

THE EFFECTS OF MACROECONOMIC AND
FINANCIAL DEVELOPMENT TOWARDS CARBON
DIOXIDE EMISSION IN MALAYSIA

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DECLARATION

We hereby declare that:

- (1) This undergraduate research project is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic, or personal.
- (2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.
- (3) Equal contribution has been made by each group member in completing the research project.
- (4) The total word count of this research report is 19,286.

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LIST OF ABBREVIATION

ARDL	Autoregressive Distributed Lag
CO ₂	Carbon Dioxide
DCPS	Domestic Credit to Private Sector
ECT	Error Correction Term
Energy	Energy Use
GDP	Gross Domestic Product
Trade	Merchandise Trade
VECM	Vector Error Correction Model

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PREFACE

This research project is submitted in order to fulfil the required of the graduate student for the degree of Bachelor of Business Administration (HONS) Banking and Finance in Universiti Tunku Abdul Rahman (UTAR). This research paper is supervised by Mr Lee Chin Yu. This study provided a detailed flow and explanation of our topic selected.

The research is titled “The Effects of Macroeconomic and Financial Development towards Carbon Dioxide Emission in Malaysia”. The variables chosen are Merchandise Trade, GDP, Domestic Credit to Private Sector, and Energy Consumption. Objective for the research is to examine the relationships between these variables and the CO₂ emission in Malaysia and the dynamic interactions among themselves.

Firstly, the study begins with the research background and explaining the relationship between each of the variables. The study further provides the explanation of each of the variables according to the objectives detailed in literature review in Chapter 2. Methodology used and description of data are discussed in Chapter 3. In Chapter 4, empirical results and the process are shown and interpreted. The whole research is then summarized in the final chapter together with policy implication, limitations, as well as recommendations.

ABSTRACT

Global warming and CO₂ emission has always been the elephant in the room especially for Malaysia, whose main industries are petroleum and liquefied natural gas, lumber, and palm oil, in its time of rapid economic and financial development. It is crucial to understand the effects of macroeconomic and financial development on CO₂ emission in Malaysia as the country moves forward trying to achieve the Sustainable Development Goals. This research, with the sample size of 34 years, focuses on understanding the relationship between the macroeconomic and financial development, and CO₂ emission in Malaysia and the dynamic interactions among the variables. In this paper, Phillips-Peron (PP) test is conducted to examine whether the time series data is stationary or non-stationary. It was found that all variables are stationary and do not contain a unit root after the first difference at the significance level of 5%. Johansen and Juselius test is then applied for the purpose of checking whether the long run equilibrium relationship exists between the dependent and independent variables. We are able to conclude that there are two co-integrating relationship between all of the 5 variables in this model at 5% significance level. Next, the standard Vector Error Correction Model (VECM) is used to determine the long-run co-integrating relationship. At 5% significance level, domestic credit to private sector and energy consumptions are not significant while GDP and merchandise trade are significant. Granger Causality test is carried out for the purpose on testing the dynamic direction and existence of causality between all stationary variables in this research based on VECM. Results showed that there is no granger cause relationship for all of the variables. On top of that, Forecast Error Variance Decomposition is used to determine the dynamic interaction of the variables which is outside the sample period. Results showed that volatility of LCO₂ is mainly affected by its own discrepancy followed by LTRADE, LDCPS, LGDP and LENERGY. Lastly, this study provides additional knowledge to the government, policy makers, and public in understanding the effects of macroeconomic and financial development towards CO₂ emissions in Malaysia.

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

Malaysia is best known as one of a fast economic growth in Asia. However, this country is facing environmental issues such as global warming and climate changes, which is currently faced by other countries as well. Even just a slight increment of climate change, the accumulation of greenhouse gases in the air can increase significantly. Carbon dioxide (CO₂) one of the major anthropogenic for greenhouse gases, and the increase in CO₂ accumulation globally are caused mainly by the usage of fossil fuel and change in land usage (IPCC, 2007). Malaysia, being one of the highest growth open economies in the developing world, has recorded a significant increase in CO₂ emissions in the recent years (Ang, 2008). It is therefore crucial to study the relationship between CO₂ emission and the macroeconomic and financial development factors in Malaysia in order to understand the root cause of climate change in Malaysia. This research paper will focus on determining the relationship between CO₂ emission and variables like Gross Domestic Product (GDP), Domestic Credit to Private Sector, Merchandise Trades, and Energy Consumption in Malaysia. The paper will first introduce the background of Malaysia in term of the stated macroeconomic and financial development variables. Next, graphs will be plotted to aid the illustration of the relationship between CO₂ emission and the macroeconomic and financial variables. The problem statement, significance of study, and research objectives will be discussed subsequently.

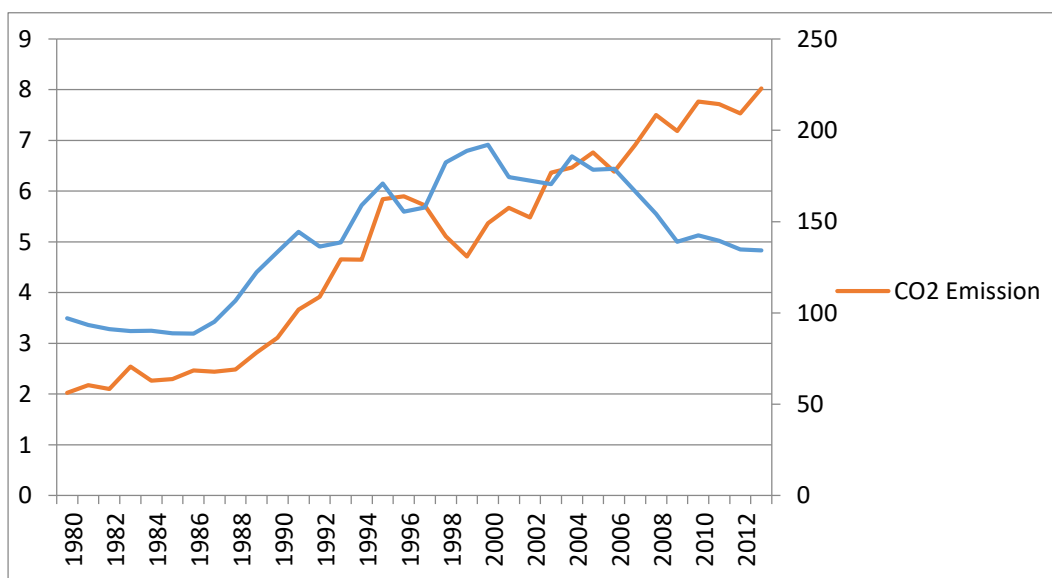
1.1 Research Background

Macroeconomic and financial development variables such as GDP, Domestic Credit to Private Sector, Trades, and Energy Consumption are the key indication to a country's economy wellbeing. They are closely monitored by the government in order to improve or at least maintain the growth of economy. According to The

World Bank (2017), Malaysia has one of the fastest growing economies with a mean growth of more than 7 percent annually at least for the past 25 years, so much so that Malaysia has almost eradicated poverty with only less than 1 percent of household living in extreme poverty. The World Bank (2017) has also identified that the essential step Malaysia has to take in order to remain competitive among other high-income economies is to further stimulate productivity growth. Similar to other countries, the figures of the key economic and financial development variables of Malaysia have to grow before the economy flourishes.

