UNIVERSITI PUTRA MALAYSIA

OIL PRICE SHOCKS, SECTORAL CO2 EMISSIONS AND FINANCIAL DEVELOPMENT IN MALAYSIA

IBRAHIM KABIRU MAJI

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By

IBRAHIM KABIRU MAJI

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the Degree of Doctor of Philosophy

OIL PRICE SHOCKS, SECTORAL CO_2 EMISSIONS AND FINANCIAL DEVELOPMENT IN MALAYSIA

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IBRAHIM KABIRU MAJI

January 2017

Chairman : Professor Muzafar Shah Habibullah, PhD
Faculty : Economics and Management

The study investigates the impact of oil price shocks and financial development on key economic indicators and sectoral carbon dioxide (CO_2) emissions in Malaysia. The first objective examines the impact of recent oil price shocks on government revenue, Gross Domestic Product (GDP) and employment. Fixed proportions production theory of Leontief 1936 was used as the theoretical framework while a high bride econometric and input-output analysis were used as the empirical model. Augmenting a time-series data with the latest 2010 Malaysia's input-output table is a contribution to knowledge. The result shows that the annual average decline in crude oil price by 48.4% between 2014 and 2015 has led to decline in government revenues by about 11.7 billion Ringgit (RM) and a fall in GDP by RM14.8 billion. Furthermore, based on Malaysia's government budget recalibration of 2016, the result shows that oil price fall by 39.6% from 2015 benchmarks. This led to a decline in 2016 tax revenues by RM5.4 billion and a GDP loss of about RM6.5 billion. The results also suggest that GDP is projected to growth at about 3.9% - 4.1%. This is consistent with Malaysia's Bank Negara release of the second quarter report for 2016, which project GDP growth at 4.0%. As such, the study recommends that policymakers should take proactive measure to further diversify the economy by promoting manufacturing and services sectors which were also identified as drivers of the economy. The second objective examines the impact of oil price shocks on sectoral CO_2 emissions in Malaysian. The linearized Environmental Kuznets Curve (EKC) theory was employed as the theoretical framework of the study while Autoregressive Distributed Lag (ARDL) bounds approach was used as the empirical framework. Dynamic Ordinary Least Squares (DOLS) and Ordinary Least Squares (OLS) with robust standard error were used to further validate the results. The datasets range from 1983-2014. Extending the impact of oil price changes to sectoral CO_2 emissions is not common in literature. The long-run results revealed an inverse relationship between oil price shocks and sectoral CO_2 emissions and CO_2 emissions per capita for all the three estimators. This suggests that higher oil price mitigates sectoral CO_2 emissions and lower oil price increases sectoral CO_2 emissions in Malaysia. On the average, the long-run impact of income on sectoral and per capita CO_2 emissions is positive, indicating

that an increase in the level of income increases both the sectoral and per capita CO_2 emissions. Furthermore, the level of capital mitigates both sectoral and per capita CO_2 emissions in Malaysia. Similarly, the result on the average, suggests that labour force also mitigates CO_2 emissions and improves environmental quality. Thus, the study recommends contractionary fiscal measures on oil related products during lower oil prices. The third objective assesses the impact of financial development on sectoral CO_2 emissions in Malaysia. The theoretical framework used was the linear version of EKC theory. The empirical model is ARDL while DOLS and OLS with robust standard error were used to verify the results. The datasets employed range from 1980-2014. Extending the impacts of financial development to sectoral CO_2 emissions is one of the contributions of this study. The consistent long-run results for all the estimators suggest that financial development invokes CO_2 emissions in the transportation sector, oil and gas sector and per capita CO_2 emissions. On the other hand, financial development mitigates CO_2 emissions from the manufacturing and construction sector but does not impact on CO_2 emissions from the agricultural sector. On the average, the results show that financial development increases CO_2 emissions and reduces environmental quality in Malaysia. Thus, the study recommends that government should pay attention to abatement policies of the manufacturing and construction sector along with an emphasis on energy conservation measures and their efficient utilisation.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

PERUBAHAN HARGA MINYAK, PELEPASAN GAS CO_2 OLEH SEKTOR EKONOMI, DAN PEMBANGUNAN SEKTOR KEWANGAN DI MALAYSIA

Oleh

IBRAHIM KABIRU MAJI

Januari 2017

Pengerusi : Profesor Muzafar Shah Habibullah, PhD
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Kajian ini menyiasat impak perubahan harga minyak dan pembangunan sektor kewangan ke atas pembolehubah makroekonomi dan pelepasan gas CO_2 oleh sektor ekonomi di Malaysia. Objektif utama kajian adalah untuk mengkaji impak perubahan harga minyak ke atas pendapatan kerajaan, Keluaran Dalam Negara Kasar (KDNK) dan peluang pekerjaan. Teori pengeluaran berkadaran tetap oleh Leontief digunakan sebagai kerangka teori, manakala analisis ekonometrik dan input-output digunakan sebagai model empirikal. Gabungan antara data siri masa dan jadual input-ouput Malaysia 2010 merupakan satu sumbangan kepada ilmu. Dapatan kajian menunjukkan bahawa purata harga minyak tahunan yang menurun sebanyak 48.4% di antara tahun 2014 dan 2015 telah membawa kepada penurunan pendapatan kerajaan sebanyak RM11.7 bilion dan kejatuhan KDNK sebanyak RM14.8 bilion. Tambahan pula, berdasarkan penstrukturan semula bajet kerajaan Malaysia 2016, hasilnya menunjukkan bahawa harga minyak akan jatuh sebanyak 39.6% daripada tahun penanda aras 2015. Ini akan membawa kepada penurunan dalam hasil cukai sebanyak RM5.4 bilion manakala KDNK dijangka jatuh sebanyak RM6.5 bilion. Dapatan kajian juga menunjukkan bahawa KDNK dijangka tumbuh pada kadar 3.9% - 4.1%. Ini adalah selaras dengan laporan suku kedua tahun 2016 Bank Negara yang melaporkan jangkaan pertumbuhan KDNK sebanyak 4.0%. Oleh itu, kajian ini mencadangkan supaya penggubal dasar perlu mengambil langkah proaktif untuk mempelbagaikan sektor ekonomi dengan mempromosikan sektor pembuatan dan perkhidmatan yang juga telah dikenal pasti sebagai pemacu ekonomi. Objektif kedua kajian adalah untuk mengkaji kesan kenaikan harga minyak ke atas pelepasan gas karbon dioksida (CO_2) oleh sektor ekonomi di Malaysia. Teori pengeluaran *Linear Environmental Kuznets Curves* (EKC) telah digunakan sebagai kerangka teori kajian manakala pendekatan *Autoregressive Distributed Lag* (ARDL) digunakan sebagai rangka kerja empirikal. *Dynamic Ordinary Least Squares* (DOLS) dan *Ordinary Least Squares* (OLS) dengan ralat piawai teguh digunakan untuk mengesahkan keputusan kajian. Set data yang digunakan adalah untuk tempoh 1983-2014. Berdasarkan sorotan literatur, kajian impak perubahan harga minyak ke atas pelepasan gas CO_2 bagi sektor ekonomi adalah terhad. Keputusan jangka panjang mendedahkan hubungan songsang antara harga

minyak dan pelepasan gas CO_2 bagi sektor ekonomi dan pelepasan gas CO_2 per kapita bagi ketiga-tiga penganggar. Ini menunjukkan bahawa harga minyak yang lebih tinggi boleh mengurangkan pelepasan gas CO_2 dan harga minyak yang lebih rendah boleh meningkatkan pelepasan gas CO_2 di Malaysia. Secara purata, impak jangka panjang ke atas pendapatan dan pelepasan gas CO_2 per kapita adalah positif dan ini menunjukkan peningkatan tingkat pendapatan akan meningkatkan pelepasan gas CO_2 per kapita dan bagi sektor ekonomi. Di samping itu, tahap modal juga boleh mengurangkan pelepasan gas CO_2 per kapita dan bagi sektor ekonomi di Malaysia. Selain itu, dapatan kajian juga menunjukkan bahawa tenaga kerja juga boleh mengurangkan pelepasan gas CO_2 dan meningkatkan kualiti alam sekitar. Oleh itu, kajian ini mencadangkan langkah-langkah fiskal menguncup ke atas produk berkaitan minyak semasa harga minyak yang lebih rendah. Objektif ketiga adalah untuk menilai kesan pembangunan sektor kewangan ke atas pelepasan gas CO_2 bagi sektor ekonomi di Malaysia. Rangka kerja teori yang digunakan ialah teori pengeluaran *linear* EKC. Model empirikal yang digunakan adalah ARDL manakala DOLS dan OLS dengan ralat piawai teguh digunakan untuk mengesahkan keputusan. Set data yang digunakan adalah untuk tempoh 1980-2014. Kajian lanjutan untuk impak pembangunan sektor kewangan terhadap pelepasan gas CO_2 bagi sektor ekonomi adalah salah satu sumbangan kajian ini. Keputusan konsisten jangka panjang untuk semua anggaran mencadangkan bahawa pembangunan sektor kewangan mendorong pelepasan gas CO_2 sektor pengangkutan, minyak dan gas, dan pelepasan gas CO_2 per kapita. Selain itu, pembangunan sektor kewangan turut dinyatakan akan mengurangkan pelepasan gas CO_2 daripada sektor pembuatan dan pembinaan tetapi tidak memberikan kesan kepada pelepasan gas CO_2 daripada sektor pertanian. Secara purata, hasil kajian menunjukkan pembangunan sektor kewangan meningkatkan pelepasan gas CO_2 dan mengurangkan kualiti alam sekitar di Malaysia. Oleh itu, kajian ini mencadangkan supaya kerajaan perlu menumpukan perhatian kepada dasar *abatement* untuk sektor pembuatan dan pembinaan dan turut menumpukan kepada langkah-langkah penjimatan tenaga.

