UNIVERSITI PUTRA MALAYSIA

ENERGY CONSUMPTION AND PASS-TROUGH EFFECT OF FUEL PRICE IN MALAYSIA

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FEP 2015 3

ENERGY CONSUMPTION AND PASS-TROUGH EFFECT OF FUEL PRICE IN MALAYSIA

By

POH PAIK XUAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

July 2015

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

ENERGY CONSUMPTION AND PASS-TROUGH EFFECT OF FUEL PRICE IN MALAYSIA

By

POH PAIK XUAN

July 2015

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The issue on energy has been hotly debated whether on its production, consumption or price due to its importance in our daily life. Essentially the purpose of this thesis is twofold. First and foremost, the first objective investigates the long run relationship between energy consumption and the economic output in Malaysia by including trade openness. This is motivated by the concern of the narrowing gap between energy consumption and production as well as the importance of the export led growth strategy. The annual data employed from 1980 until 2011 utilizing the Fully Modified Ordinary Least Square (FMOLS) as the main method and Dynamic Ordinary Least Square (DOLS) for robustness check. The finding drawn shows that energy is a restrictive factor to economic development and the export led growth strategy implemented contribute to the vital role of trade openness as a stimulus to economic growth. Hence government can provide incentive at various levels to encourage the usage of renewable energy as well the research and development (R&D) to increase the usage of renewable energy. Besides that, a more active role can be played by the government through ASEAN Free Trade (AFTA) in order to harvest good relationship with the neighboring countries to ensure conducive trade liberalization environment.

On the other hand, the second objective studies the pass-through effect of actual diesel price and retail diesel price into Malaysia's consumer price. As the government is rationalizing the subsidy on fuel, this inspires this study to compare the effect of actual diesel price and retail diesel price on consumer price. The well-established Autoregressive Distributed Lags (ARDL) method is adopted by incorporating the quarterly data spanning from 2005 until 2013. The results indicated that the

transmission effect of actual diesel price is bigger where no subsidy is given comparatively to the retail diesel price whereby the price is subsidizes by the government. The sub-price indexes that are most affected by the transmission of the actual diesel price is the food and non-alcoholic price index as well as the transport price index. Therefore the policies outline should include efficient distribution and marketing chains of food products besides developing the public transportation, encourage carpooling as well improve the freight transport management. This will essentially reduce reliance of consumers on the fuel.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

PENGGUNAAN TENAGA DAN KESAN TRANSMISI HARGA MINYAK DI MALAYSIA

Oleh

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Isu tenaga telah menjadi perdebatan hangat sama ada berkenaan pengeluaran, penggunaan atau harganya kerana kepentingannya dalam kehidupan seharian kita yang tidak dapat dielakkan. Pada dasarnya, tujuan tesis ini adalah untuk menepati dua sasaran. Pertama sekali, objektif pertama adalah untuk mengkaji hubungan jangka panjang antara penggunaan tenaga dan pengeluaran ekonomi di Malaysia dengan mengambil kira keterbukaan perdagangan. Ini didorong oleh kebimbangan pengurangan jurang di antara penggunaan dan pengeluaran tenaga serta kepentingan eksport yang menyumbang kepada pertumbuhan ekonomi. Data tahunan dari tahun 1980 sehingga 2011 menggunakan 'Fully Modified Ordinary Least Square' (FMOLS) merupakan kaedah utama yang diguna pakai dan 'Dynamic Ordinary Least Square' (DOLS) digunakan untuk ujian penyemakan keteguhan. Penemuan menunjukkan bahawa tenaga adalah faktor terhad kepada pembangunan ekonomi dan pertumbuhan berteraskan eksport yang dilaksanakan menyumbang kepada peranan penting keterbukaan perdagangan sebagai perangsang kepada pertumbuhan ekonomi. Oleh itu kerajaan boleh memberikan insentif di pelbagai peringkat serta penyelidikan dan pembangunan (R & D) untuk menggalakkan penggunaan tenaga boleh diperbaharui. Selain itu, peranan yang lebih aktif boleh dimainkan oleh kerajaan melalui Perdagangan Bebas ASEAN (AFTA) untuk merapatkan hubungan dengan negara-negara jiran untuk memastikan persekitaran yang kondusif untuk liberalisasi perdagangan.

Selain itu, objektif kedua kajian adalah kesan transmisi harga diesel sebenar dan harga diesel runcit ke atas harga pengguna Malaysia. Disebabkan oleh, usaha kerajaan merasionalisasikan subsidi ke atas bahan api; ini memberi inspirasi kepada kajian ini untuk membandingkan kesan harga diesel sebenar dan harga diesel runcit ke atas harga pengguna. 'Autoregressive Distributed Lags' (ARDL) adalah kaedah yang diguna pakai dengan menggabungkan data suku tahunan bermula dari 2005 sehingga 2013.

Hasil kajian menunjukkan bahawa kesan transmisi harga diesel sebenar adalah lebih besar kerana tiada subsidi diberikan jika dibandingkan kepada harga diesel runcit di mana harganya disubsidi oleh kerajaan. Indeks sub-harga yang paling terjejas oleh transmisi harga diesel sebenar adalah indeks harga makanan dan minuman tidak beralkohol dan indeks harga pengangkutan. Oleh itu dasar-dasar yang digariskan perlu mengambil kira pengedaran dan pemasaran rangkaian produk makanan yang cekap selain membangunkan pengangkutan awam, menggalakkan perkongsian kereta serta meningkatkan pengurusan pengangkutan barang. Ini pada dasarnya akan mengurangkan kebergantungan pengguna terhadap bahan api.

ACKNOWLEDGEMENTS

I would like to take this opportunity to extend my gratitude and acknowledgement to those who have directly or indirectly contributed to the success of this thesis. First and foremost, I would like to dedicate my sincere appreciation and thankfulness to Associate Professor Dr. Lee Chin for her supervision, generosity in knowledge sharing as well as insightful feedback on my work. Besides that, I am also extremely grateful for her thoughtfulness by sending me to workshops to gain hands on experience as well to conferences to improve my presentation skills.

Besides that, I would also like express my gratitude to my co-supervisor, Associate Professor Dr. Normaz Wana Ismail for her continuous encouragement, guidance as well as consistently channeling positive energy to me throughout my thesis journey. Next, my sincere appreciation also goes to all the staff in the Department of Economics as well as the library of Universiti Putra Malaysia for their generous and kind help.

In addition, I would also like to convey my acknowledgment to all my friends and seniors for their unconditional support and assistance in enlightening me throughout the challenging time. Last but not least, I would also like to express a million thanks to my family for their absolute love and support.