As suggested by The World Bank (2017), CO₂ emissions made up the largest portion of greenhouse gases that has a direct linkage to climate change and global warming. The primary causes of CO₂ emissions are the burning of fossil fuel and process of cement manufacturing. Being one of the fastest developing countries, Malaysia's CO₂ emission, measured in metric tons per capita, indicates a significant upward trend from year 1980 to 2013, recording an increase of more than 300 percent. If Malaysia's economy continues to grow at the expense of the environment, global warming will worsen at a much quicker rate than we can imagine.

Figure 1.1.1: Merchandise Trade (% of GDP) and CO₂ Emission (Metric Tons per Capita) in Malaysia



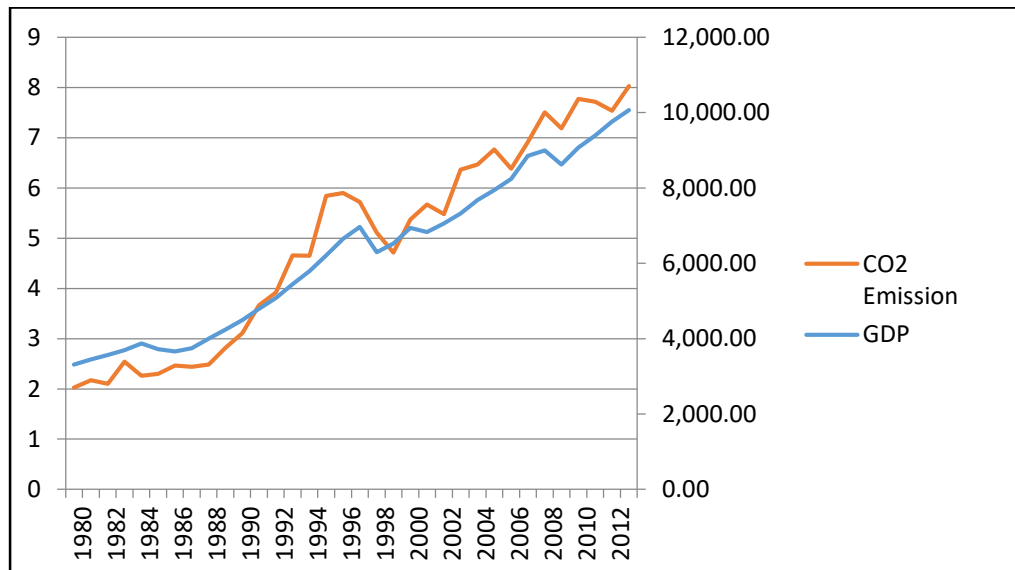
source: The World Bank

According to The World Bank, merchandise trade (% of GDP) is defined as the total merchandise exports and imports over the total value of GDP. The data are retrieved both from reports of merchandises flowing in and out of a country and financial reports that are linked to merchandise trade as stated in the balance of payments.

Malaysia's merchandise trade has recorded an upward trend from year 1986 to 2000 with slight fluctuation between year 1991 to 1993 and year 1995 to 1997, indicating a stable growth of trade in terms of percentage of GDP. On the other hand, CO₂ emission in Malaysia has shown a similar trend up until year 1996 where it plunged roughly 20%, indicating an opposite trend as compared to merchandise trade.

The opposite trend happened again from year 2006 to 2013 where merchandise trade dropped by roughly 25% while CO₂ emission increased steadily by 16%.

Figure 1.1.2: GDP per Capita (Read US\$) and CO₂ Emission (Metric Tons per Capita) in Malaysia



source: The World Bank

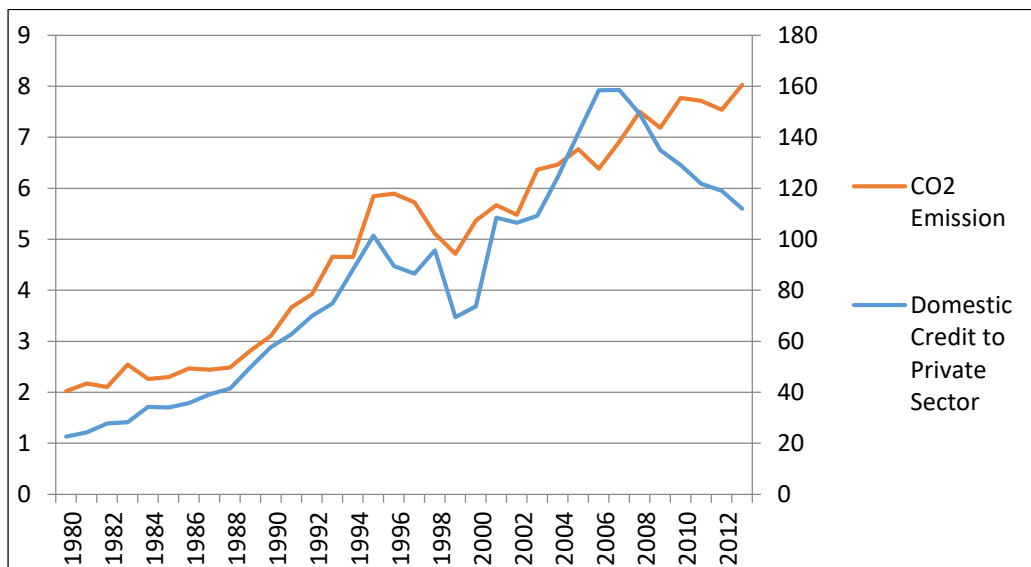
The World Bank suggested that GDP is the total of gross value including all local manufacturers in the economy together with taxes associated with the product and subtract any subsidies that are excluded from the products' value. The figures are

obtained without excluding the depreciation of fabricated products or for deterioration of natural resources.