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I certify that a Thesis Examination Committee has met on 17 January 2017 to conduct the final examination of Ibrahim Kabiru Maji on his thesis entitled "Oil Price Shocks, Sectoral CO_2 Emissions and Financial Development in 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 Doctor of Philosophy.

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This is to confirm that:

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey and Fuller
ARDL	Autoregressive Distributed Lag
BBC	British Broadcasting Cooperation
CBN	Central Bank of Nigeria
CDIAC	Carbon Dioxide Information Analysis Center
CGE	Computable General Equilibrium
CO_2	Carbon Dioxide
DOLS	Dynamic Ordinary Least Squares
DOS	Department of Statistics
EIA	Energy Information Administration
EKC	Environmental Kuznets Curves
EPU	Economic Planning Unit
FAO	Food and Agriculture Organisation
FDI	Foreign Direct Investment
FMLS	Fully Modified Ordinary Least Squares
FSMP	Financial Sector Master Plan
GDP	Gross Domestic Product
GHG	Greenhouse Gas
ICU	Implementation and Coordination Unit
IPCC	Intergovernmental Panel on Climate Change
KC	Kuznets Curve
MF	Ministry of Finance
OLS	Ordinary Least Squares
OGJ	Oil and Gas Journal

OPEC	Organization of Petroleum Exporting Countries
PCI	per Capita Income
PP	Phillips and Perron
RM	Ringgit Malaysia
SAM	Social Accounting Matrix
SVAR	Structural Vector Autoregressive
UECM	Unrestricted Error-Correction Model
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United State
VAR	Vector Autoregressive
WDI	World Development Indicator
WTI	West Texas Intermediate

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Since the middle of the 1960s, crude oil has been one of the most important primary energy sources all over the globe. Most economic activities rely on crude oil for input which supplies around 40% of the global total energy demands. The price of a barrel of crude oil has emerged to be a point of reference that affects other energy markets. More, so, shocks from oil prices does not only impact energy markets but also have a direct or indirect effect on the rest of the economy by being able to influence government revenue, economic growth and employment. A number of empirical research have analysed the effects of oil price shocks on economic activity (Ali and Harvie, 2013). As such, crude oil is among the most important primary energy sources used worldwide.

Oil price shock was further identified in the 1970s' as a major cause of fluctuations in the level output and employment. Owing to the importance of oil price shocks, literature has analysed its impacts on the economy from different perspectives. Previous research shows that oil price shocks during the 1970s have caused recessions in industrialised countries (Hamilton, 2005). However, the collapse of oil prices from the 1980s triggers a new debate in the literature as to the direction of the impact of oil price shocks on the economy. Some of the literature suggest an asymmetric effect of oil price shocks on economic performance (An et al., 2014) while others suggest diminishing impact of oil price shocks on economic activities after the 1980s. As a result, studies have suggested that oil price shocks have contributed to fluctuation in economic activities and recession experience by many economies in the past.

Pioneer studies of this nexus such as Hamilton (1983) and Mork (1989) and more recent study like Milani (2009) reported a significant negative impact of oil price shocks on economic indicators like aggregate consumption, investments, government expenditure, exchange rate, inflation, employment, aggregate price level and particularly Gross Domestic Product (GDP). The negative impact of oil price shocks has the momentum to generated uncertainty about the future that subsequently leads to a reduction in government expenditure, consumption of durable goods and investment goods (Hamilton, 2005).

In the year 2004, the price of crude oil fluctuates rapidly over a wide range of period. Starting from $60 per barrel in 2004, the price of West Texas Intermediate (WTI) crude oil rises to $148 in July 2008, and then falls to $40 per barrel six months later, and further rises to $107 per barrel in March 2012. In July 2012, the price of WTI crude oil then dropped again below $80 (Kolodziej et al., 2014). As such, oil price shocks have imposed costs on various economic activity which result in losses and slow economic growth.

To shade more light on the possibility of this, Figure 1.1 contains crude oil price movement of five different grades of crude oil that include WTI, Brent, Mars, Tapis and Dubai light. The increase in the crude oil price over time up to 2007 was largely associated to market fundamentals. However, the sudden increase from $50 per barrel in 2007 to as high as the historical $145 per barrel in the middle of 2008 trigger debates as to whether the oil price shocks are caused by market fundamentals or speculative activities. Further, the subsequent fall in oil price to as low as $40 per barrel during the end of 2008 and early 2009 result from the global financial crisis. On the other hand, the recent fall in crude oil price that begins from the middle of 2014 is said to be largely associated with excess supply resulting from an increase in production of crude oil by non-OPEC countries in addition to OPEC production.

In particular, the British broadcasting cooperation (BBC) announced that the Brent crude oil price which is the proxy for global crude oil price falls to $36.05 per barrel on December 21, 2015, while the Organization of Petroleum Exporting Countries (OPEC) revealed a fall in crude oil price to $31.71 per barrel in December 28, 2015. Thus, the ending of the year 2015 is remarkable in the history of oil price shocks as it represents eleven years history that crude oil was last sold below $35 per barrel.

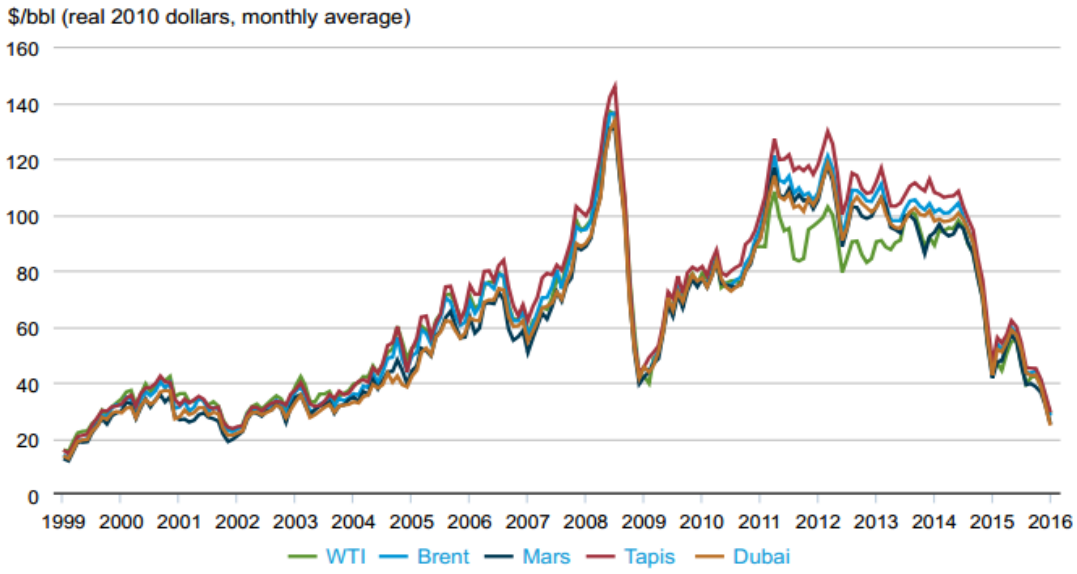

Figure 1.1 : Crude oil price movement from 1999-2016
Source: United State Energy Information Administration (EIA)

In the literature, however, there exist two main views on the impact of oil shocks on economic indicators. The first view relates to Hamilton (1983) and his proponents. Having investigated the causes of economic recession in United State (US), revealed that 9 out of 10 recessions in the US since World War II were preceded by sharp rises in the oil price. In more recent times, a similar study was carried out by Cunado and Gracia (2003) for a sample of European countries and found that oil price shocks have a significant negative effect on the performance of those countries.

The second view focused on the asymmetric effect of oil price shocks on the level of output. They contend that output response to oil price shocks is not symmetric in nature. Increase in oil price increases firm's costs of production which necessitates invention and investment on new technology that uses alternative energy sources like solar and hydropower. Since funds are invested on these alternative sources, a further decline in oil price in the future will have less impact on output compared to increase in oil price, because the rational investor does not normally abandon their investment as it involves sunk cost. Therefore the adjustment process of positive and negative oil price shocks is asymmetric (Mork, 1989).