I certify that a Thesis Examination Committee has met on 9 July 2015 to conduct the final examination of Poh Paik Xuan on her thesis entitled "Energy Consumption and Fuel Price into Output and Inflation for Malaysia" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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LIST OF ABBREVIATIONS

AD	Aggregate Demand
ADF	Augmented Dickey-Fuller
AFTA	ASEAN Free Trade Area
AIC	Akaike Information Criterion
AP	Actual Diesel Price
ARCH	Autoregressive Conditional Heteroskedasticity
ARDL	Autoregressive Distributed Lags
AS	Aggregate Supply
AS	Aggregate Supply
ASEAN	Association of Southeast Asian Nations
ATF	Aviation Turbine Fuel
ATPI	Alcoholic Beverages and Tobacco Price Index
AV	Aviation gas
Btu	British thermal units
CFPI	Clothing and Footwear Price Index
CMPI	Communication Price Index
CPI	Consumer Price Index
CUSUM	Cumulative Sum
DF	Dickey Fuller
DHT	Demetrescu, Hassler and Tarcolea Test
DOLS	Dynamic Ordinary Least Square
E	Energy Consumption
ECT	Error Correction Term
EG	Engle Granger
EIA	Energy Information Administration
EME	Emerging Market Economies
EPI	Education Price Index
FDI	Foreign Direct Investment
FHRPI	Furnishing, Household Equipment and Routine Price Index
FMOLS	Fully Modified Ordinary Least Square
FNAPI	Food and Non-alcoholic Beverages Price Index
FPI	Food Price Index
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
HPI	Health Price Index
HWEPI	Housing, Water, Electricity, Gas and Other Fuels Price Index
ICC	International Chamber of Commerce
K	Capital
KPSS	Kwaitkowski-Phillips-Schmidt-Shin
ktoe	kilotons of oil equivalent

kWh	kilowatt hours
LDCs	Less Developed Countries
LPG	Liquefied Petroleum Gas
MGSPI	Miscellaneous Goods and Services Price Index
MHPI	Medical care and Health Price Index
MITI	Ministry of International Trade and Industry
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Lest Square
PCA	Price Control Act
pCADF	Constantini and Lupi Test
PP	Phillips-Perron
R&D	Research and Development
RFPI	Rent, Fuel and Power Price Index
RGDP	Real Gross Domestic Product
RHPI	Restaurant and Hotels Price Index
RM	Ringgit Malaysia
RP	Retail Diesel Price
RSCPI	Recreation Services and Culture Price Index
SBC	Schwarz Bayesian Criterion
SIC	Schwarz Information Criterion
SSA	Sub-Saharan African
TCPI	Transportation and Communication Price Index
TO	Trade Openness
TPI	Transport Price Index
TVP-SVAR	Time-varying Parameter Structural Vector Auto-regression
UECM	Unrestricted Error Correction Model
US	United States
USD	United States Dollar
VAR	Vector Autoregressive
VEC	Vector Error-correction
WTI	West Texas Intermediate
WTO	World Trade Organization
Y	Output

CHAPTER 1

INTRODUCTION

The issue on energy has been hotly debated whether on its production, consumption or price due to its importance in our daily life. This thesis aims to investigate the long run relationship between energy consumption and the economic output in Malaysia and to study the pass-through effect of energy price into Malaysia's consumer price.

1.0 An Overview on Energy

Energy is defined as capability for doing work measured by the potential energy or kinetic energy. Nevertheless energy can take several forms which include those convertible and can be easily converted in another form which deemed to be useful for work. Furthermore majority of the world's convertible energy is contributed by fossil fuels that are burned in order to produce heat. This is then later utilized as a transfer medium to mechanical as well as other means to finish tasks. The heat energy is generally expressed in British thermal units (Btu) whereas the electrical energy measured in kilowatt hours (kWh)[1].

It is recognized that energy resources is divided into two major components which comprises of the renewable and the non-renewable energy sources. According to United States Energy Information Administration (EIA), renewable energy is defined as the energy sources that can be regenerate and sustained indefinitely in which the typically used renewable energy sources include biomass, water, geothermal, wind and solar. On the other hand, the non-renewable energy sources is described as the energy sources that cannot be replenished naturally in a short period of time which consists mainly of oil and petroleum products, natural gas, coal and nuclear energy.

Figure 1.1 indicates the world energy consumption by fuel type which incorporates two set of data; the historical data from 1990 until 2010 and from 2010 onwards up to 2040 which is the projected data. It is clearly observed that fossil fuels[2] are predicted to be the main driving force by contributing greatly to the energy consumed worldwide. The largest source of energy consumed is liquid fuels which are mainly petroleum-based; the liquids portion of the world energy consumption is projected to fall to 28% in 2040 from 34% in 2010. This is mainly due to the shift from the liquid fuels when possible as the higher world oil price is anticipated. On the other hand, the consumption of the renewables shares of the total energy is expected to increase from 11% in 2010 to 15% in 2040.

[1] The definition is acquired from U.S Energy Information Administration Glossary.
[2] Fossil fuels generally include liquids (mostly petroleum based), coal as well as natural gas.

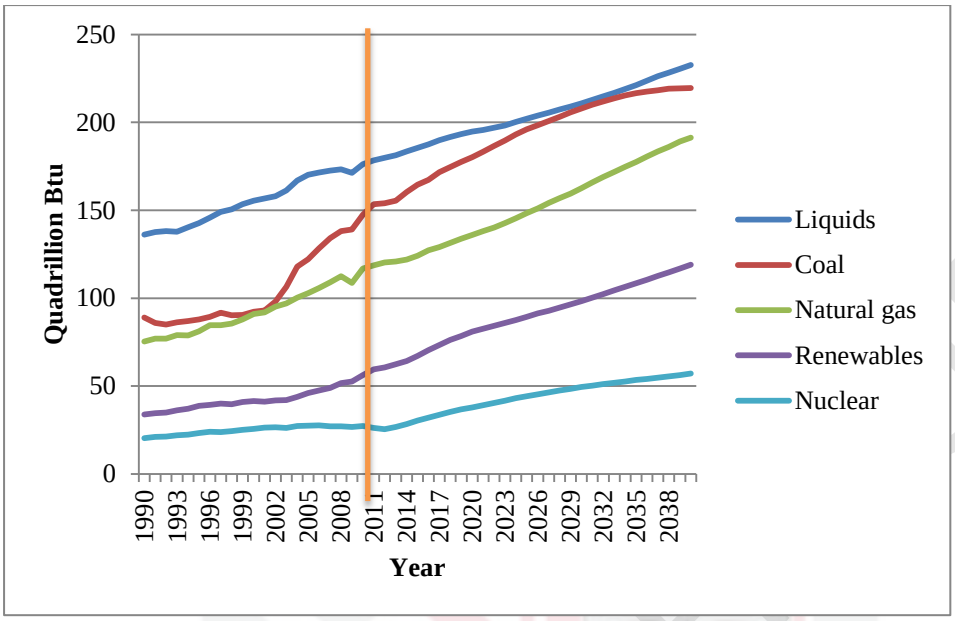

Figure 1.1 World energy consumption by fuel type

(Source: International Energy Outlook Report 2013)

It is arguable that the renewable energy sources should be used at a larger scale compares to the non-renewable energy sources because the non-renewable energy appears to be more harmful to the environment; however, there are numerous contributing factors that have to be taken into account which makes the renewable energy sources a less popular choice. Among others, the renewable energy has been more costly to produce and to use comparatively to the fossil fuels. Production cost is a major factor influencing any economic decisions because high production cost cannot be sustained in the long run. Furthermore the process of harvesting renewable energy can be tricky due to fact it is not always available. For instance, cloudy days will hinder the collection of solar power; calm days reduce wind power as well as dryness decrease water available for hydropower.

Energy has become a necessity and is an essential component in our daily life which affects most of our routine be it in the agriculture, telecommunication or transportation sectors that have significant impact to our economic output. The relevance of its effect on the economic growth can be microscopically view into its importance of uninterrupted energy supply that ensures the smooth flow of the growth of the economy at large. Fundamentally energy affects the production of output and price. This is because a decrease in the supply of the energy will increase the cost production and lead to drop in output. Hence energy is recognized an essential factor of input in a production process. Furthermore increase in the energy input price will cause an increase in the production cost and lead to increase in product price for consumer.