GDP per capita of Malaysia, similar to CO₂ emission, indicates an upward trend from year 1980 up to 1997, recorded an increase of 110%. According to Chowdhry and Goyal (2000), when the financial crisis hit Asia in year 1997, Malaysia's GDY plunged by 0.6% in just one year before making slight recovery from year 1998 onwards. Within the same period, CO₂ emission also dropped by roughly 10%, again, indicating a similar trend to GDP.

From year 1999 onwards, both GDP and CO₂ emission recorded a steady upward trend with little fluctuation. Overall, there is a positive relationship between GDP and CO₂ emission from year 1980 to 2013.

Figure 1.1.3: Domestic Credit to Private Sector (% of GDP) and CO₂ Emission (Metric Tons per Capita) in Malaysia



source: The World Bank

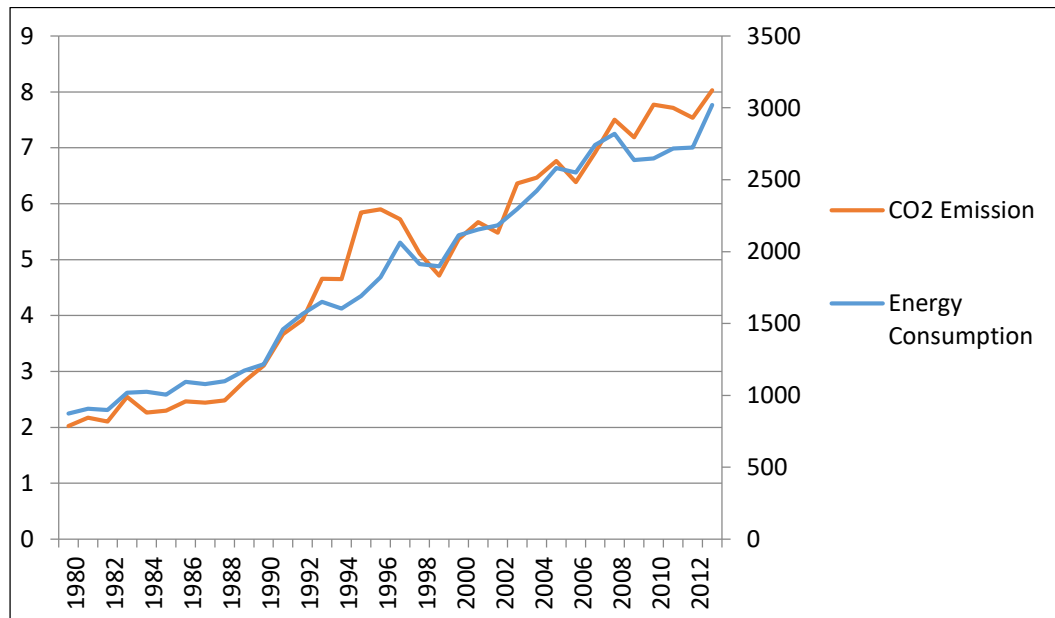
Domestic credit to private sector, according to The World Bank, is defined as the sum of financial resources allocated to the private sector by financial institutions through method like borrowing and the purchase of non-equity securities. This includes financial institutions such as finance and leasing companies, insurance corporations, and foreign exchange companies. Alongside the contribution from

public sector, private investments are one of the key contributors to economic growth, creating jobs with high incomes.

Similar to CO₂ emission, domestic credit to private sector rose steadily from year 1980 to 1995 by roughly 350% before plunging alongside CO₂ emission to year 1999 by 30% due to the Asian financial crisis (Chowdhry and Goyal, 2000). Since then Malaysia has made tremendous recovery up until year 2007 where domestic credit to private sector skyrocketed by a whopping 130%. From year 2008 onwards, however, CO₂ emission and domestic credit to private sector showed an opposite trend where CO₂ emission increased slightly by 13% while domestic credit to private sector decreased by 17%.

Overall, CO₂ and domestic credit to private sector showed a positive relationship from year 1980 up until 2008.

Figure 1.1.4: Energy consumption (kg of oil equivalent per capita) and CO₂ Emission (Metric Tons per Capita) in Malaysia



source: The World Bank

According to The World Bank, energy consumption is defined as the total usage of primary energy that has not been transformed to other end products. The figure is calculated by adding indigenous production to imports and stock transport, and

subtracting exports and fuels used in international transport. Energy consumption has a direct link to economic growth in sectors like industry and motorized transport, especially in a developing country like Malaysia. Raising the efficiency of energy consumption has become the focus of the governments in many countries to cut down the usage of the limited resources and to reduce greenhouse gas emissions.

Energy consumption in Malaysia indicates an upward trend throughout the years. A steep climb of nearly 30% was observed from year 1994 to 1997 alongside the huge climb in CO₂ emission. A downward trend from year 1997 to 1998 was also found in the case of energy consumption before making a steady recovery of roughly 50% up to year 2008. Energy consumption fell by 6% from year 2008 to 2009 and remains stagnant up to year 2012. A strong recovery of 11% was recorded in just a year from year 2012 to 2013.

All in all, there is a positive relationship between energy consumption and CO₂ emission from year 1980 to 2013.

1.2 Problem Statement

We are living in a time where the globe is moving towards creating a sustainable world, especially Malaysia that has committed itself to the 17 Sustainable Development Goals or SDG by the United Nations (UN) where at least 5 of the 17 goals are set to tackle climate issues and promote economic growth in a sustainable manner (United Nations Development Programme [UNDP], n.d.). A future with less CO₂ emission seems inevitable.

According to TheSunDaily, the Malaysian government funded 200 green projects nationwide at a cost of RM2.6 billion, in the country's commitment towards reducing the problems of climate change and pledged to cut CO₂ emissions intensity by 45% by 2030. However, despite numerous efforts like passing the Environmental Quality Act 1974, Environmental Quality (Clean Air) Regulations 1978, Environmental Quality Order of 1987, and ratifying the Kyoto Protocol and

the recent Paris Agreement (MNREM, 2007), Malaysia is still the fourth largest emitter of greenhouse gases in Asean that contributes to 0.52% of the world's carbon emissions (Cheng, 2016).

As shown in the previous section, according to the data provided by The World Bank, there has always been an upward trend in CO₂ emissions in Malaysia since 1970. In fact, in year 2003 - 2013 alone, Malaysia has recorded a 50% increase in CO₂ emission. In the same period, GDP per capita increased from USD7,323.70 to USD 10,062.91, indicating an increase of nearly 40%. Domestic credit to private sector in increased by 8% from 118.97% to 119.90% of GDP. Energy use (kg of oil equivalent per capita) increased by 32% from 2295.67kg to 3019.82kg. While merchandise trade decreased by 20% from 170.60% to 134.32% of GDP, a positive relationship with CO₂ emission can still be seen in the long run from 1980 to 2013. Overall, the collected data suggests that, in the long run, there exists a positive relationship between macroeconomic advancement and financial development and the air pollution in Malaysia where all of them shown an upward trend in the same period of time.

