]. The estimated result of long run analysis shows that there was a strong relationship between real GDP and energy demand, with a positive sign. These results inferred that the growth rate of national income and energy demand complements each other, which is shown by the positive relationship among them.

However, the coefficient estimates of real GDP in the energy demand Model (Model 1) are slightly higher than parameter estimates of energy demand in GDP Model (Model 2), which are 0.86 and 0.81, respectively (refer table 4). This means that energy demand is more depend on GDP rather than GDP depend on energy demand. This result would have important energy policy implications**.** In another research, Maamor and Sahlan (2005) also found a strong long run relationship between Real GDP and energy demand in Malaysia [23]. These results were also found in other literatures, for instance Ghosh (2002) [26], Fatai *et al* (2004) [27], Hatemi and Irandoust (2005) [28]. Furthermore, a positive *bidirectional* causality running from economic growth to total energy demand and vice versa suggests that in the short run energy demand and economic growth complement each other but efficiency policies or other policy would not have any *adverse* impact to each other. Given the non *adverse* effects between energy demand and economic growth, better response and right mechanism of energy conservation and fiscal policy should exist to curb the use of non-renewable subsidized energy and to shift extensively inter fuel substitution towards indigenous resources, mainly renewable energy as well as to restore sound macroeconomic balances. In other words, energy conservation policy i.e. energy efficiency policy, green energy policy and energy saving policies may be implemented with little *adverse* or no harm effects on economic growth in the short run. The findings of this study which is a *bidirectiona*l running from real GDP to energy demand also have been supported by the previous research especially in developed countries for instance Soytas and Sari (2003) [29] and Oh and Lee (2004) [30]. They found the *bidirectional* causality from GNP growth to energy demand and vice versa in the USA for the period of 1947-1974.

Importantly, the *bidirectiona*l causality result also had been supported by the Granger causality analysis, suggested that there could be two-way causality between energy demand growth and economic growth in the future. There could be a similar *unidirectional* influence from economic growth to disaggregated energy demand and from disaggregated energy demand growth to economic growth [31]. Surprisingly, the most important finding here indicated that the changes in world oil price would have *a beneficial impact* to Malaysia's real GDP in the short term but not in the long term.

TABLE VI: REAL GDP AND FISCAL COMPONENTS FROM OIL 2005-2010 (RM BILLIONS)

	2005	2006	2007	2008	2009	2010
Real GDP	4493	4755	5049.2	5283	5192.2	5596
Total Revenue	106.3	123.5	139.9	159.8	158.6	160.9
Revenues from Oil*	31	45.5	51.1	67	68.8	68
Fuel Subsidies	9.717	10.86	10.437	8.1	7.89	na
Total Subsidies	11.85	14.48	14.7	16.2	26.3	48.41**
Fuel Subsidies/Oil Revenues (%)	31.35	23.87	20.42	12.09	11.47	na
Oil Revenue/Total Revenue (%)	29.16	36.84	36.53	41.93	43.38	42.26
Fuel subsidies/Real GDP (%)	0.216	0.228	0.207	0.153	0.152	na
Oil Revenue/Real GDP (%)	0.690	0.957	1.012	1.268	1.325	1.215

Note : *Oil tax, royalty and dividend and export duty

**The figures include other transfer payments & education subsidies

Source : www.epu.com.my and Ministry of Finance Malaysia

However, the insignificant of oil price changes affect to the Malaysia's GDP for long term analysis also have been supported by other studies of oil price effects in Malaysia, but they found the insignificant result in the short term [32].

The significant difference in findings for short term analysis could be that the authors used different methodology which was VECM and covered only in year 1980 to 2005 (less than 30 years) whereas our research use ARDL approach, which is more robust to capture a small sample size of the analysis. The difference of five year time series also carried varies significant result, especially during rising world oil prices in the year 2007 and 2008.

Furthermore, the impact of high world oil prices would also depend on the degree of the exposure of the Malaysian economy to oil (as Malaysia is a small oil exporting countries), especially in the case of fuel subsidies economy that could lessen the worst effects on household energy and non energy demand and also depends on energy elasticity of demand, especially for short term and in the long term effects.

As an oil exporting country, high oil prices in the short term, especially for the year 2005 to 2009, where crude oil price has increased sharply from USD57 to USD 95 per barrel, the latter would benefit from slightly higher crude oil price. (Refer Table 6). Thus, volatility in crude oil prices i.e. positive shocks have proven gives a *beneficial* impact on the Malaysia economy, as it has to other oil producing countries.

This is also being supported by earlier findings by Villafuerte and Murphy (2009) which focused on the 31 Oil Producing Countries (OPCs). The studied found that oil revenue is a critical source of fiscal revenue where fiscal oil revenue accounted for more than 25% of total fiscal revenue over the (2005-2008) period [33]. In the case of Malaysia, oil revenue has contributed 29.2% up to 42% of total revenue for the (2005-2008) period. (Refer Table 6.)

Furthermore, it is found that crude oil is the Malaysia's biggest mineral export accounting for about 5% (RM32 billion) of total exports in the year 2011. Petroleum related income is the largest single contributor to the government revenue. It accounted about 33.9% or RM62.9 billions of government's total revenue in 2011. In 2009, it reached its highest level at almost 40% or RM 68.8 billions. This latter would also help to narrow the deficit gap for Malaysia. Moreover, the positive gains from slightly higher oil prices could also offset any *adverse* impact to the economy. This is done through pump priming whereby revenue from higher oil prices can be channeled back into the domestic economy through government expenditure via fuel subsidies and later increase others sectors output contribution.