1.1 Energy supply and demand in Malaysia

Malaysia emerges as the third-largest energy consumer in the Association of Southeast Asian Nations (ASEAN) region besides being a large net oil and natural gas exporter[3]. One of the main driving forces in the increase of the primary energy demand in Malaysia is contributed by the increase in population as well the swelling of the economy. This is a foreseen situation as Malaysia is progressing rapidly. The primary energy consumption is defined as the direct use of a source which indicates a supply to users without any transformation of the crude energy. In other words, the energy has not undergone any conversion or transformation process[4].

Figure 1.2 shows the main primary energy supply in Malaysia according to the sources spanning from 1978 until 2012. According to Figure 1.2, it is observed that natural gas leads the group with the biggest contribution to the primary energy supply followed by crude oil, coal and coke as well as hydropower. Hence it can be concluded that Malaysia rely heavily on the non-renewable energy resources as the main source of primary energy namely the natural gas, crude oil as well coal and coke. Furthermore from the trend pattern for the non-renewable primary energy supply indicates that the supply has been inconsistent throughout the years; however the renewable primary energy, hydropower is consistent. The supply of hydropower has been observed to be constant all the time with minimal fluctuation. It is recognized that Malaysia is endowed with great hydropower potential because of its hilly terrain. However the water supplies have been disrupted due to the frequent event of drought as well as recent alteration in the rainfall pattern. Furthermore the current situation in hand is worsening due to high usage of water for domestic, irrigation and industrial purposes. Hence it can be concluded that the Malaysia's water resources do not prioritized on power consumption. This is not a very promising sign and is definitely a worrying indicator because if the hydropower supply is constant or with minimal increment even with additional power plant; it will not be able to replace the role of non-renewable energy sources.

[3] Information based on World Energy Outlook Special Report 2013.
[4] Definition is based on OECD Glossary of Statistical Terms.

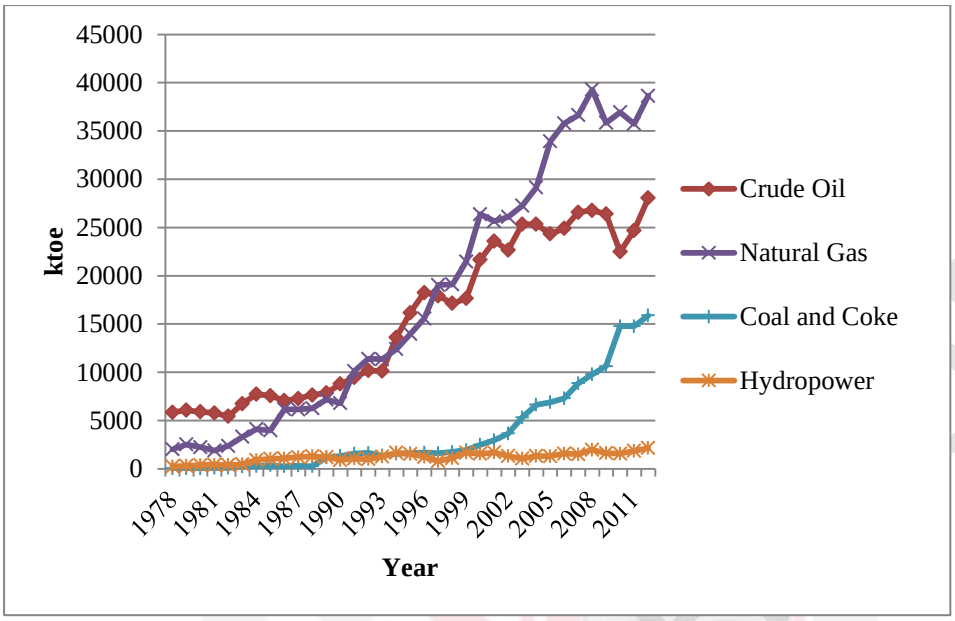

Figure 1.2 Malaysia's primary energy supply according to the sources (ktoe)

(Source: Malaysia Energy Information Hub)

Malaysia has been incorporating the use of other renewable primary energy sources such as biodiesel, biomass and biogas in order to shift its reliance from the non-renewable energy sources to renewable energy sources. However the fact is that the supply of the renewable primary energy is still too lacking behind and without a shadow of doubt, it will not be able to replace the non-renewable energy in the near future. In order to examine the issue further, a closer look is taken on Figure 1.3.

Figure 1.3 exhibits the total primary energy production and total primary energy consumption for Malaysia. The most concerning observation is the narrowing gap between the total primary energy production and total primary energy consumption as time progresses. It is observed that the production and consumption increase at a similar pace from 1986 until 2005. However the production begins to slow down after 2005 whereas the consumption continues to increase. Therefore if the total primary energy production continues to decline and the total primary energy consumption persist to increase; this will then lead to a shortage problem in which the consumption is more than the production. This scenario is unfavorable because this will definitely translate into higher cost of production. This is because in order to sustain the increasing domestic demand for primary energy, Malaysia will have to import from neighboring countries.

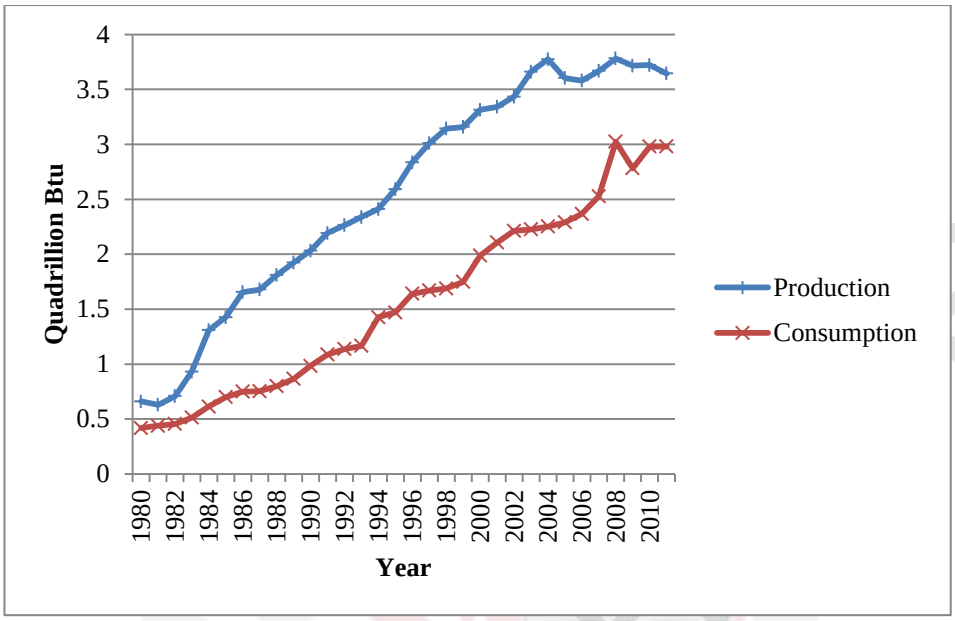

Figure 1.3 Malaysia's total primary energy production and total primary energy consumption (Quadrillion Btu)

(Source: U.S. Energy Information Administration)

On the other hand, Figure 1.4 shows the final energy demand by fuel type for Malaysia. Figure 1.4 clearly shows that the final energy demand by fuel type is divided into two groups; the higher demanded and lower demanded fuel type. The higher demanded fuel type comprises of diesel, natural gas, motor petrol and electricity whereas the lower demanded fuel type incorporate kerosene, Aviation Turbine Fuel (ATF) and Aviation (AV) gas, non-energy, fuel oil, coal and coke as well as liquefied petroleum gas (LPG). Nevertheless throughout the years it is observed that diesel is one of the highest demanded fuel types besides motor petrol. Generally the motor petrol comprises of RON 92, RON 95 and RON 97. The high demand of diesel is because of its cheaper price comparatively to other fuel types which is the effect of the subsidy program undertaken by the government. Moreover diesel is utilized mainly in the transportation sector which include large vehicles such as busses, transport trucks as well ships. Furthermore it is also used for agriculture purposes as well as backup fuel for power generation. Hence high demand for diesel is definitely justified by its high consumption in various sectors.