Are financial and macroeconomic development happening at the expense of the health of Malaysian and the environment? It is critical to study the linkage between CO₂ emission per capita and the financial and macroeconomic development in order to discover the root of air pollution in Malaysia.

1.3 Research Objectives

To examine the effects of macroeconomic and financial development on CO₂ emission per capita (metric tonne) in Malaysia. The variables are Gross Domestic Product per capita (GDP), Domestic Credit to Private Sector, Trades, and Energy Consumption.

1.4 Specific Objectives

1. To investigate the impact of GDP on CO₂ emissions in short and long run.
2. To investigate the impact of Domestic Credit to Private Sector on CO₂ emissions in short and long run.
3. To investigate the impact of Trade on CO₂ emissions in short and long run.
4. To investigate the impact of Energy Consumption on CO₂ emissions in short and long run.
5. To examine the dynamic interactions among all variables.

1.5 Significance of Study

This research investigates the relationship between the macroeconomic and financial development of Malaysia towards CO₂ emission by variables such as GDP, Domestic Credit to Private Sector, Merchandise Trades, and Energy Consumption. This study enables us to gain better understanding as each variable consists of different level of impacts toward the emission of CO₂ in Malaysia. For example, the study showed that GDP and CO₂ have long run relationship between each other and concluded that higher GDP will lead to higher emission of CO₂ in which air pollution will occur as a consequence (Saboori et al., 2012). With this study, policy makers and community will be benefited by having the ability in sustaining the environment and maintaining the growth of economy simultaneously (Bak, Chong, Ho & Teng, 2016). For instance, policy makers or community can cut down their energy consumption to reduce CO₂ emission due to their direct proportion relationship. According to Chik, Rahim, Radam & Shamsudin (2013), it is crucial that actions are taken to reduce emission intensity of Malaysia to avoid the increment of climate change and greenhouse effect.

1.6 Chapter Layout

This research paper consists of five major chapters as follow:

1.6.1 Chapter 1: Research Overview

As an introductory part of the paper, Chapter 1 covers an introduction and provides a brief overview of the overall research conducted. It includes the introduction of Chapter 1 itself, followed by the research background, problem statement of the study, general and specific objective of the research, and the significance of study.

1.6.2 Chapter 2: Literature Review

Relevant studies done by other researchers and also the theories and method used to conduct their studies will be included in this chapter. Relevant theoretical framework of CO₂ emission and other variables related to macroeconomic and financial development will also be discussed. Generally, Chapter 2 shows the foundation of the theoretical framework in explaining the links between CO₂ emission and rest of the variables, supported by the viewpoints from other researchers.

1.6.3 Chapter 3: Methodology

The main focus of this chapter is on how the studies conducted are carried out. It includes the identification of the sources of data and method applied in collecting the data, the proxy for the variables, units used in measuring each variable, research model, research techniques and instruments, and methodology flows. Generally, Chapter 3 talks about the methodology and tests that been carried out in meeting the objective of this study.

1.6.4 Chapter 4: Data Analysis

This chapter discusses about the results and findings of the tests that were carried out in this study. Chapter 4 focuses on the interpreting, reporting, and analyzing the empirical result by using the methodology in Chapter 3. The overall trends of each variable will also be presented, including the relationship between the dependant variable and independent variables.

1.6.5 Chapter 5: Discussion, Conclusion and Implications

The last chapter of the research paper summarizes the discussions, interpretations, and findings that were conducted in the earlier chapters. Policy implications suggested to the regulators, as well as the limitations of this study will also be discussed.

1.7 Conclusion

As one of the fastest growing countries in Asia, Malaysia is facing the problem of high level CO₂ emission. The main purpose of this research is to examine the effects of macroeconomic and financial development on CO₂ emission per capita (metric tonne) in Malaysia. The independent variables used are GDP, Domestic Credit to Private Sector, Trades, and Energy Consumption. Literature reviews and theoretical framework from the viewpoints of other researchers will be discussed in the following chapter.

There are various view points on the effects of macroeconomic and financial development towards CO₂ emission in Malaysia. Hence, the literature review regarding the relationship between dependent variable (CO₂ emission) and independent variables (DCPS, ENERGY, GDP, and TRADE) will be discussed in detail on this chapter. First and foremost, the review of the past researchers' literatures regarding the explanation of the relationship between respond variable

and explanatory variables will be carry out in this chapter. Besides, this chapter will also discuss the relevant theoretical framework of CO₂ emission with the macroeconomic and financial development. Last but not least, the last part of this chapter will be the proposal of the theoretical model of this study and the brief summary of this chapter.

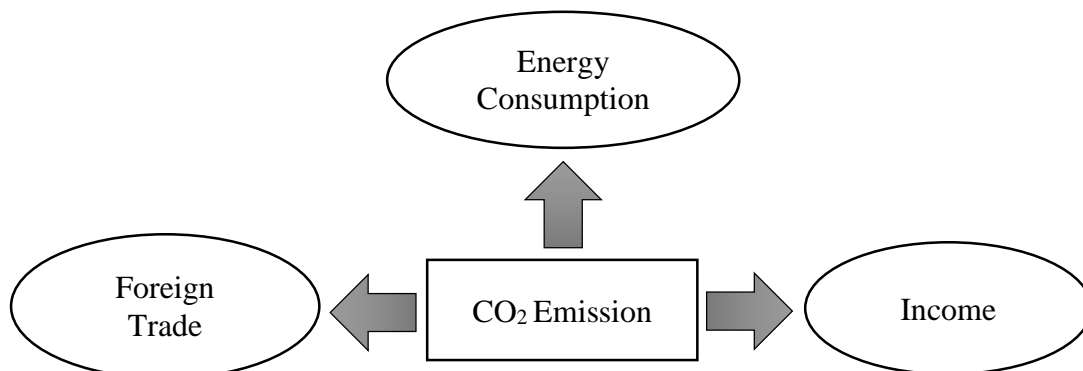
CHAPTER 2: :LITERATURE REVIEW

2.0 Introduction

There are various view points on the effects of macroeconomic and financial development towards CO₂ emission in Malaysia. Hence, the literature review regarding the relationship between dependent variable (CO₂ emission) and independent variables (DCPS, ENERGY, GDP, and TRADE) will be discussed in detail on this chapter. First and foremost, the review of the past researchers' literatures regarding the explanation of the relationship between respond variable and explanatory variables will be carry out in this chapter. Besides, this chapter will also discuss the relevant theoretical framework of CO₂ emission with the macroeconomic and financial development. Last but not least, the last part of this chapter will be the proposal of the theoretical model of this study and the brief summary of this chapter.