The potential impact of oil price volatility necessitates the need to ask a question about its causes. The possible empirical questions include: what are the cause of oil price shocks? What is the impact of oil price shocks on non-oil sectors of the economy? How does oil price shocks affect key sectors with the highest forward and backward linkages? What is the impact of recent oil price shocks on tax revenue to the government, Gross Domestic Product (GDP) and unemployment? Three out of the possible identified causes of oil price volatility in the past include speculative expectations, the correlation among markets due to capital flows and market fundamentals.

1.1.1 Oil Price, financial market and economic activity

As highlighted by Energy Information Administration (EIA) of United State (2016), financial market situations in the past few years have experienced an increased trend of holding crude oil as a financial asset rather than as a commodity. More so, markets for other securities such as equities, bonds, and foreign exchange has become more highly correlated with crude oil prices.

Speculative expectations where non-commercial traders hold crude oil as a financial asset was traced to be responsible for changes in crude oil prices. The speculative expectation has since been observed to have occupied more than 50% of oil price future and expected to increase further (Masters, 2008; Kolodziej et al., 2014). Similarly, huge capital outflows or inflows among markets are also said to be responsible for oil price shocks. For example, a large capital outflow from goods market to financial market could alter price fluctuation beyond prediction of market fundamentals. This is in line with the theoretical expectation which postulates that goods price and or crude oil price is positively related to inflation and inversely related to equities, stocks and bonds prices. Moreover, market fundamentals relating to the forces of demand and supply of energy products may result in energy price fluctuations. However, the chances for intervention will be limited if the cause of crude oil price shocks is traceable to capital flows and speculation expectations (Kolodziej et al., 2014).

Similarly, an indirect relationship exists between oil and gas sector and financial sector of an economy. The output of oil and gas sector are used as an input by the financial sector of the economy. For instance, to achieve financial development, the money and

capital market and other financial intermediaries use petroleum, gas and diesel as an input for transportation and electricity generation among others. In the same vain, the oil and gas sector uses the financial sectors' services as part of their input to enable them to generate output. For example, the oil and gas sector uses banking services to carry out transactions with other sectors of the economy. The oil and gas sector also patronises the capital market to get their companies listed and to also sell shares to the general public. This suggests that there exists interdependence between the oil sector and financial sector of an economy (EIA, 2015). Figure 1.3 shows the increasing trend of crude oil future market where crude oil was held as a financial asset rather than as a commodity. Starting from 2005 the number of contracts have increased rapidly to as high as 1,600 in 2015.

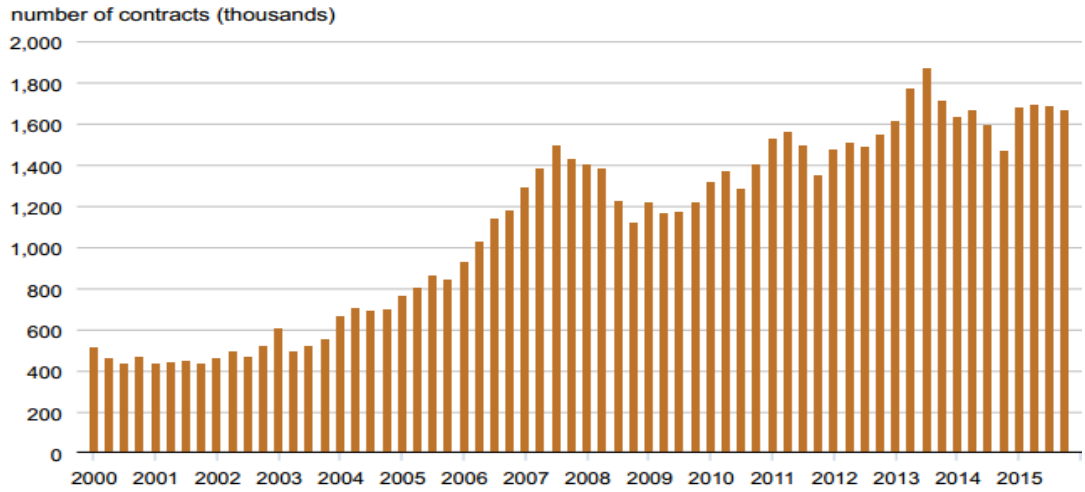

Figure 1.2 : Growth in crude oil future market over the last decade
Source: EIA(2016)

In line with the above propositions, evidence suggests that the effect of oil price shocks have more impact on oil-importing developing countries as compared to oil-importing advanced countries, owing to the lesser technology of exploiting alternative energy sources that could substitute crude oil. Aydin and Acar (2011) remarked that the extent of exposure of oil-importing countries depends on the degree of their net import and dependence on crude oil. As a result, developing countries are more affected because the share of taxes to the oil price in developed countries is much higher than that of developing countries. Therefore, taxation assists in crowding out the effect of oil shocks in the advanced nation compared to developing nations. Other effects to the oil-importing countries are the worsening of the term of trade and transfer of wealth to the oil-exporting countries.

The diminishing effect of oil shocks on the economy results from the apparent collapse of the power of oil price shocks to affect economic growth as firms and producers try to incorporate rational expectation principles in their business activities. Before 1985, oil price shocks was predominantly on the increasing trend, but after 1985, oil shocks have demonstrated both increases as well as decreasing trend. However, only rising

oil prices seems to have a negative impact on output, therefore, the combination of an increase in crude oil price and fall in the price have jointly reduced the strength and effect of the relationship between oil price and economic growth. As such, these combined with the asymmetric effect of oil price have weakened the oil–macroeconomic relationship (Iwayemi and Fowowe, 2011).

Furthermore, fluctuations in energy price are important for both producers and traders. From the producers' point of view, persistent in energy price could discourage investment in fixed capital due to uncertainty and encourage firms to hedge their assets against price risk. While from the perspective of traders, increasing price fluctuation of a good creates arbitrage opportunities as volatility is a key yardstick in the pricing of derivatives (Karali and Ramirez, 2014). Hence, to correctly measure fluctuations requires understanding the relationship between different energy products, their price determinants, and the reasons behind their price fluctuations.

The year 2014 marked another important history of oil price shocks in the world when a dramatic fall in oil price was witnessed after the first half of the year 2014 until early months of the year 2015. The oil price recorded a fall below $50 per barrel (OPEC, 2015). This has affected the revenue of most economies, particularly the oil-exporting countries like Malaysia that rely heavily on crude oil as their main source of revenue and foreign exchange earnings. It has also affected the level output and employment in the economy. Thus, oil price fall seems to be correlated with government revenue, GDP, employment, exchange rate, government budget, consumption and investments. Figure 1.3(a-c) shows a scattered plot of the link between oil price, government revenue and employment in Malaysia. The illustrations show that a positive relationship exists between oil price and the three economic indicators of government revenue, GDP and employment.