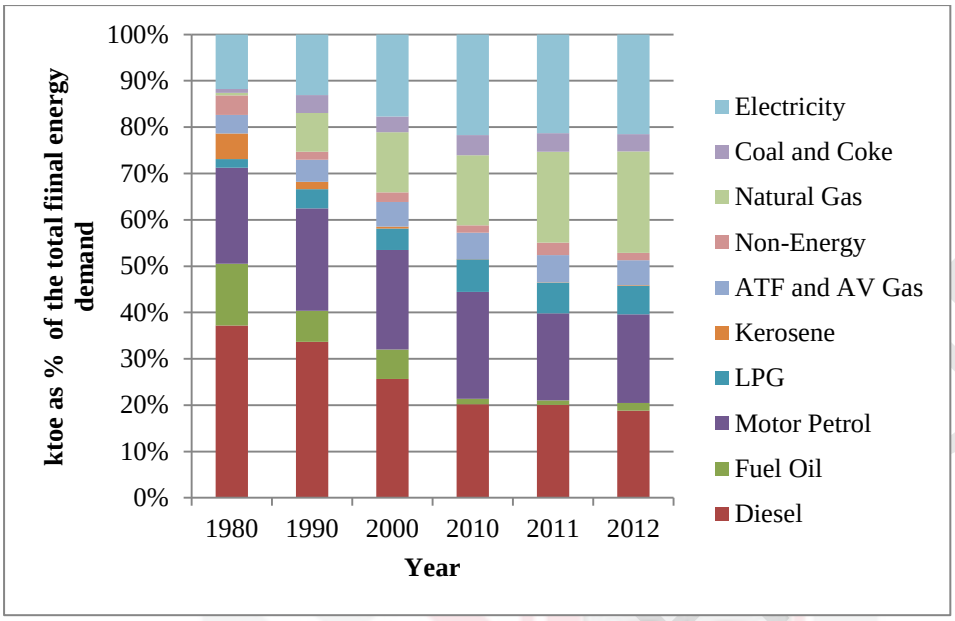

Figure 1.4 Malaysia's final energy demand by fuel types

(Source: Malaysia Energy Information Hub)

Besides that the fossil-fuel subsidies in Malaysia include the 95-octane gasoline, diesel, LPG and electricity. Hence in September 2013 in order to overcome the problem of the blistering budget deficit the subsidies for petrol and diesel were reduced. The notion of retail price refers to the price with subsidy whereas the actual price indicates the price without subsidy. The retail price for petrol as of 3 March 2013 is priced at RM 2.10 per liter for RON 95 whereas the diesel is priced at RM 2.00 per liter. The estimated savings from the fuel subsidy rationalization is about RM 1.1 billion[5]. On the other hand, government scraped the subsidy for the premium grade petrol, RON 97 which is currently on a managed float system in which the retail price will reflect on the price movements of the international market. Currently the RON 97 is priced at RM 2.90 per liter[6]. Since the diesel price is among the cheapest in the region; the government has implemented numerous ways to avoid the exploitation of the fuel subsidies. For instance, in order to reduce bootlegging activities across the border; the petrol stations in the border areas are required to end their operation at 10 pm. Furthermore the restriction for diesel sale of 20 liters per vehicles is enforced for any station that is located within a 50 kilometer radius from the point of entry into Malaysia. Although there is no restrictions imposed on the sale of the RON 97 to foreigners but for Malaysian utilizing foreign-registered vehicles are not entitle for the subsidized RON95 and natural gas.

[5] Facts obtained from Economic Report 2013/2014.
[6] The retail price is as of the price for 7 March 2014 onwards at the petrol station.

1.2 Malaysia Economic Growth

Malaysia's economic growth has recorded quite an impressive performance by registering high growth rates since gaining independence. The peak of the economic growth was observed between 1988 until 1996 with an average of 9.6% of growth throughout those years whereby the inflation rate was kept low between 3% - 4%. The driving cause of this remarkable performance is due to the two digits growth in the manufacturing sector[7]. Besides that it is notable that the unemployment rate has decreased significantly from 8.3% in 1986 to 2.5% in 1996. This is due to the fact that the severe shortage of labor has been filled by the immigrant workers mainly in the plantation, construction and manufacturing sectors (Ariff, 1998).

On the other hand, Malaysia also experienced three episodes of crises which are indicated by the negative economic growth. Figure 1.5 shows Malaysia's real gross domestic product (RGDP) growth. The first crisis observed in 1985 which was due to the commodity shock. The 1985 crisis was set off by the United States' high interest rates policy or is also known as the Volker Shock which lead to the huge debacle of the world's commodity trade. Hence this cause a sharp decrease in the tin and palm oil prices which is mirrored by the declining of the export price index by 30%. Furthermore the terms trade for Malaysia also show depreciation by 20%. Therefore Malaysia's economy was also affected but manages to rebound from the crisis with a stronger economy performance on the following year (Athukorala, 2010).

However the unforeseen Asian financial crisis that had hit hard in mid July 1997 on the South East Asia region's economy has then hold back the progress and transition that is taking place. In the light of this crisis, Malaysia did not escape the catastrophic. The effect was visible through a huge drop in the stock market coupled with the depreciation of currency as well as an increase in the interest rate. It was a devastating time for the South East Asia's countries but steps has been taken through numerous changes in the fiscal and monetary policies in order to cope with the crisis.

Malaysia picked up its economic progress after recovering from the Asian financial crisis. Roughly after ten years later, a similar scenario has been observed with yet another downfall of the economy but this time was the domino effect from the mighty economy, the United States. It was like a huge tsunami that came unalarmed on the global economy but the effect to the advanced economies were more severe comparatively to the developing economies which is also known as the sub-prime mortgage crisis. Nevertheless the penetration through the trade links and various other channels causes adverse economic pressure and was inevitable. Therefore a negative growth was observed in 2009 in Figure 1.5. In a nutshell, it can be concluded that the Asian financial crisis has the most prominent effect on Malaysia's economy with a negative growth 7.4% observed.

[7] Information based on the Malaysia's Economic Report 1996/1997.