2.1 Proposed Theoretical / Conceptual Framework

Figure 2.1.1: Theoretical Model



Adapted from AKIN, C. S. (2014). The impact of foreign trade, energy consumption and income on CO₂ Emissions. *Energy Economics and Policy*, 4(3), 465-475.

Figure 2.1.1 shows the model which is done by AKIN (2013) in his research. The research is study about the foreign trade, energy consumption and income toward the CO₂ emission.

Figure 2.1.2: Research Model

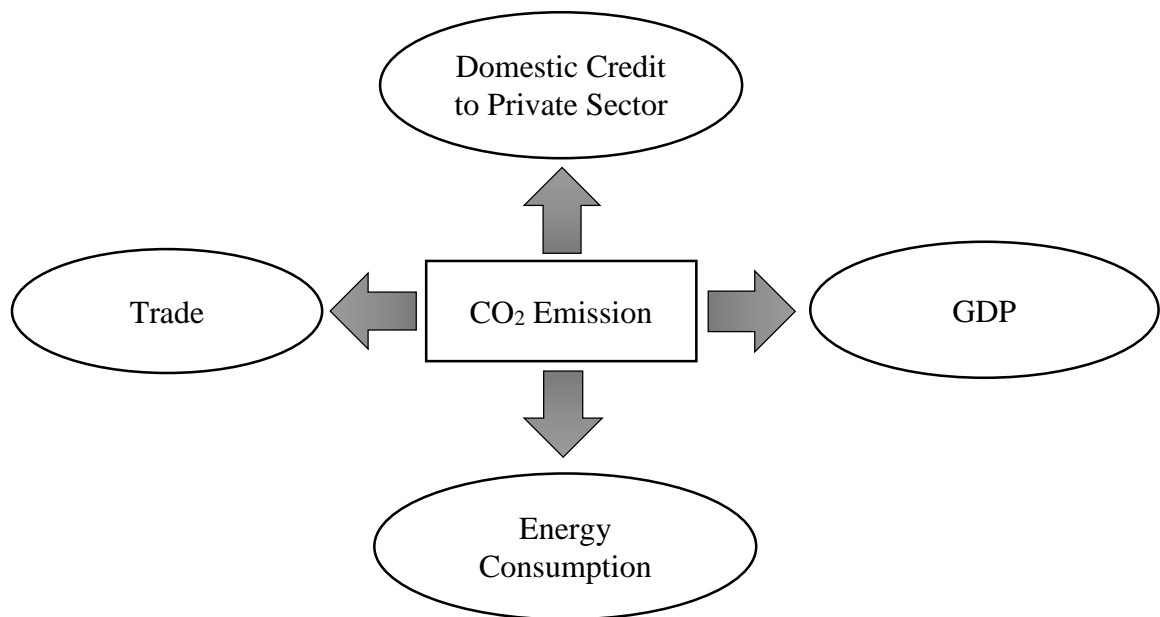


Figure 2.1.2 shows the conceptual framework about the effects of macroeconomic variables and financial development towards CO₂ in Malaysia. As for this study, it is proposed that all the independent variables such as domestic credit to private sector, gross domestic product, energy consumption and trade have a relationship towards CO₂ emission.

2.2 Domestic Credit to Private Sector

Shahbaz et al. (2013) suggested that there is a long run relationship between CO₂ emissions and financial development in Indonesia. They found that financial development is negatively related to CO₂ emissions at the significance level of

1%. It indicates that every 1% increase in financial development will lead to a 0.2071% decrease in CO₂ emissions level. This means that financial development contributes in condensing CO₂ emissions because banks will bail out the loans to the firms for those environmental friendly projects. Besides that, they also found that there is an inverted U shaped relationship between CO₂ emissions and financial development. The impact, in linear and non-linear terms, of financial development on CO₂ emissions is positive and negative accordingly at the significance level of 1%. They suggested that the financial sector should give out loans for energy efficient technologies and exploring new sources of energy which is renewable energy. The unidirectional causality is found running from financial development to CO₂ emissions. This is in line with the previous statement which is providing loans to the firms who will emit less CO₂ emissions during production.

According to Shahbaz, Solarin, Mahmood and Arouri (2013), the correlation analysis showed that there is a negative correlation between CO₂ emissions and financial development. The non-linear relationship between financial development and CO₂ emissions and financial development are U-shaped but it is statistically insignificant. They suggested policy makers to redirect the financial sector to provide loans to the environmental friendly firms which will improve the quality of life by saving the environment from degradation. In conclusion, financial development reduces CO₂ emissions in Malaysia.

According to Shahbaz, Tiwari and Nasir (2013), there is a long run relationship between CO₂ emissions and financial development in their study. Financial development has a negative effect on CO₂ emissions at the conventional levels of significance. They found that every 0.0273% reduction in CO₂ emissions would lead to an increase in financial development by 1%. Financial development has a significant and negative effect on CO₂ emissions. They suggested that there is a relationship between the increase in financial development and environmental qualities, in which financial development decreases energy pollutants. They also found that advancement in the banking sector helps to lower CO₂ per capita emissions. Thus, the environment can be kept clean through financial reforms by using financial development as the tool to do so.

According to Boutabba (2014), the researcher found that, in the long run, financial development brings a positive impact onto CO₂ emissions. Every 1% increase in domestic credit to private sector will result in roughly 0.182% rise in CO₂ emissions at the significance level of 1%. The results showed that financial development promotes the degradation of environment. The relationship, however, between CO₂ emissions and financial development in the short run is negative but not statistically significant. This indicates that financial development promotes CO₂ emissions and thus investment projects are not environmentally friendly.

2.3 Gross Domestic Product (GDP)

There are a large number of papers empirically examining the issues of relations between GDP and CO₂ emissions. One of the papers from Shahbaz, Solarin, Mahmood and Arouri (2013) found that there is a relationship between GDP and CO₂ emission from 1980 to 2007 for countries Brazil, Russia, India and China (BRIC). However, Russia has a negative growth during that period because of the disintegration of Soviet Union 1991 and there is less information. Ang, Tamazian et al. (2010) also mention that the elasticity of GDP on emission is above unity when GDP is less than 1.174 and is inelastic if its greater than 1.174.