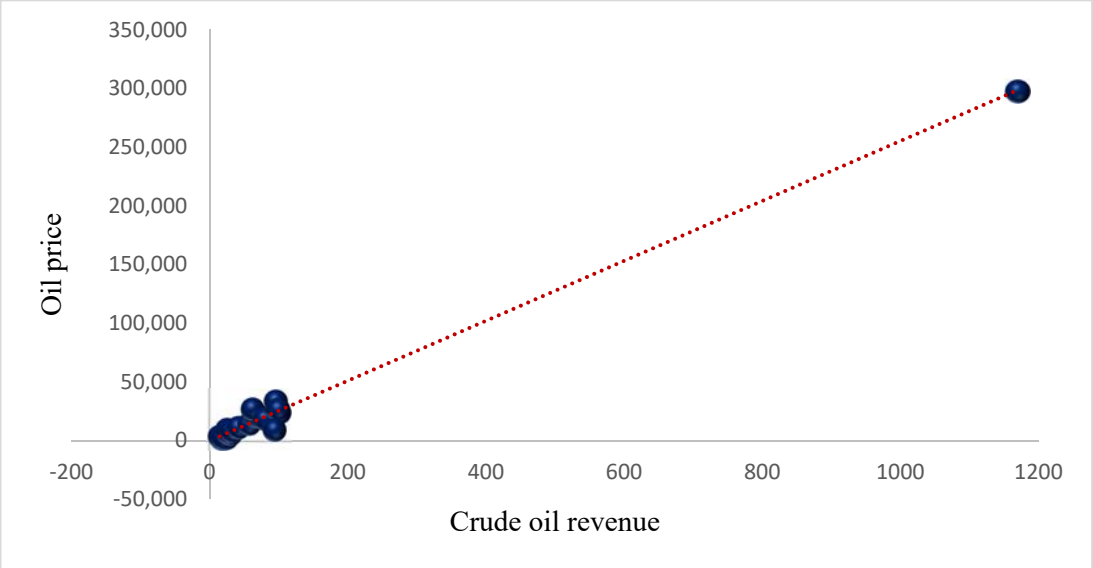

Figure 1.3a : Oil price and revenue 1990-2014

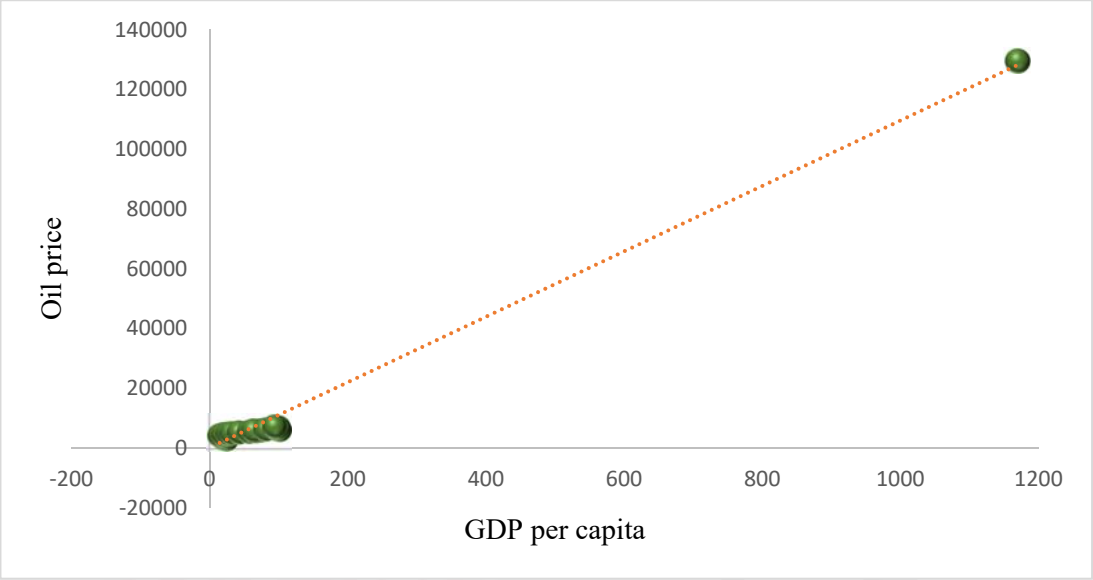

Figure 1.3b : Oil price and GDP per capita 1990-2014

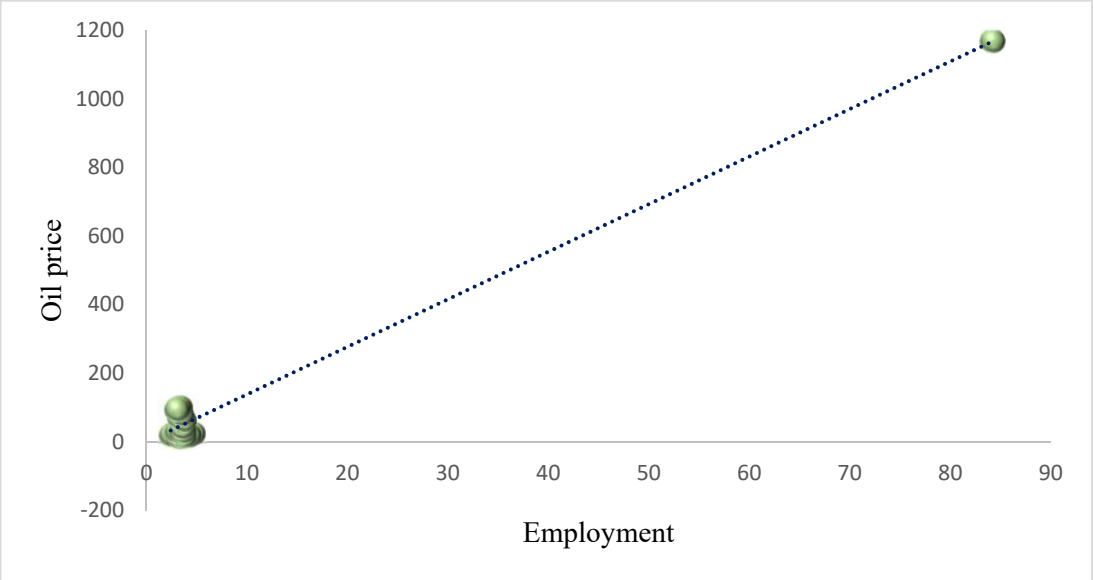

Figure 1.3c : Oil price and employment 1990-2014
Source: Author, using data from EIA, WDI and MF

Malaysia is the world's second-largest exporter of liquefied natural gas and the second largest crude oil and natural gas producer in Southeast Asia. Malaysia's energy industry is a key sector with high integration capacity of growth for the entire economy, and it constitutes up to 20% of the total gross domestic product. Petroleum and other liquids and natural gas are the main primary energy sources consumed in Malaysia, with estimated shares of 40% and 36%, respectively in 2012 (EIA, 2015). In addition, a report from the Oil and Gas Journal (OGJ) reveal that Malaysia holds a proved of oil reserves that are up to 4 billion barrels as at January 2014. Thus,

representing the fourth largest reserves in Asia-Pacific after China, India, and Vietnam.

Energy policy in Malaysia is under the watch of the Economic Planning Unit (EPU) and the Implementation and Coordination Unit (ICU), which report directly to the Prime Minister. Malaysia's national oil and gas company (PETRONAS) is the largest contributor to the government revenue represent up to 45%, generated through taxes and dividends (EIA, 2015).

1.1.2 Oil consumption, CO_2 emissions and environmental quality

The consumption of oil-related energy such petroleum, diesel oil, furnace oil, lubricant, gas in addition to coal contributes to carbon dioxide (CO_2) emissions and environmental pollution. As remarked by World Development Indicators (WDI) in 2015, more than 40% of CO_2 emissions comes from fossil fuel energy consumption which is identified to be the most important anthropogenic source of pollution.

However, literature is less prolific on the relationship between energy price and its indirect effect on CO_2 emissions and environmental quality. The amount of energy consumed for production in the manufacturing and services sectors of the economy depends on the price of energy and quantity required. Higher energy price can regulate its consumption and leads to the use of alternative energy sources such as renewable energy. This indirectly reduces a number of CO_2 emissions from primary energy consumption.

If CO_2 emissions are calculated by multiplying various primary energy consumption such as petroleum, natural gas, coal and tar sand among others by their corresponding emissions rate, then, the price of primary energy can influence CO_2 emissions and environmental quality. Thus, CO_2 emissions could be perceived not from the impact of energy consumption and economic growth but also from its other determinants such as energy price (Balaguer and Cantavella, 2016). However, investigating the impact of oil price as the determinant of the variations of energy consumption on environmental quality has eluded literature (Aydın and Acar, 2011).

The concern on the impacts of CO_2 emissions has led to the establishment of intergovernmental and environmentally friendly organisations. For example, the Intergovernmental Panel on Climate Change (IPCC) is part of the leading international organ for the assessment of global climate change, established by the United Nations (UN) Environmental Program (UNEP) and the World Meteorological Organization (WMO) in 1988. Its function is to provide the world with a clearer scientific perspective on the current state of information on climate change and its subsequent environmental and socio-economic effects. In the same year, the UN General Assembly endorsed the action of WMO and UNEP that jointly establish the IPCC with currently 195 countries as members.

Subsequently, the Kyoto Protocol was adopted on 11 December 1997 in Kyoto, Japan. It is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), whose objective is to reduce greenhouse effect and global warming. Among the main aims of this protocol is to mitigate CO_2 emissions and achieve stabilised greenhouse gas concentrations in the atmosphere. Although it was founded in 1997, the agreement was revalidated with actions in 2005. As at June 2013, there were 192 members who have ratified the protocol, with Malaysia ratifying on 4th September 2002.

The focus of this section is to examine the impact of energy consumption on sectoral CO_2 emission through oil price. Thus, Figure 1.4 (a-f) shows stylised facts on the relationship between oil price and energy consumption and oil price and sectoral CO_2 emissions in Malaysia. The figures provide evidence of positive correlation between oil price and energy consumption; the negative relationship between oil price and CO_2 emissions from manufacturing and construction sector, transportation sector and oil and gas sector. On the other hand, a positive relationship exists between oil price and CO_2 emissions from the agricultural sector and per capita CO_2 emissions. Moreover, Figure 1.5 shows a comparison between CO_2 emissions in Malaysia and other oil-exporting countries in OPEC. The comparison shows that apart from Saudi Arabia and Iran, Malaysian economy emits more CO_2 than other OPEC members.