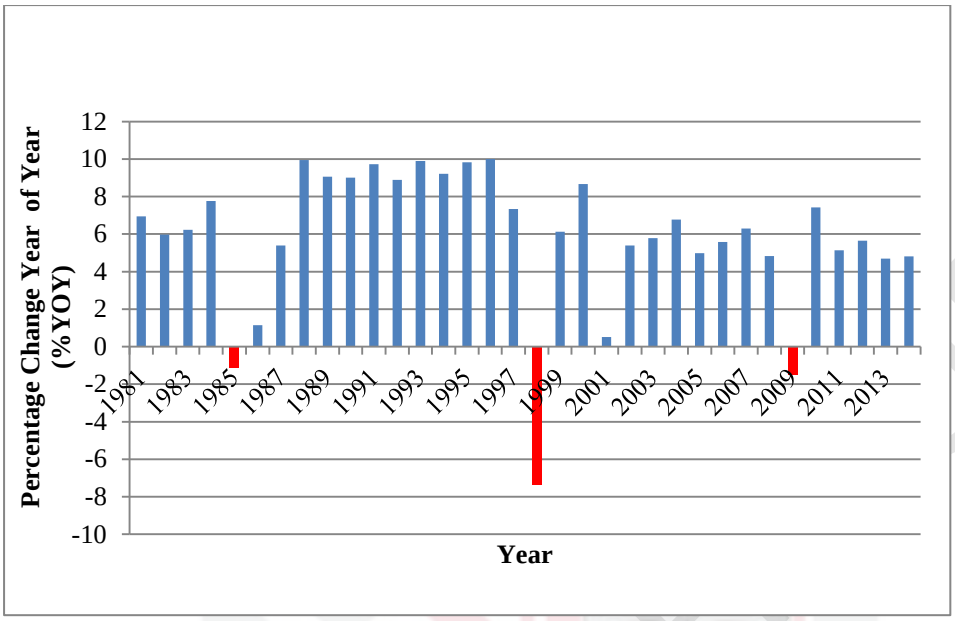

Figure 1.5 Malaysia's real gross domestic products (RGDP) growth

(Source: Oxford Economics)

Fundamentally, energy consumption is a crucial key input in producing the output. Figure 1.6 shows Malaysia's primary energy consumption versus GDP. Based on Figure 1.6, it is observed that there is a very close relationship between energy use and GDP. Hence from the first impression it can be concluded that energy is an essential and necessary input along with other factors of production such as capital and labor in producing output for the case of Malaysia.

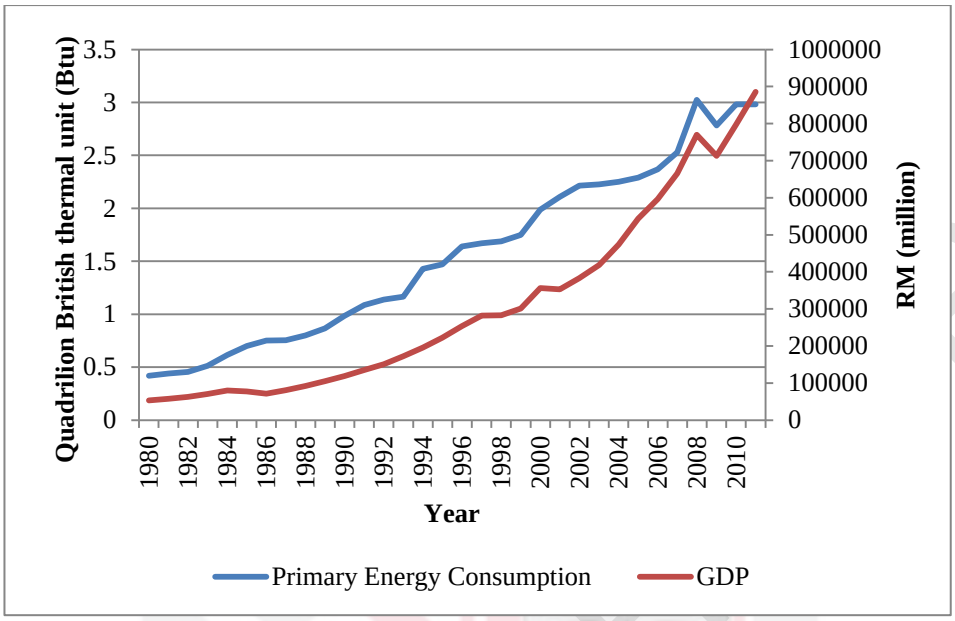

Figure 1.6 Malaysia's primary energy consumption versus GDP

(Source: U.S. Energy Information Administration and International Financial Statistics)

1.3 Malaysian Trade

Malaysia had been actively involved in the international trade since 1980s whereby Malaysia adopted the export led growth strategy or is also known as the outward-oriented development strategy. The export-oriented strategy to foster growth is deem to be successful due to some of the fundamental factors such as export based development forces industries to compete in international market; encourages greater economies of scale as well as the export performance can be easily monitor leads to ease in measuring effectiveness of the export promotion strategies. Figure 1.7 shows the import and export for goods and services in Malaysia. Based on Figure 1.7, it is denoted that the import and export appear to be quite similar from 1980 until 1998. After 1998 it is observed that the export seems higher than import. The trigger point of this event is due to the Asian financial crisis leading to the depreciation in the domestic currency which foster export but dampen the demand for import. Since then, the export has remained higher than import. However it is also observe that there are two significant events that recorded a decrease in both the export and import in 2001 as well as 2009. The drop in the import and export in 2001 is most likely associated with the dot-com bubble that hit the world economy. On the other hand, the effect of the sub-prime mortgage crisis that occurred in 2009 is an aftermath reaction which led to a decrease in the import and export.

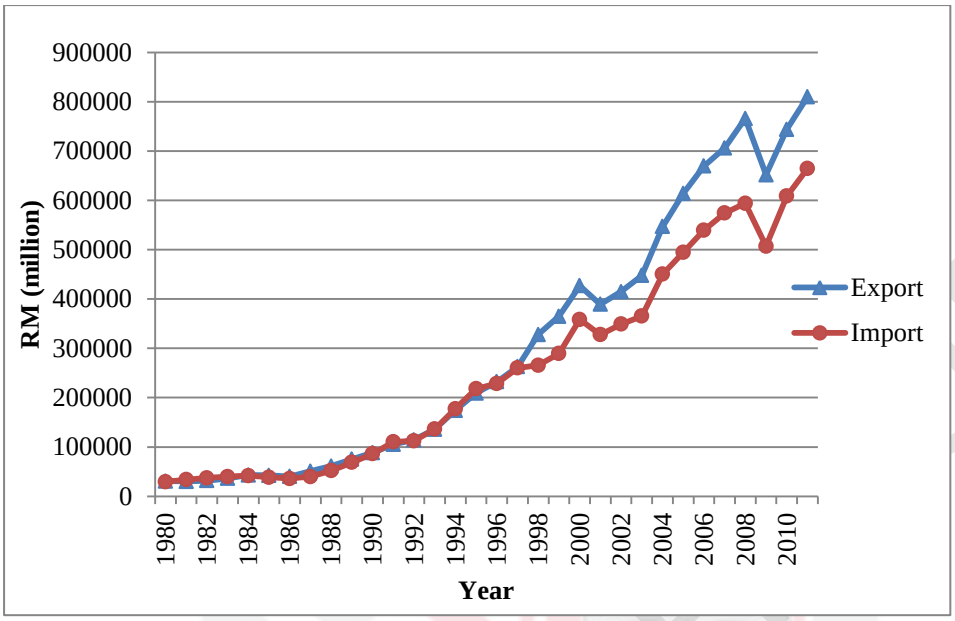

Figure 1.7 Malaysia's import and export for goods and services

(Source: Oxford Economics)

Trade openness or also widely known as trade liberalization refers to the reduction in trade barriers to facilitate the international trade of an open economy. Hence trade openness has become one of the critical economic players in the process of globalization. Since Malaysia is a small-open-developing economy; the international trade is inseparable from its economic progress. Furthermore the International Chamber of Commerce (ICC) ranked Malaysia at 30 globally in 2013 for its trade openness and is second behind Singapore for the South East Asia region[8]. Therefore it is crucial to note that one of the fundamental key determinants for analyzing the economic performance should definitely include the trade openness.