Mitic, Ivanovic and Zdravkovic (2017) proved that the existences of long run co-integrating relationship between CO₂ emission and real GDP from 1997 to 2014 is statistically significant, meaning that, on average, a 1% change in GDP leads to around a 0.35% change of CO₂ emission on average in the case of the selected countries. However, the estimation of static and dynamic contemporaneous relationship of GDP and CO₂ emission is not in line because of the inadequate allocation of resources leads to their inefficient use as well as the combustion of fossil fuels. On the other hand, the authors considered both GDP and carbon-dioxide being non-stationary in levels and stationary in differences because the results of the panel unit root testing are mixed, where Levin, Lin and Chu (LLC) and Im, Pesaran, and Shin (IPS) tests in heterogeneous panels indicate stationary

in both levels in first differences, while Cross sectional IPS test (CIPS) mostly suggests that some panels are not stationary when trend is included.

Another study conducted by Cederborg and Snobohm (2016) made an analysis between GDP and CO₂ emission for 69 industrial countries and 45 poor countries. For industrial countries, it is proven that there is a positive correlation between GDP per capita and CO₂ emission at the highest level of significance in all model variations. CO₂ emission increase as economic growth increases. On the other hand, in order to exclude collinearity amongst the variables in the regression model, GDP per capita squared is function as non-multi-collinearity. The relationship between GDP per capita squared is negatively correlated. The coefficient is significant in all models although the level of significance is different. A 1-dollar increase in GDP per capita would cause a decrease in CO₂ emission by 1.44965e-09 tons (1.44965 mg) per capita when all other variables are being held constant. The results of the regression analysis for poor countries showed positive relationship between GDP per capita and CO₂ emission. As the economy grows, CO₂ emission grows as well. However, there is no variation between GDP per capita squared and CO₂ emission, meaning that, the shape of curve of CO₂ emission is polynomial.

After studying various GDP variables, Morancho, Tamarit and Zarzoso (2000) separated into two groups, Belgium, Denmark, France, Italy, the Netherlands, and the United Kingdom are countries with higher level of income while Greece, Ireland, Portugal, and Spain are lower level of income. Although the above-average and below average income countries show similar patterns regarding the relationship between the increase in GDP and CO₂, they do differ in certain ways as each of them started at dissimilar levels of CO₂ emissions. Test results indicates that the same pattern could not be implied on the ten selected countries. In contrast, the analysis indicates those countries with a level of income above the European Union (EU) average and those below the average behave differently. Fixed effect appears to be significant which the departure point of CO₂ emission differs among countries.

The relationship between per capita CO₂ emission and per capita of real GDP was researched by Saboori, Sulaiman and Mohd (2012) to identify the significant

relationship between per capita CO₂ emission and per capita of real GDP. There is an inverted U shaped relationship between CO₂ emission and GDP, confirming the carbon Kuznets Curve in Malaysia. This is in line with a few researches that have done succeeded in finding a U shaped curve between these two variables. The results are support the Environmental Kuznets Curve (EKC) hypothesis in Malaysia. The authors did not find any presence in serial correlation and heteroscedasticity as well as pass through normality test and functional form. There is a positive significant relationship between CO₂ emission and GDP in the short run. The significant lagged error term is more efficient in establishing co-integration which has concluded that the relationship is strong enough among variables in the model because the coefficient is significant at 1% significance level. There is also a unidirectional causal relationship between CO₂ emission and GDP in the long run but there is no causal relationship in the short run. This shows that the emission reduction policies and more investment in pollution abatement will not hurt GDP growth, instead it could be a feasible tool in sustaining the development in the long-run.

Kuo, Kanyasathaporn and Lai (2014) showed that there is a unidirectional Granger causality between CO₂ emission and GDP in Hong Kong. However, the results from the study are conflicted with the researches by both Ho and Siu (2007) and Chiou et al. (2008) because the time series data used is different. It indicates that the CO₂ emission has impact on GDP of Hong Kong which contributes higher CO₂ emission into the atmosphere and lead to higher economic growth. They are positively correlated between each other.

2.4 Energy Consumption

Ahmad et al. (2016) found that there is a strong positive relationship between energy consumption with CO₂ emission where recorded as 98.2%. Malaysia had been faced a rapid economic growth and high growth rate of energy consumption for the past four decades. The annual growth rate of energy uses (kt of oil equivalent) was recorded as 6.60% from 1970 to 2012. A result from the growth in energy consumption, where there is an increase in income and increase in vehicles. Yu (2015) found that the energy consumption shows an increasing trend

when the total CO₂ emissions fluctuated from 1980 to 2011. Throughout the result, 1% of increase in the energy consumption will lead to 2.081btu increase in CO₂ emissions. There was a significant relationship between energy consumption toward the CO₂ emission since the p-value was found less than the significance level.

Arouri et al. (2012) found that increase in income will tend to increase in CO₂ emissions. There is a positive relationship between energy consumption and CO₂ emissions except in Kuwait, Bahrain and Egypt. The results were recorded as 1% increase in energy consumption per capita will tend to increase 1.688% and 0.052% of CO₂ emissions in Saudi Arabia and Oman respectively. Mohiuddin et al. (2016) found that the 51% contributor of greenhouse gases (GHG) production in Pakistan was from the energy sectors. Based on the result given, the energy consumption was increase from 28 million tons of oil to 66.8 million tons of oil from 1991 to 2014 and it was lead to increase in CO₂ emission rates.

Saidi and Hammami (2015) found that energy consumption and CO₂ in Malaysia has positive relationship. CO₂ emission increase by 1% was estimated to increase the energy consumption by 0.136%. At 5% significance level, a 1% increase in domestic credit to the private sector tends to increase 0.00027% in energy demand.

Menyah and Wolde (2010) found that the energy usage and the CO₂ emissions in Malaysia was significant related in the long-run. The same researcher was also found that the higher the income, the higher the energy consumption to the effect of CO₂ emissions in China. In South Africa, there are about 70% of primary energy supply is come from coal, coal-fired power stations to provide the more than 90% of the electricity production. The effect of greenhouse gas effect due to the fossil fuel emission in South Africa was recorded as 81.2% as the highest around the world. Therefore, reduced in consumption of fossil fuels will definitely reduce the CO₂ emissions.

According to Shahbaz et al. (2013), there is a long run positively and statistically impact between energy consumption and CO₂ emission. The results shows that an

increase in energy consumption will lead to significant increase toward energy pollutants. The results concluded that one per cent increase in energy consumption is contribute to 0.6793 per cent increase in CO₂ emissions.