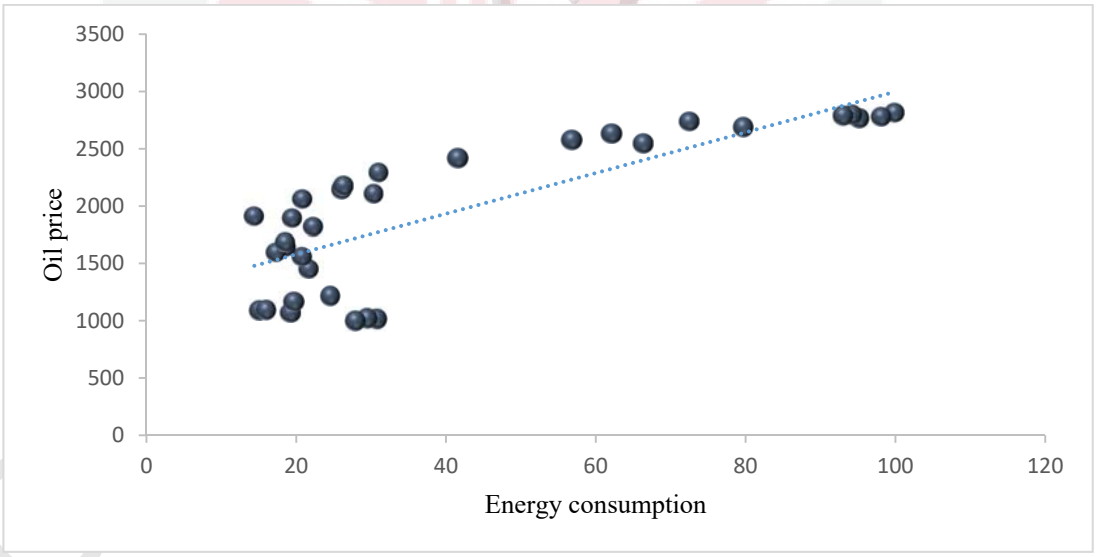

Figure 1.4a : Oil price and energy consumption 1983-2014

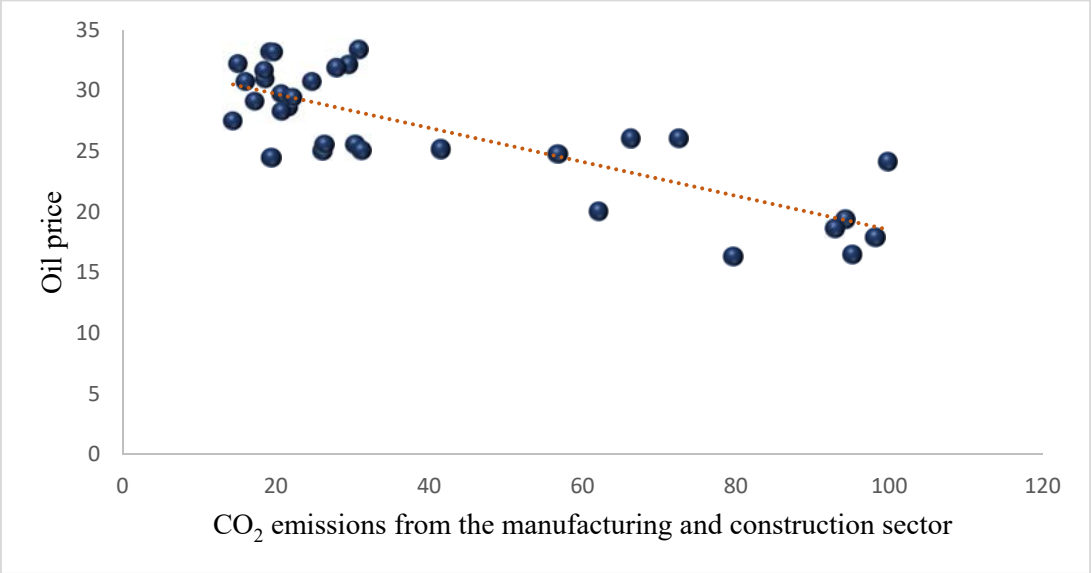

Figure 1.4b : Oil price and CO_2 emissions from the manufacturing and construction sector 1983-2014

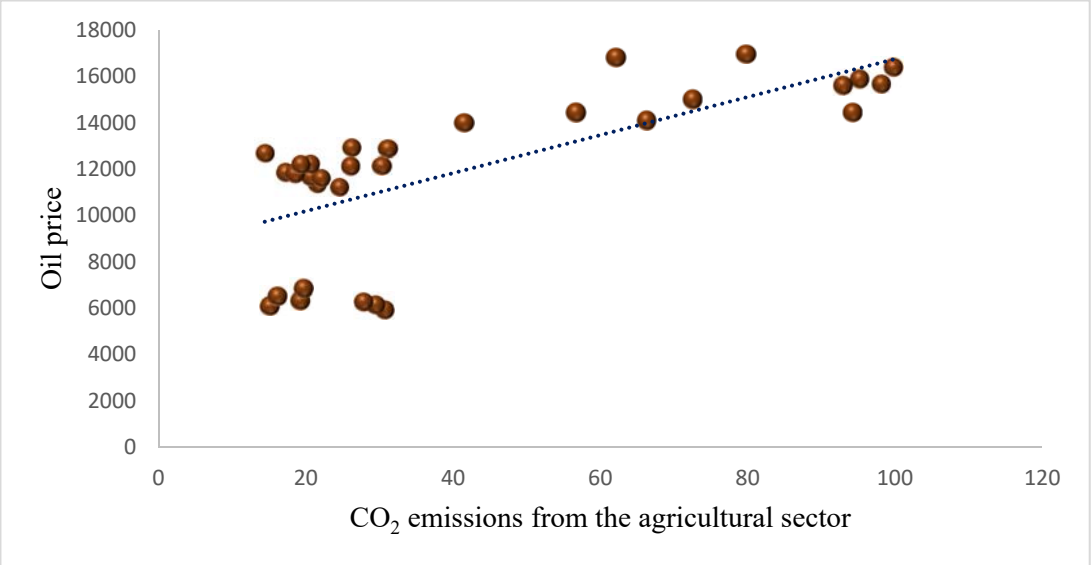

Figure 1.4c : Oil price and CO_2 emissions from the agricultural sector 1983-2014

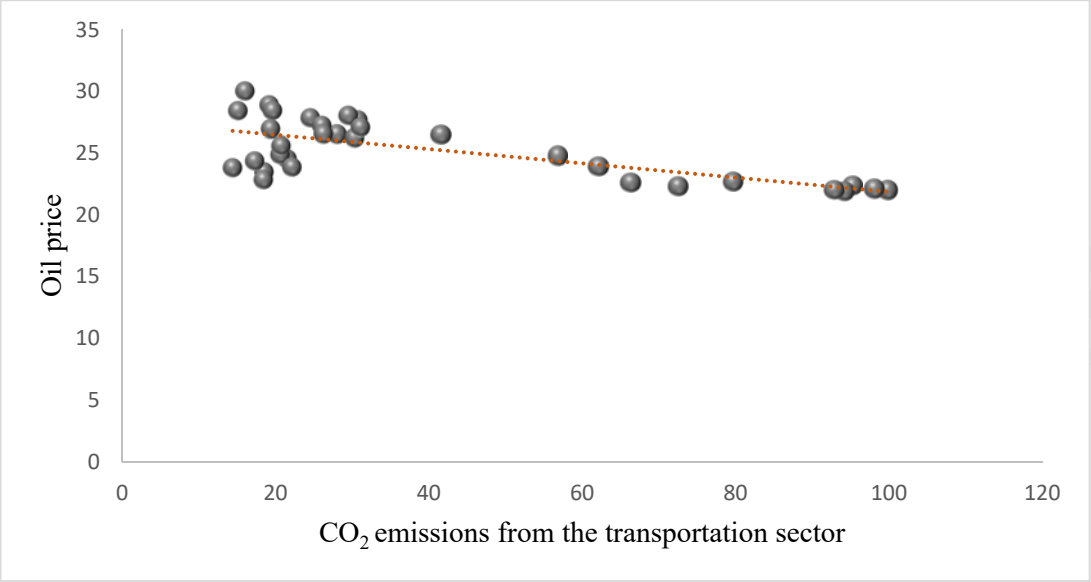

Figure 1.4d : Oil price and CO_2 emissions from the transportation sector 1983-2014