A closer look can be undertaken by examining the development of trade openness expressed as export plus import as a percentage of GDP throughout the years. Figure 1.8 shows the trade openness in Malaysia. It is observed that the trade openness is at the highest point from 2005 until 2007 whereby the trade volume was approximately twice the size of the economy of those years. However the trade openness decreased on the following year (2008) and it became more significant in 2009 by which is the lowest in the 2000s. The event can be justified by the fact that in 2009, the global economy undergoes its deepest downturn in the modern history. Hence this lead to the downfall in the global demands as well as the world trade.

[8] The calculation of the trade openness is aggregation based on four components namely observed openness to trade, trade policy, foreign direct investment (FDI) openness and infrastructure of trade.

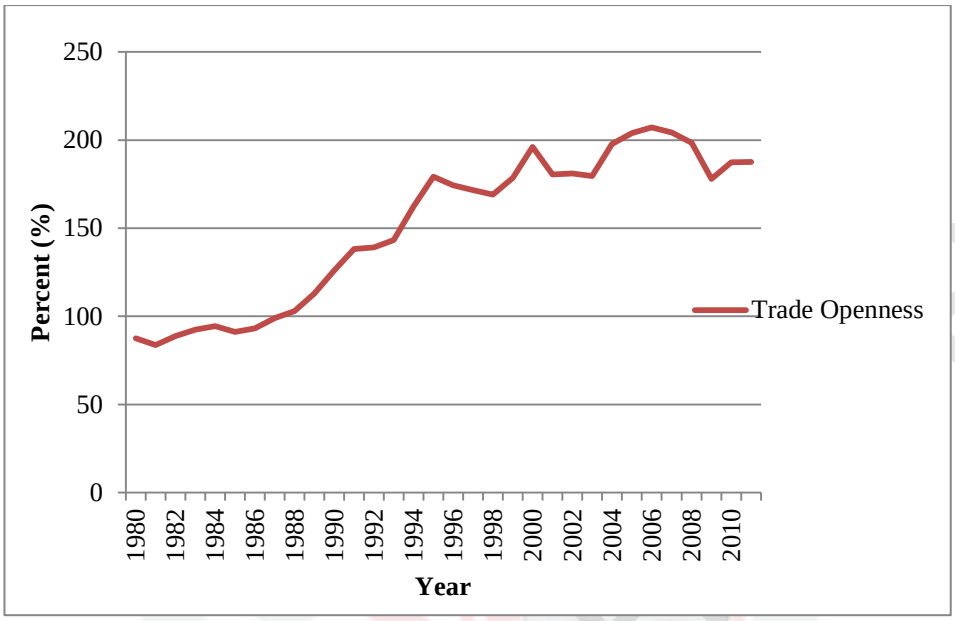

Figure 1.8 Malaysia's trade openness

(Source: World Development Indicators)

Malaysia's keen interest in trade openness can be seen through the primary participation in General Agreement on Tariffs and Trade (GATT) since 1948 and took part in the Uruguay Round which led to the establishment of the World Trade Organization (WTO) in 1995. Furthermore Malaysia also joined ASEAN Free Trade Area (AFTA) which was created in 1992 during the ASEAN Summit in Singapore. The fundamental aim for AFTA is to construct a single market as well as an international production base, encourage foreign direct investment and broaden the intra-ASEAN trade and investment[9]. Therefore the reduction in trade barriers in the export markets has essentially increased the market opportunities which lead to growth in Malaysia's export. Besides that the Ministry of International Trade and Industry (MITI) has been appointed to consolidate and integrate Malaysia's stand on international trade and investment.

1.4 Malaysian Inflation

The inflation has been one of the most discussed topics in the recent years throughout the nation regardless of the economy class. This scenario is definitely a validated one due to the fact that the alleviated cost of living that has everyone starts spending mindfully. Nevertheless a scrutinized discussion on the determinants of inflation will give a clearer picture on the episodes of inflation that has taken place in Malaysia. The

[9] Information obtained from Ministry of International Trade and Industry (MITI).

evolution of the Malaysia's economy progressed from the agriculture based to the manufacturing-driven and at this point in time engaging in the service-driven and knowledge-based economy. This is a very similar progression observed in countries in the path of achieving the high income economy status.

Historically Malaysia's inflation has maintained a reputation of being one of the lowest in the region with a long term average at 2.9%. The low inflation climate over the course of 50 years has been interrupted by four chapters of high inflation that took place namely in the mid-1970s, early 1980s, 1990s and late 2000s. This situation is inevitable since Malaysia is a small and highly open economy whereby the domestic inflation is influenced by developments abroad. Figure 1.9 shows Malaysia's inflation timeline. From Figure 1.9, it is observed that the inflation episodes took place chronologically with the onset in the 1970s and 1980s; the inflation was due to the global oil price shocks as well as surging food prices. On the other hand, in the 1990s the inflation was triggered by the period of robust domestic demand and large capital inflows into the country. Last but not least, the inflation occurred in the late 2000s was due to the continuous increase in the global commodity prices[10].

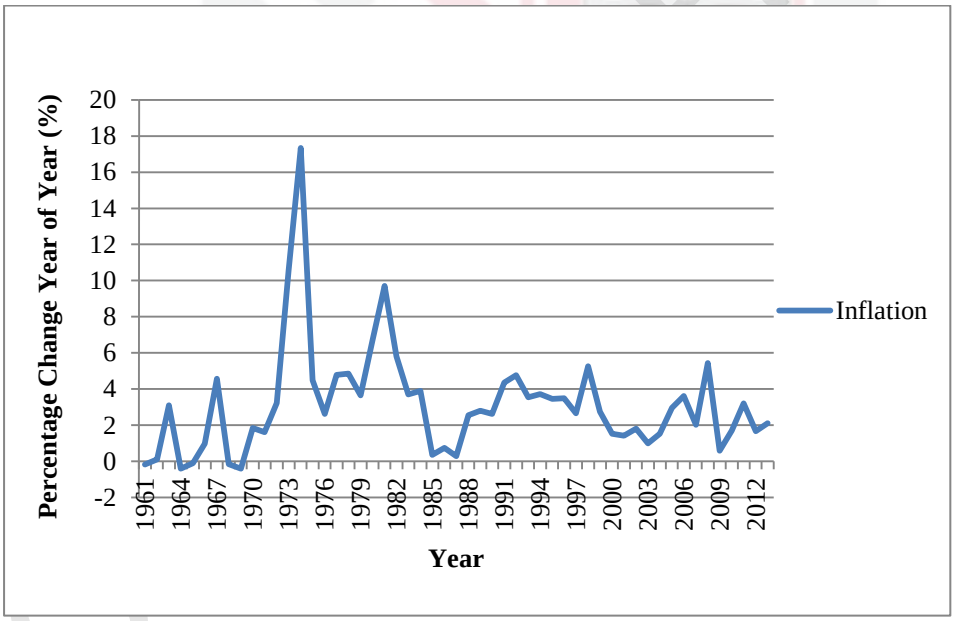

Figure 1.9 Malaysia's inflation timeline

(Source: World Development Indicators)

[10] Information based on Bank Negara Malaysia Annual Report 2010.