2.5 Trade

Sato (2012) estimated that volumes of embodied carbon in global trade are significant and is increasing. Estimates from 2004 lie between 4Gt and 6Gt CO₂ (roughly 20-30% of global emissions) while estimates from 2006 range between 7Gt and 8Gt CO₂ (around 25-35%). On the other hand, Sato (2012) found higher volumes of embodied emissions in China's exports. In contrast, higher volumes of embodied emission are found in the imports of USA and Japan in general.

AKIN (2014) states that the increase of trade openness affects the CO₂ emission positively in short term. Increase of trade openness will decrease the CO₂ emission after a threshold level. Test results estimated that developed countries are responsible for over half of the growth in Chinese exported carbon emissions from 2002 to 2005.

Guan et al. (2009) showed that the growth in Chinese exports between 2002 and 2005 is the primary cause of China's emissions growth. It is also found out that the export of manufactured products is the major contributor to export growth.

Opoku et al. (2014) concluded that, in the long run, the results indicate a positive relationship between per capita CO₂ emissions and real GDP per capita. It is also found that, in the long run, CO₂ emissions per capita is positively related to trade openness. Test results suggest that Ghana's trade (imports and exports) has contributed to the increase in the emissions of CO₂. The statistical insignificance implies that economic growth and trade do not really explain CO₂ emissions in the short-run.

In addition, Shahbaz and Leitão (2013) showed that the effect of trade on CO₂ emissions is statically significant being positively correlated with CO₂ emissions.

2.6 Conclusion

In a nut shell, financial development is one of the key factors towards the reduction of CO₂ emissions such that their relationships are to be stated as negatively related. Researches were done by several researchers and most of them concluded to be negatively related. For instance, Shahbaz, Qazi, Tiwari, et.al (2013) confirms that there is a long run relationship between CO₂ emissions and financial development in Indonesia by implying that a 0.2071% decline in CO₂ emissions is linked with a 1% increase in financial development. Besides, Shahbaz, Sakiru, Haider, et al (2013) stated that the correlation analysis shows a negative correlation between CO₂ emissions and financial development in Malaysia. Meanwhile, the authors found that there is a long run relationship between CO₂ emissions and financial development in their study such that a 0.0273% reduction in CO₂ emissions would cause a 1% increase in financial development. Jalil and Feridun (2011) found that an increase in financial development leads to an improvement in the environmental performance in China as well. However, there are authors stating that financial development has a long-run positive impact on CO₂ emissions. Suggestions were given on shifting the loans to environmental friendly firms.

For GDP, the overall research showed a positive relationship with CO₂ emissions. Mitic, Ivanovic and Zdravkovic (2017) proved that the existences of long run co-integrating relationship between CO₂ emission and real GDP from 1997 to 2014 is statistically significant. another study conducted by Cederborg and Snobohm (2016) made an analysis between GDP and CO₂ emission and concluded that there is a positive correlation between GDP per capita and CO₂ emission at the highest level of significance in all model variations. In the research of Saboori, Sulaiman and Mohd (2012), there is a unidirectional causal relationship between CO₂ emission and GDP in the long run but there is no causal relationship in the short run, indicating that GDP will not be affected when there are emission reduction policies or excess investment in pollution abatement. Ho & Siu. (2007). and Chiou et al. (2008) used different time series data to conduct the research and found that the CO₂ emission has impact on GDP of Hong Kong which contribute

higher CO₂ emission into the atmosphere and lead to higher economic growth. They are positively correlated between each other.

Similarly, the relationship between energy consumption and CO₂ emissions are being tested too. Dritsaki (2014) found that there is a strong positive relationship between energy consumption with CO₂ emission in Malaysia. Whereby an increase in energy consumption will increase level of income and number of vehicles in Malaysia eventually increases the CO₂ emissions. Not only that, Yu (2015) found that the energy consumption shows an increasing trend when the total CO₂ emissions fluctuated from 1980 to 2011 with the results of 2.081btu increase in CO₂ emissions for every 1% increase in energy consumption. Christophe (2012) found that increase in income will tend to increase in CO₂ emissions. There is a positive relationship between energy consumption and CO₂ emissions. Tang and Tan (2012) found that energy consumption and CO₂ in Malaysia has positive relationship. CO₂ emission increase by 1% was estimated to increase the energy consumption by 0.136%. Lastly, Ang (2008) found that the energy usage and the CO₂ emissions in Malaysia was significant related in the long-run, indicating that higher income leads to higher energy consumption.

As for trade variable, researches were done by previous researchers, concluding that there is significant relationship between trade and CO₂ emissions. For example, Sato (2012) estimated that volumes of embodied carbon in global trade are significant and is increasing. The author stated that generally, higher volumes of embodied emissions in China's exports and USA and Japan's imports. AKIN (2014) states that the increase of trade openness affects the CO₂ emission positively in short term. Increase of trade openness will decrease the CO₂ emission after a threshold level. Moreover, Guan et al. (2009) showed that the growth in Chinese exports between 2002 and 2005 is the primary cause of China's emissions growth. Opoku et al. (2014) concluded that, in the long run, it is found that per capita CO₂ emissions and real GDP per capita are positively related. Last but not least, Shahbaz and Leitão (2013) showed that the effect of trade on CO₂ emissions is statically significant being positively correlated with CO₂ emissions.

By far, none of the researches were being done using these four variables which consists of financial development, GDP, energy consumption, and trade. According to the previous studies, the researchers have been conducted their studies separately between those variables. Therefore, our study is attempt to combine these four variables together toward CO₂ emission in order to get a better result. Hence, the purpose of this research is to produce the same results with different approaches such that the combination of these four variables might give a different impact as compared to the previous researches.

CHAPTER 3: METHODOLOGY

3.0 Introduction

The effects of macroeconomic and financial variables on the CO₂ emission in Malaysia will be examined in this paper. The methodology and tests used are also discussed and explained. Specifically in this chapter, the sources of data and methods applied in retrieving the data, the proxy for the variables, units used in measuring each variable, research model, research techniques and instruments, and methodology flows will be presented.

Initially, the determinants of CO₂ emission is testified against four independent variables, namely domestic credit to private sector, GDP, energy consumption and trade. The data used in this paper is from 1980 to 2013, with a total of 34 observations. This study also apply time series econometric models to interpret, analyze and test the hypothesis in regards with the data used in this paper. Besides, in order to read and analyse the results output, E-views 8 software has been used for better understanding.