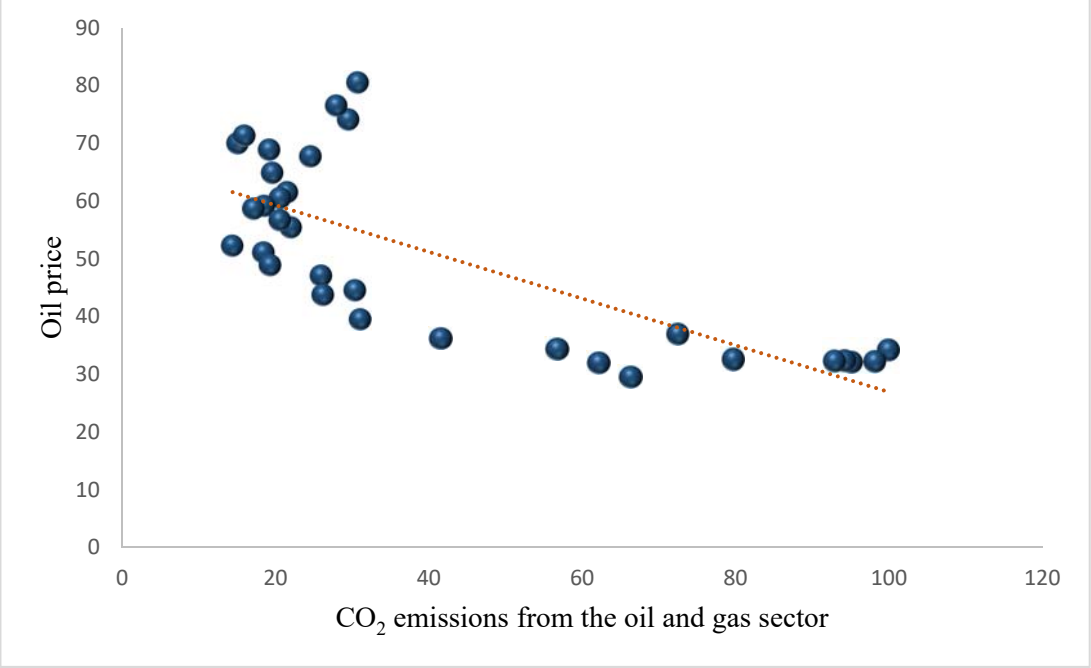

Figure 1.4e : Oil price and CO_2 emissions from the oil and gas sector 1983-2014

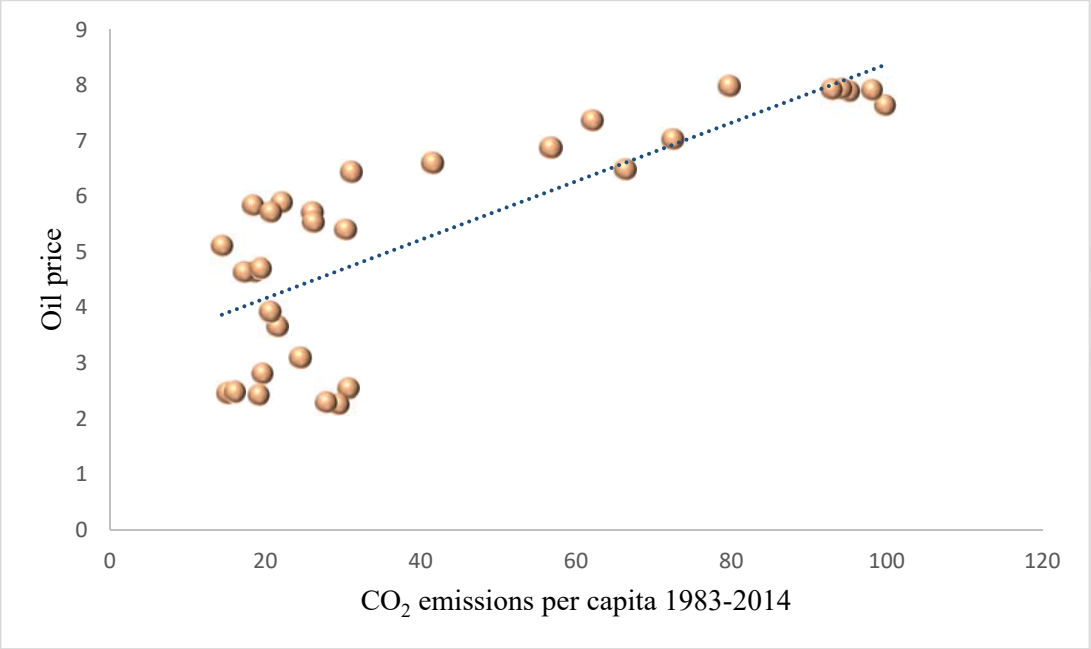

Figure 1.4f : Oil price and CO_2 emissions per capita 1983-2014

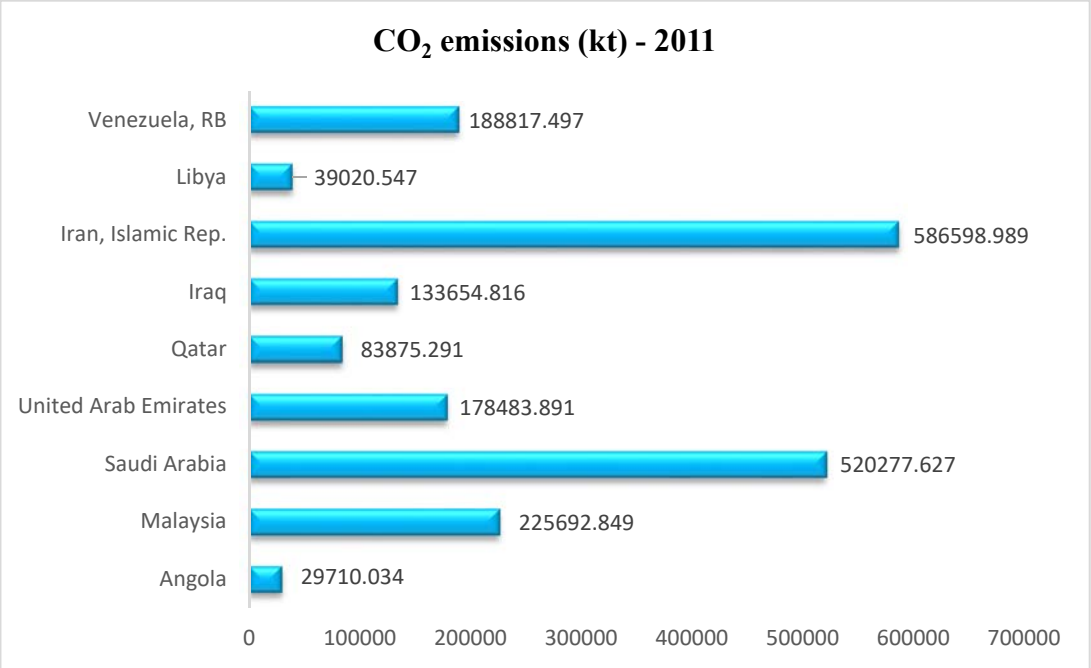

Figure 1.5 : Comparison between Malaysia CO_2 emissions and some OPEC members
Source: Author, using data from WDI, 2015

1.1.3 Financial development, CO_2 emissions and environmental quality

Financial development plays a key role in ensuring the flow of funds between lenders and borrowers. It ensures that financial resources are allocated efficiently in promoting economic growth and development. While financial stability describes the situation in which the financial intermediaries function smoothly and ensures the working of key financial institutions within the economy (Bank Negara Malaysia, 2016). In Malaysia, the Financial Sector Master Plan (FSMP), which was set up for the period 2001-2010, provides the foundation for the development of the financial sector. The Master Plan helps in strengthening the domestic financial intermediaries and their infrastructure. This was later supported by the Second Master Plan called the Financial Sector Blueprint for the period of 2011-2020, to provide a guide to financial institutions on increase financial inclusion for high value added and to ensure Malaysian economy is among the developed countries by the year 2020.

To sustainably achieve these plans, financial institutions must live by example through ensuring friendly environment and by minimising the negative impact on the environment. This requires the management of financial institutions' environmental footprint through efficient use of resources such as energy consumption in physical operations and supply chains. Thus, this requires the development of an environmental management programme that addresses climate change and greenhouse gas emissions reduction (Central Bank of Nigeria, 2015). For instance, a Bank can assist in mitigating CO_2 emissions and support energy efficiency by promoting renewable power generation and adopting the green environmental standard practice in their operations.

Financial development and environmental quality nexus have also been documented in the literature. Recent literature in this respect made an emphasis on the role of financial sector in increasing energy consumption (Aslan et al., 2014) when it provides services to other sectors, that subsequently increase CO_2 emission (Shahbaz et al., 2013) and reduce environmental quality. As such, some of the studies revealed that greater economic growth and financial development are associated with greater environmental pollution because growth and financial development lead to more consumption and production.

On the other hand, financial development has also been perceived as one of the ways that help in attaining sustainable and quality environment (Sadorsky, 2010). In this instance, it is expected that higher financial development can mitigate CO_2 emissions and improves environmental quality (Sadorsky, 2011). This divergence views in literature further call for an innovative solution through which the dual objectives of greater economic growth and sustainable environment can be achieved. In Figure 1.6 (a-c), the scattered plots show that a positive relationship exists between financial development and energy consumption and financial development and CO_2 emissions in Malaysia.