The movement in the world oil price has always been associated with inflation. Figure 1.10 shows the Malaysia's inflation against the movement of the world oil price. The oil price has essentially gone through periods of high and lows throughout the three decades. It is clearly observed that the oil price is between $15 and $40 per barrel with its ups and downs during 1980s until 1990s. However since the year 2000, the oil price has been climbing steadily and peaked at 2008 with approximately $99 per barrel. This phenomenon is fundamentally motivated by the strong demand for oil as well as stagnating of world oil production

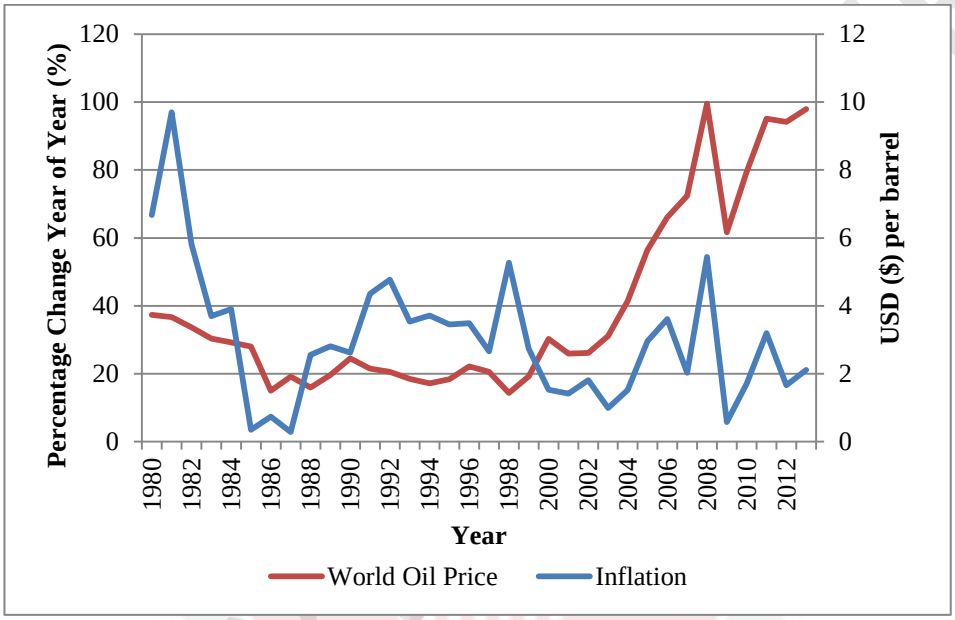

Figure 1.10 Malaysia's inflation versus world oil price

(Source: World Development Indicators and Oxford Economics)

The key feature influencing the transmission of inflation in Malaysia is the administered price mechanism. The price of some necessity goods are controlled by the government as the changes of these prices will have significant impact on the cost of living for the low and middle-income group. There are two main categories for the price of administered goods. The first category is under the Price Control Act (PCA) in which the retail price is determined by the government and it is divided into two sub-groups of food and non-food. The food group includes items such as rice, oils and sugars whereas the non-food includes gas, fuels and lubricants. On the other hand, the second category is items where any changes in price require government approval. The items are parked under four main sub-indexes which are the alcoholic beverages and tobacco; housing, water, electricity, gas and other fuels; communication and transport services. Hence with the administered price mechanism implemented, the effect of

supply shocks and external price developments on domestic price are less direct and less immediate[11].

In order to measure inflation, changes in Consumer Price Index (CPI) have been essentially utilized as a proxy. According to the Department of Statistics Malaysia, the CPI measures the percentage change through time in the cost of purchasing a constant basket of goods and services representing the average pattern of purchases made by a particular population group in a specified time period. A detailed discussion on the sub-indexes is crucial in order to provide a clearer picture on how the CPI is affected at the disaggregated level.

Table 1.1 indicates the disaggregated consumer price index at constant price 2005 annual growth rate (%). The food and non-alcoholic beverages sub-index has the highest weightage with 31.4 followed by the housing, water, electricity, gas and other fuels sub-index of 21.4 whereas health sub-index has the lowest weightage of only 1.4. Based on Table 1.1, it can be observed that transport price index appear to have the most fluctuations in the annual growth from 2005 until 2013 comparatively to other price index. Acknowledging the fact that the oil price shock that took place in 2007 and 2008 due to the strong demand for oil coupled with the stagnating world production; it can be seen that the food and non-alcoholic beverages price index as well as the transport price index has the biggest impact where the former increase from 3.1% in 2007 to 9.4% in 2008 and the latter increase from 2.6% in 2007 to 10.1% in 2008. This shows that the occurrence of oil price shock will lead to different effects on the disaggregated price index where some price index will indicate significant effect whereas others only shows negligible effect in their annual growth rate.

[11] Facts obtained from Bank Negara Malaysia Annual Report 2010.

Table 1.1 Disaggregated consumer price index at constant prices 2005 annual growth rate (%)

Sub-Index	Weights	2006	2007	2008	2009	2010	2011	2012	2013
Food and non-alcoholic beverages	31.4	3.4	3.1	9.4	4.8	2.9	5.9	3.5	4.7
Alcoholic beverages and tobacco	1.9	6.9	8.2	8.4	7.5	5.1	6.3	0.6	8.5
Clothing and footwear	3.1	-1.3	-1.3	-0.6	-0.9	-1.2	-0.2	-0.5	-0.5
Housing, water, electricity, gas and other fuels	21.4	1.5	1.3	1.6	1.5	1.2	5	1.8	2
Furnishing, household equipment and routine household maintenance	4.3	1.1	1.1	3.1	3.2	0.8	1.9	2.2	1.8
Health	1.4	2.2	1.5	2.3	2.4	1.8	3	2.3	2.2
Transport	15.9	11	2.6	10.1	-11.6	1.8	5	0.8	2.4
Communication	5.1	-1.4	-1.2	-0.6	-0.5	-0.2	-0.3	-0.6	-0.6
Recreation services and culture	4.6	0.8	1.4	1.8	1.6	1.7	2.1	1.3	0.1
Education	1.9	1.6	1.8	2.5	2.5	1.8	2.5	2.7	2.8
Restaurants and hotels	3	3.7	3.8	7.1	3.3	2.3	7	3.8	3.2
Miscellaneous goods and services	6	2.3	0.9	3.5	3.9	3	2.8	2.3	0.4

(Source: Department of Statistics, Malaysia and Author's Calculation)

1.5 Problem statement

Essentially there is a continuous argument among the energy economists regarding the relationship between energy consumption and output development leading to opposing views on this issue. Based on Ghali and Sakka (2004) the first point of view suggested that the energy use is estimated to be a restrictive factor to economic growth. This is largely due to the fact that the other factors of production for instance labor and capital cannot function without energy. On the other hand, in accordance with the neutrality hypothesis lead to the birth of the conflicting point of view where the energy is assumed to be neutral to growth. In other words, the cost of energy is negligible comparatively to the GDP and is unlikely to have significant contribution on the output growth.

Since energy is a necessary requirement for economic and social development; it is important to note the fact that the consumption-production gap is narrowing as per Figure 1.3. Eventually Malaysia may face the challenge to sustain our economic growth as energy might be potentially a "limiting factor to economic growth''. Therefore this thesis shadows the work of Ghali and Sakka (2004); Oh and Lee (2004); Lee and Chang (2005) as well as Stern (1993) who fundamentally contends that energy use is one of the crucial factors in production. Furthermore, the production side model is adopted by incorporating energy use, capital and labor to produce output.