In other words, gaining income from oil revenue from slightly higher oil price is larger than the amount of fuel subsidies that government has to bear. (Refer Table 6 and Fig. 2). Fig. 2 shows that the revenue growth rate is on average at 9.5 per cent of the (2000-2010) period while the average expenditure growth rate for the (2000-2010) was slightly below then revenue (9 percent). In terms of per oil revenue, fuel subsidies accounted for 31.4% of oil revenues for the year 2005 and decrease to 12.1% and 11.5% for the year 2008 and 2009, respectively. It also shows that fuel subsidy per real GDP also have decreased from 0.22% in the year (2005) to 0.153% and 0.152% for the year (2008 – 2009), respectively. (Refer Table 6).

The non adverse effects of higher oil price to real GDP growth in the short term also could be explained by the implementation of several government policies. For instance, the monetary policy that relates to attain an appropriate balance between maintaining price stability has able to absorb the *adverse* effects of oil price shocks as well as achieving the maximum sustainable level of economic growth. While fiscal policy that relates to macro-economic policy management i.e. price mechanism, fuel subsidy reforms and tax rebate, has able to help the economy return to the right track with sound macroeconomic balance.

Furthermore, this could also be explained by the successful fuel rebalancing which significantly decreased Malaysia's oil demand between (1980 and 2002) period. The dramatic shift reduced Malaysia's exposure to oil prices, and provided the foundations for a stable power sector; in turn avoid the severe or *adverse* impact to nation's real GDP growth.

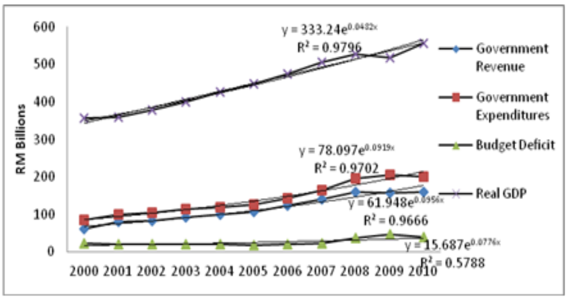

Fig. 2. Revenues, Expenditures, Real GDP and Deficit, 2000-2010 (RM Billion).

Regarding the negative unidirectional causality effects running from oil prices to energy demand, it shows that, in the short term the world oil price changes would have an *adverse* effect of the energy demand. This result seems to support our expected finding and theoretically correct, as there could be a negative relationship between oil price and energy demand in the short term. Indeed, the negative effects of oil price in energy demand have contributed a *beneficial effect* which could support the government energy saving and efficiency policy to reduce the carbon emission in the economy. Also, the aggregate energy demand is found to be *oil price inelastic demand* ($\alpha < 1$) while the value of income elasticity of energy demand is greater than unity (1.77). This would imply that in the short term increase in world oil price have *adverse affects* to the aggregate energy demand in Malaysia. However, in other hand, the energy demand aggregate is elastic or more sensitive the changes in growth of real output rather than the oil price.

The negative *unidirectional* causality effects running from oil prices to energy demand in the short term also has indirect effects to real GDP growth. This could be explained by the spillover effects that trigger the economy's response. Increasing the price of energy (i.e. gas and fuel price) in the short term will have two effects: direct and indirect effects on the general price level. The increase of oil price directly increases in the consumer price index (CPI) and causes the indirect effect to the Producer Price Index (PPI) [34]. The industry producers will transfer the increase in the energy prices in their operating cost to the goods and services price. This will trigger macroeconomic effects (i.e. household consumption, government expenditure, investment) in the form of the increases in petroleum product price and other prices of goods and services. This in turn would increase the real GDP growth via total aggregate demand (AD) in the economy.

On the other hand, the uncertainty of the oil prices may also affect the consumer expectation as they expect the higher oil price could be long. As a result, in the short term, they will reduce the energy used, and in the long term they probably shift to the inter fuel substitution mainly bio fuel or alternatives. Hence, in the short term, the high oil price will lead a decrease in the non-renewable energy demand.

However, in the long terms the economic system had corrected its previous disequilibrium by responding to this feedback (which showed by the negative value of ECT in Equation 1 and 2) and move towards equilibrium. The reasons could be that when there is an oil price shock or crisis in the economy the government will respond and give feedback to this shock through its various policies mechanisms. For instance, price mechanism control, fiscal stabilizing policies, monetary policies and fuel subsidy policies in order to control the *adverse* effects to the economy. This in turn could help return the economy to the right track which could lessen the worst impact of the shock to the economy.

VI. Conclusions and Future Studies

Given the *non-adverse* effects between energy demand and economic growth that is bidirectional effects, the study could suggest that for achieving higher economic growth, reducing oil, gas and coal especially in the consumption sectors of the economy would have a *beneficial* impact on the current account balance via reducing the deficit. The consumption of these non-renewable energies would increase the deficit in Malaysia's balance of payment position of the economy in the future.

Therefore, there should be extensive efforts by all parties in the country to exploit the renewable sources of energy for consumption and production purposes especially in the industrial sector. It has been suggested that in order to reduce the fuel import growth, inter fuel substitution towards indigenous resources, mainly renewable energy would be required critically. One can also undertake a study on the energy use in different sectors and their contribution to the growth of the sector as each sector has the different energy use intensity for different forms of energy use.

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