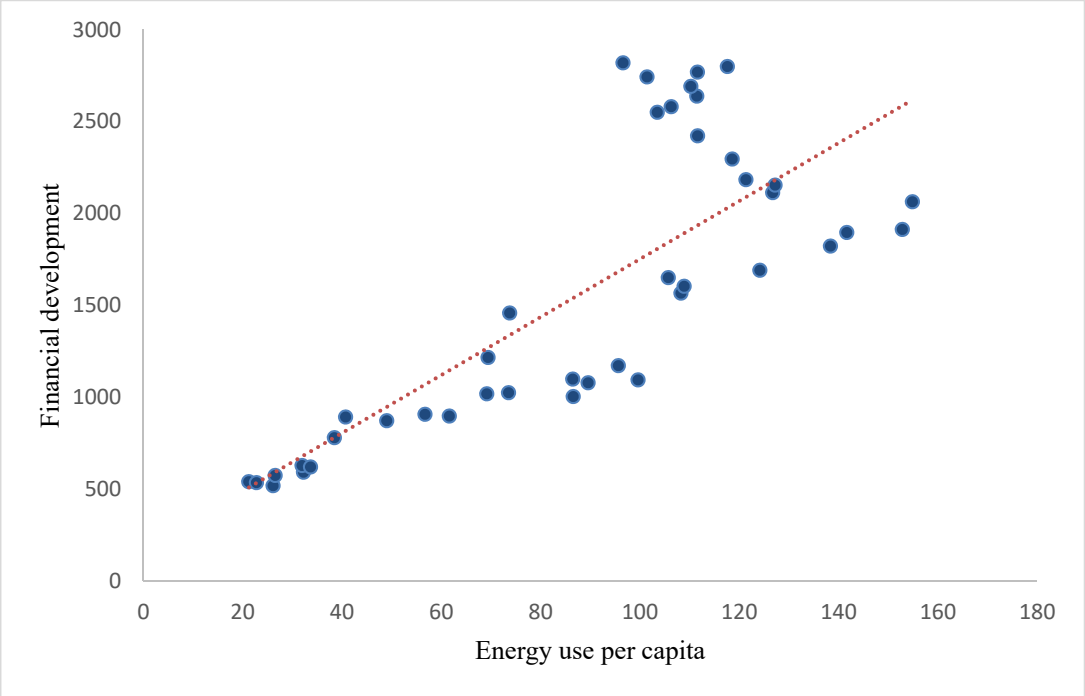

Figure 1.6a : Financial development and energy use per capita 1980-2014

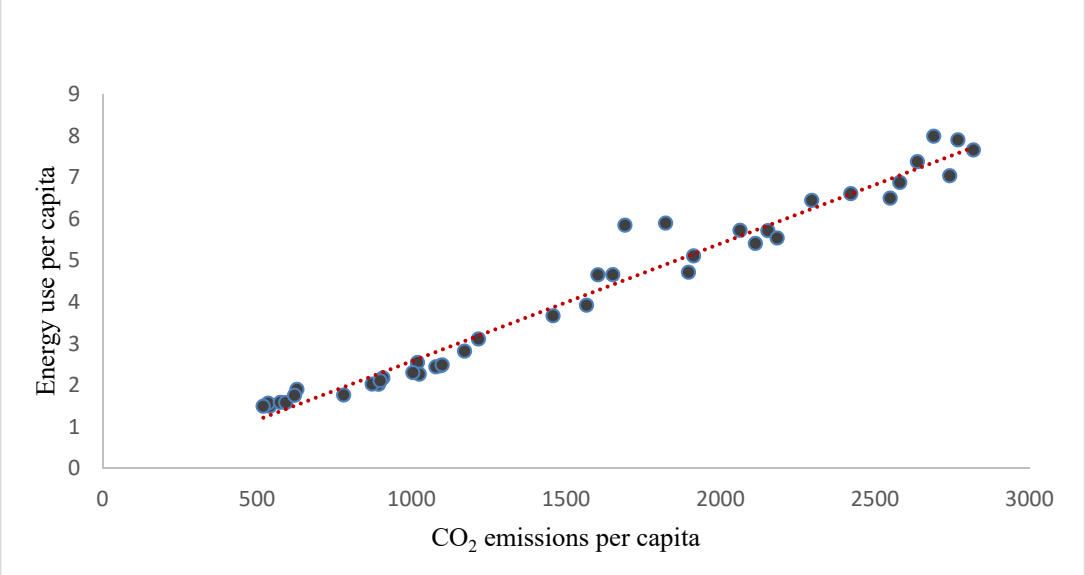

Figure 1.6b : Energy demand and CO_2 emission in Per Capita 1980-2014

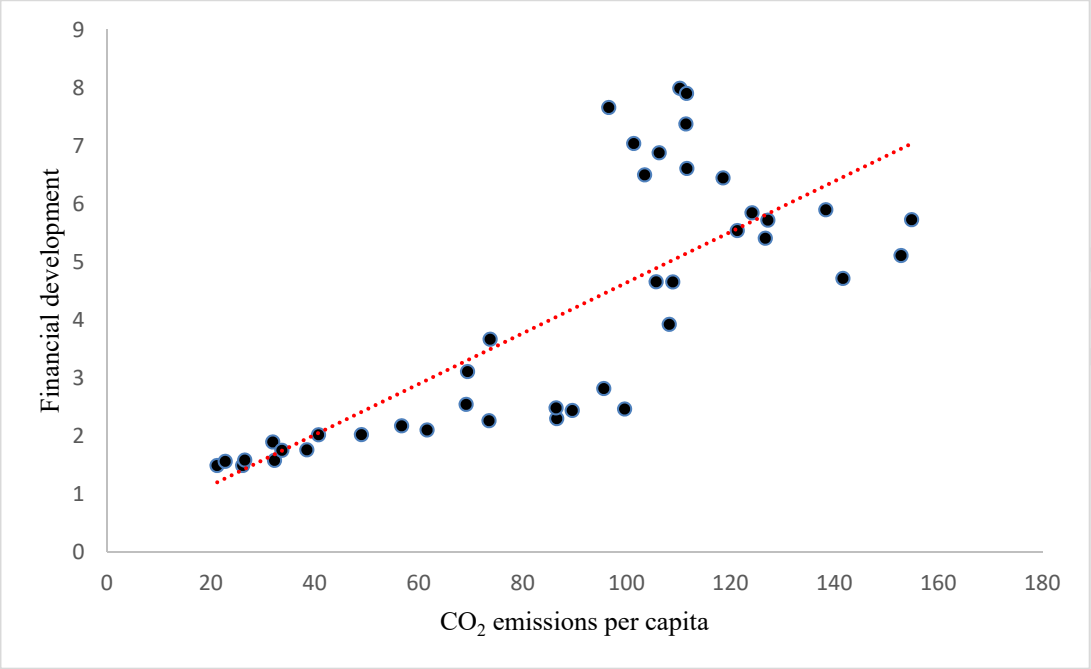

Figure 1.6c : Financial development and CO_2 emissions per capita 1980-2014
Source: Author, using data from WDI, 2015

These scattered diagrams provide a rough idea regarding the relationship between financial development and environmental quality in Malaysia. Despite that the relationship between financial development and environmental quality is a recent issue in literature, investigating the financial development and sectoral CO_2 emissions have eluded literature. Thus, examining the effect of oil price shocks and financial development on the macroeconomy and sectoral CO_2 emissions constitutes the research gap that this research work addressed.

1.2 Statement of the Problem

Malaysia is an oil-exporting country which oil and natural gas sector are among the key drivers of the economy. It is the second largest producer of oil and natural gas in Southeast Asia. The direct contribution of oil sector can be measured through the sector's contribution to the Gross Domestic Products (GDP). While the indirect contribution can be ascertained by the sector's contribution to revenue generated to the government and the sectors' linkage benefits to other sectors of the economy. In 2014, oil and natural gas sector generated 9.3% to the total GDP (Department of Statistics Malaysia, 2014). In the Eleventh Malaysian Plan (2016-2020), the mining sector is expected to contribute about 7.1% to the GDP in 2020. This suggests that about 90% of the total value added of the mining sector is expected to be generated from the oil and gas sector. For the indirect contribution, the sector contributes about 16.4% or RM (Ringgit Malaysia) 26,956 million to the total tax revenues of 2014.

However, Malaysian economy has become highly vulnerable to global oil price shocks owing to the fact that the economy depends heavily on crude oil exports as a main source of revenue to the government. The decline in oil price tends to have a significant impact on the fiscal stability of the economy. Despite the fact that the economy has benefited from the oil boom since the 1970s, subsequent oil price shocks which were exogenously determined has been a source of instability to the Malaysia's economic performance. Oil price shocks have affected government revenue, employment, output growth, price stability, and exchange rate, the balance of payment and interest rate.

Moreover, the second half of the year 2014 until January 2016, has witnessed another historical evolution of global oil price shocks. Oil price drops sharply from about $100 per barrel to about $50 in December 2015. The price then declined to $35 per barrel and later dropped to as low as $27 per barrel in January 2016 (EIA, 2016). This marked eleven years history that oil price was last sold below $30 per barrel. As a result of this, the government budget for 2016 was recalibrated to an oil price benchmark of $30-35 per barrel from the initial benchmark of $48 per barrel. Forecasted GDP for 2016 was also revised to 4%-4.5%. As such, oil price shocks has a significant impact on government revenue, output and employment.

In addition, the recent oil price drops led to currency depreciation of most economies against US Dollar. During the special address by the Prime Minister of Malaysia on 2016 budget recalibration, he mentions some of the countries whose currency were affected by the recent oil price shocks. For instance, Brazil real depreciated by 23.2%, China renminbi depreciated by 5.7%, Canadian dollar depreciated by 11.3%, Russian ruble depreciated by 29.3% and Singapore dollar depreciated by 5.6% while the Malaysia's ringgit depreciated by 11.3% against the US Dollar.