However the relationship between energy consumption and output relationship needs to be viewed in a broader context. In order to achieve the economic development, Malaysia has undertaken the export-led growth strategy. Malaysia's exports as a percentage of GDP increased from 41% in 1970 to 82% in 2013[12]. This lead to the recognition by World Bank in which Malaysia is acknowledged as one of the eight Southeast Asian countries that has successfully implemented the export promotion strategies in order to achieve high rate of economic growth[13]. Therefore, the vital role of trade openness as a stimulus to economic growth cannot be ignored in the context of Malaysia.

The relationship between the trade openness and economic output trace back to one of the essential variable utilize in the calculation of trade openness which is none other than export. The increase in the trade openness is illustrated through the export led growth strategy. Essentially the export led growth hypothesis advocates the fact that an increase in the demand for a country's economic output essentially lead to an increase in real economic activity. Furthermore, the increase in output is only feasible with the availability of sufficient energy. Therefore, with adequate energy consumption accompanied with the trade openness leads to increase in Malaysia's output.

[12] The figures were obtained from World Bank National Account Data.
[13] Facts are based on report titled The East Asian Miracle.

Another important aspect of this thesis is to examine the pass-through effect of oil price into the consumer price. Besides that, it is observe that the recent trend movement for inflation and world oil price seems to exhibit similar trend movement since 2005 onwards. Does this event validate the perception that oil price hike presage inflation in general? Hence, this drives our interest to investigate the existence of the relationship between oil price and inflation for the case of Malaysia spanning from 2005 until 2013 on quarterly basis. Particularly this can be undertaken by analyzing whether the CPI will be affected by the movement of the oil price.

There are concern arises regarding the transition of Malaysia's role from a net oil exporter to net oil importer in the near future. This has definitely set-off alarms on the future prospects of Malaysia's energy industry. The uncertainty of the world oil price has been exerting pressure on the government spending since the oil price is subsidized by the government. However the government has begun implementing the subsidy rationalization. Therefore it is crucial to compare the effect of oil price with or without the subsidy on the consumer price. Acknowledging this fact, this research utilized the diesel price as the proxy for oil price because it is the highest demanded fuel type in Malaysia besides it is still heavily subsidized by the government.

The data for diesel price will be investigated both at the actual price as well as the retail price. The oil price quoted in the actual and retail price will have different effect on the consumer price. The actual price refers to the diesel price before the government subsidy whereas the retail price indicates the diesel price after the government subsidy. Hence by taking into account of the retail price; the effect of subsidies will be incorporated. The transmission effect of the retail price will translate the actual effect bore by the consumer after considering the subsidy effect into the consumer price level.

Currently there is a lack of empirical evidence on the pass-through effect of oil prices into inflation at a disaggregated level. To our best knowledge there is one study namely, Ibrahim and Said (2012) that examine the pass-through effect of oil prices into four sub-price indexes for the case of Malaysia. This study will examine the transmission effect of oil price on the consumer price index at the aggregated level as well as at the disaggregated level which incorporates all the twelve sub-indexes by investigating the long run relationship between inflation and oil price. In addition the fundamental difference between this thesis and Ibrahim and Said (2012) is that this thesis utilized all the twelve sub-indexes from newly defined CPI data whereas Ibrahim and Said (2012) only utilized four sub-indexes from the previously defined CPI (before year 2005). The knowledge of the pass-through effect at the disaggregated level through the findings from this thesis will be able to shed some lights on to what extend each good category is affected by the energy price. Hence this study will indicate how many percent of the variation in the inflation for each good category is explained by the oil price shock as well as if there is a long run significance of the oil price to each sub-price index.

In a nutshell, by being able to comprehend the transmission of the oil price into the consumer price index will be able to assist policymakers in outlining effective policies particularly the future subsidies policies. Since the government has planned to phase

out subsidy in near future; the effect of inflation and transmission into the price levels has to be monitored carefully in order to avoid further burdening the consumer's cost of living which has been soaring in the recent years.

1.6 Objectives

There are two main objectives for this research:-

a) To study the long run relationship between energy consumption and the economic output proxy by real GDP with the inclusion of trade openness.
b) To investigate the pass through effect of the actual diesel price and retail diesel price into consumer price.

1.7 Significance of the study

The relationship between energy consumption and the economy growth has been one of the most discussed topics and the central attention among researches around the world (Kraft and Kraft, 1978; Akarca and Long, 1980; Stern, 1993; as well as Hwang and Gum, 1992). However the focus of majority researches is on the causality relationship by adopting the Granger causality method to determine the direction of the causality.

According to Stern (2000), one of the dominant reasons that results in these contradicting findings is due to the fact that the Granger causality studies experience omitted variable bias. Therefore this thesis focuses on introducing variables that is 'deemed crucial' which are capital, labor and trade openness in the relationship between energy consumption and economic output with the interest to investigate on the long run relationship instead of the Granger causality.

Since, most of the current studies undertaken involve the developed nations and only a handful research discussed the developing nations. Hence this is a good platform to compare the result between the developing nations and developed nations in order to further understand the relationship between energy consumption and the economic output taking into account the trade openness. Also to best of our knowledge; there is yet to have studies undertaken for the case of Malaysia in examining the relationship between energy consumption and economic output incorporating trade openness.

On the other hand, the uncertainty in the world oil price and the increasing concern over the depleting oil production due to the maturing oil rig in Malaysia coupled with pressure of increasing demand has led to the interest to investigate the pass-through effect of the oil price into the inflation. Moreover this thesis utilized the data for CPI at the disaggregated level from the year 2005 onwards because the sub-index has been redefined in which there were nine sub-indexes before 2005 and has been elaborated to twelve sub-indexes from 2005 onwards. Besides that the fundamental difference

between this objective of the thesis with Ibrahim and Said (2012) is that this thesis utilized all the twelve sub-indexes whereas Ibrahim and Said (2012) only utilized four sub-indexes namely the food price index (FPI); rent, fuel and power price index (RFPI); transportation and communication price index (TCPI) and medical care and health price index (MHPI). Hence this research intends to fill the gap by examining the relationship at a complete disaggregated level by contributing fresh and new findings to the pool existing literature.

In addition, the oil price proxy adopted by Ibrahim and Said (2012) is the West Texas Intermediate (WTI) crude oil price data. However Malaysia's oil price is subsidizes by the government or in other words part of the transmission effect of the oil price into consumer price is absorbed by the government. The usage of world oil price as proxy might not be able to capture the actual effect undergone by the consumer in general. Therefore with that in mind this thesis introduces the usage of diesel price both in the actual price as well as the retail price. This will be a crucial contribution if the government were to phase out all the subsidies that are currently provided to the consumer. Currently only the partial transmission is observed taking into account of the subsidy by examining the retail oil price. Nonetheless, the full transmission can be captured through the actual oil price. Therefore the empirical findings obtained from this research can be utilized as an important guideline in preparing the subsidies policies in the future. This will provide a new dimension in interpreting the current challenges faced.

1.8 Organization of the thesis

The rest of this thesis is organized as follows. In chapter two, literature review on the dynamic interaction between the energy consumption and economic output as well as the transmission effect of oil prices into inflation is deliberated. A comprehensive discussion on the model and description of the data is presented in chapter three. Next in chapter four an extensive discussion on the result is carried out. Last but not least, in chapter five concluding remarks is presented.

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