Moreover, the consumption of energy such as petroleum, gas and diesel from oil and gas sector for economic activities may also contribute to CO_2 emissions. Petroleum and other liquids and natural energy sources consumed in Malaysia account for 40% and 36% of total energy consumed in 2012 respectively (EIA, 2015). Utilising these amount of petroleum and natural gas for domestic consumption could contribute to CO_2 emissions and environmental problem.

In 2010, Malaysia CO_2 emissions per capita share of total emissions is 0.77%. This is greater than some of the oil-exporting countries like Iraq and Venezuela that emit 0.37% and 0.67% respectively. CO_2 emissions are mostly associated with energy consumption (WDI, 2015). As at 2012, the Malaysia's total CO_2 emissions from the consumption of energy in million metric tons is 199; CO_2 emissions from consumption of petroleum in the same year is 84 million metric tons; CO_2 emissions from the consumption of natural gas is 62 million metric tons; while per capita CO_2 emissions from energy consumption is 6.8 metric tons (EIA, 2016). As such, measuring energy consumption through changes in oil price for sectoral CO_2 emissions contributes to knowledge.

On the other hand, financial sector plays a key role in ensuring financial intermediation by facilitating the flow of funds from the surplus spending unit to the productive sector of the economy. It reduces information cost, transaction cost and increases productivity of firms (Shahbaz, 2013) when it provides them with the credit facility. As at January 2016, private sector financing in Malaysia grew by 8.3%, and between January 2014 and January 2016, the gross private sector financing has increased to about RM140 billion, representing 12.7% of 2014 GDP. Similarly, the loan disbursement to private businesses and household has also increased to about RM110 billion from 2014 to 2016 (BNM, 2016). This helps households and private sectors to purchase big ticket items such as machines, vehicles and equipment that consume energy and hence contribute indirectly to CO2 emissions and environmental pollution.

On the other hand, Shahbaz (2013) and Aslan et al. (2014) are of the opinion that financial sector could help in directing firms to use environment-friendly technology in production to reduce environmental pollution. This is achieved when financial sector encourage private firms to comply with the requirement of environmentally friendly practices (Frankel and Rose, 2002) before accessing credit facilities to grow their business. Financial sector could indirectly prevent firms that do not abide by such requirement, by denying them access to credit facilities. Thus, the financial sector can reduce energy emissions and enhance technological invention in the energy related industry (Sadorsky, 2010) and promote environmental quality. To further contribute to this debate, the study investigates the impact of financial development on sectoral CO_2 emissions.

In a nutshell, the study filled the literature gap of examining the impact of oil price shocks and financial development on economic activity and sectoral CO_2 emissions. The macroeconomic indicators include Government revenue, GDP and employment. While the sectoral CO_2 emissions include: CO_2 emissions from manufacturing and construction sector, CO_2 emissions from the agricultural sector, CO_2 emissions from the transportation sector and CO_2 emissions from oil and gas sector. To the best of our knowledge, these have not been investigated in the literature, as such, constitute a major contribution to scientific knowledge.

1.3 Statement of Research Questions

This research work empirically provides answer to the following question:

i. What is the impact of recent oil price shocks on Government revenue, GDP and employment in Malaysia?
ii. Does oil price shocks impact on sectoral CO_2 emissions in Malaysia?
iii. What is the impact of financial development on sectoral CO_2 emissions in Malaysia?

1.4 Research Objectives

The broad objective of this research work is to investigate the impact of recent oil price shocks and financial development on economic indicators and sectoral CO_2 emissions and environmental quality in Malaysia.

The specific objectives of the research work include:

i. To examine the impact of recent oil price shocks on government revenue, GDP and employment in Malaysia.
ii. To assess the impact of oil price shocks on sectoral CO_2 emissions in Malaysia.
iii. To investigate the impact of financial development on sectoral CO_2 emissions and environmental quality in Malaysia.

1.5 Research Hypothesis

The null hypothesis of this research work includes:

Ho_1: Oil price shocks does not have any impact on government revenue, GDP and employment in the Malaysian economy
Ho_2: Energy price changes does not impact on sectoral CO_2 emissions in Malaysia
Ho_3: Financial development does not affect sectoral CO_2 emissions and environmental quality in Malaysia

1.6 Significance of the Study

To examine the impact of oil price shocks on Government revenue, GDP and employment, the study focused on sectoral linkages and interdependence to identify the sectors that are the drivers of the Malaysian economy. In identifying the key sectors of the economy, multipliers and linkages (forward and backward) were utilised. The backward linkages refer to the input supply chain required by a particular industry or sector to produce its output. The higher the input supply chain the greater the multiplier and the more important the sector becomes for policy analysis. On the other hand, the forward linkages refer to the demand chain or the use of a sectors' output as intermediate input for other sectors' production. The higher the forward linkages the greater the multiplier and the more important the sector becomes.

Another significance of this study is that it contributes to the body of knowledge by incorporating the impact of oil price changes on sectoral CO_2 emissions in Malaysia. This is a major departure from existing literature. Most literature have concentrated on the impact of oil price shocks on the macroeconomy without considering its environmental impact in the same framework. This study further contributes to knowledge by considering the impact of oil price shocks on sectoral CO_2 emissions.

In addition, the study further expands the effect of financial development to capture disaggregated CO_2 emissions. These include; CO_2 emissions from the manufacturing and construction sector, CO_2 emissions from the agricultural sector, CO_2 emissions the transportation sector and CO_2 emissions from the oil and gas sector. As such, this distinguishes our study with most of the related studies in the literature. We have further contributed to knowledge by including domestic credit provided by banks to the private sector as an indicator of financial development. Most related literature used the capital market indicators. Even among literature that used the money market indicators to measure financial development, the use of domestic credit provided by banks to the private sector is less prolific.

Furthermore, the high bride methodology of input-output analysis and econometric method employed in this study differentiates the study with other studies in existing literature. Most of the existing literature used econometric methods as their empirical framework. As such, they employed econometric methods, such as Vector Autoregressive (VAR), Structural Vector Autoregressive (SVAR) and Threshold Vector Autoregressive (TVAR) in their analysis. On the other hand, the input-output method deals with general equilibrium behaviour of the economy as a whole by considering sectoral linkages that show the sale of intermediate input by one industry to other industries in the economy. Thus, input-output analysis application is more suitable for policy analysis.

Additionally, the focus of the study is on the oil-exporting country rather than oil-importing country. Most literature on oil price shocks have concentrated their analysis on oil-importing countries. However, literature is less prolific in exploring similar relationship for oil-exporting countries. This study contributes to knowledge by exploring the effect of oil price shocks on the macroeconomic activity of an oil-exporting country, Malaysia.

Hence, this research work would be of high interest to policy maker concerning various economic activities in Malaysia. The study provides detailed information regarding economic activities in Malaysia, as a result, contribute to the existing body of knowledge in various respects and serves as a reference point for policy makers.

1.7 Scope of the Study

The study looked at the relationship between oil price shocks and other key macroeconomic indicators like tax revenue, Gross Domestic Product (GDP) and employment in Malaysian. The study then relates energy consumption through oil price and; financial development with sectoral CO_2 emissions and environmental quality in Malaysia. Since we used input-output analysis in achieving the first objective, the study used the 2010 input-output table of Malaysia as a benchmark and our work put into consideration some important variables, such as, private consumption, investment, government spending, Gross fixed capital formation, export, gross output, import, taxes, value added, compensation of employees and operating surplus.

To assess the effect of energy consumption (proxy by oil price) on sectoral CO_2 emissions in Malaysia, we used three separate econometric methods with datasets from 1983-2014. The Autoregressive Distributed Lag (ARDL) as the empirical model and Dynamic Ordinary Least Squares (DOLS) and Ordinary Least Squares (OLS) with a robust standard error for robustness checking. Studies have investigated the contribution of energy consumption to CO_2 emissions, but investigating its effect on disaggregated CO_2 emissions has eluded literature. The impact of financial development on sectoral CO_2 emissions and environment quality which relates to the third objective uses datasets from 1980-20014. An econometric method such as ARDL, DOLS and OLS were utilised. Sectoral data availability constitutes constraints to the study.

1.8 Organisation of the Study

The study is organised into five chapters. Chapter one focused on the introduction that lays the foundation to the research work. This includes the background of the study, problem statement that informs the need to embark on the research work. This was followed by research questions, objectives, hypothesis scope and organisation of the study. Chapter two deals with conceptual clarifications, theoretical literature review and empirical literature review.

Chapter three discussed various methods used in achieving the objectives of the study. The chapter explains the theoretical frameworks, the input-output analysis and the modelling techniques used and their specifications. Variable selections and their measurement were also discussed in chapter three. The chapter further discussed the type of data used and their sources. Chapter four, on the other hand, concentrated on analysis and interpretation of results while chapter five deals with conclusion and policy implications.

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