In brief, section 3.1 will be discussing the proposed empirical model of this study. Explanations of all variables are included in section 3.2 while section 3.3 discussed about the sources of data and method applied in retrieving the data of

this study. Section 3.4 will be elaborating the data processing of this research. The ideas, theories and functions of each methodology will be discussed in the section 3.5. Last but not least, conclusion of this study will be concluded in the last section.

3.1 Proposed Empirical Model

The effect of domestic credit to private sector, GDP, energy consumption and trade towards the CO₂ emission has been investigated in this study. Based on Shahbaz, Tiwari and Nasir (2013), Solarin, et.al (2013) & Hye, et.al (2013), the proposed empirical model consist of two to three independent variables. We then modify the equation by adding more independent variables. The empirical model of this study can be specified as below:

$$\ln\text{CO}_2 \text{ emission per capita (metric tonne)}_t = \beta_0 + \beta_1 \ln\text{GDP per capita}_t + \beta_2 \ln\text{DCPS}_t + \beta_3 \ln\text{trade}_t + \beta_4 \ln\text{energy}_t + u_t$$

Where,

GDP = Gross domestic product in Malaysia

DCPS = Domestic credit to private sector in Malaysia

Trade = Trade in Malaysia

Energy = Energy consumption in Malaysia

In representing the natural logarithm form, u_t represents uncorrelated white-noise error terms. β_0 is the intercept of the regression model and $\beta(1,2,3,4)$ represent the slope of coefficient. There are several reasons for this study to apply natural logarithm form to the variables.

Firstly, log the variables will turn the data series into linear trend. Many of the economic variables are underlying rate of growth, which the data may or may not be constant. The mean will continue to increase and the data are not integrated because no amount of differencing can make the data stationary (Asteriou & Hall, 2007). The second reason is it can narrow down the scale of data if the scale of the

sample data is too big. Specifically, unit measurement of household income is millions in Ringgit Malaysia which data figure is very large compared to the consumer price index which data figure is small. Lastly, the coefficients on the natural logarithm scale can be directly interpreted as approximately proportionally different (Gujarati & Porter, 2009). For example, a small percentage changes in dependent variable (Y) correspond to an approximate small percentage changes in independent variable (X)

3.2 Variable Descriptions

3.2.1 Domestic Credit to Private Sector

Domestic credit to private sector is referring to financial corporations provide financial resources to private sector through loans, buying non-equity securities and trade credits and other account receivable that stimulate for a claim in repayment. From this view, credit can be classified into commercial credit and banking system credit (Olowofeso, Adeleke & Udoji, 2015). The positive and significant effect can be shown by domestic credit to private sector in relation to CO₂ emission because excess credit will lead to the emission of CO₂. As we know, CO₂ emission tend to be higher if a person has more credit and resources and hence the economic growth can be enhanced. In addition, financial crises will be happened if there is an increase in domestic credit to private sector. (Masood, Butt, Ali, Bellalah, Teulone & Levyne, 2011).

In this study, due to the economic growth, demand of energy increase as financial development enhances in investment. Consumers able to purchase more with easy excess of credit and therefore it will lead to the energy demand increase as well (Saidi & Hammami, 2015). Our study would like to use this variable as proxy as it is an important indicator that affect CO₂ emission that has positive relationship in long and short run. Therefore, the

positive sign of the domestic credit to private sector is expected to be occurred. This is because according to Talukdar and Meisner (2001), a good financial sector can act as a channel for firms to use environmental friendly techniques and advanced cleaner in order to help environment free from degradation if were to upgrade industrial sector from financial sector.

3.2.2 Gross Domestic Product (GDP)

GDP is described as the perceived value of all finished products in the marketplace that are officially acknowledged by a country within a certain time frame. GDP per expenditure, however, is generally used as gauge of standard of living within a country and the particular country's economic condition will be reflected by GDP. Saboori, Sulaiman and Mohd (2012) stated that the economic performance play san important role in affecting the CO₂ emission. The cost of degradation associated with GDP grows over time and negatively impact the economic prosperity by the economic and human activities (Boopen & Vinesh, n.d.).

In Malaysia, GDP is assumed to be positive depending on the economic development stage of a country's level. Generally, an establish or developed country which are rich and full with labor and natural resources will attract those industrial industries for their production process. This situation can be pollution intensive and most of the foreign direct investments are involving it. However, in opposition, a country will be more eco green and environmental friendly if the industries in this particular are technology-intensive industries.

3.2.3 Trade

Trade can be representing as the commercial transaction when buying and selling of products. CO₂ emissions trading is a type of policy which government-granted allotments of CO₂ output can be purchased and sold by

corporations. The increase in trade openness has a positive relationship to CO₂ emission in short run (AKIN & Cemil Serhat, 2014). From the study of Muftaul, Iyoboyi and Ademola (2014), trade openness contributes a negative link to environmental deterioration in and has a non-significant effect on environmental pollution which the greater the trade openness, the less the CO₂ emission can be happened.

Thus, as a consequences, trade must be considered in the environmental factor which affect CO₂ emission subsequently. Our study includes trade as one of the independent variable and forecast the relationship between trade and CO₂ emission. From the study (Hye, et.al, 2013), sign of trade is expecting to be either positive or negative. Therefore, we are expecting the sign of trade to be positive because developing countries are busy producing large amount of CO₂ emission in their process of production (Grossman & Krueger, 1995) and (Halicioglu, 2009).

3.2.4 Energy Consumption

Energy consumption is defining as the total amount of energy consumed in a system by society. Due to the speedy growth of economy and stadand of living is stable, people would love to demand more new products with variety and advance functionality, thus, number of appliances such as vehicles and machines will increase. Since energy consumption is one of the impact that affect the environment, the underlying trends in energy consumption needs a good quality of statistics.

Based on the study conducted by Ali, Waqas and Ahmad (2015), energy consumption is one of the major cause to CO₂ emission in long run relationship. There is a positive and significant impact on CO₂ emission in long run and has a bidirectional causality between variables. Moreover, the inverted U shape pattern of association between CO₂ and economic growth has confirmed by the empirical analysis. However, there was a bidirectional causality in short run. It is found that energy consumption is a suitable proxy

in this study as CO₂ emission is largely depending on energy consumption because the higher energy consumed will cause higher emission. Hence, energy consumption is a key indicator to examine the CO₂ emission. From the study of Boutabba (2014), the sign of energy consumption is expecting to be positive. The reason is because greater economic activity can be performed and stimulate CO₂ emissions if energy consumption is high.

3.3 Data Collection Method

The research data and all relevant information has been collected to identify the relationship between CO₂ emission and the four selected macroeconomic and financial development factors in Malaysia. All of the research data used in this paper are largely focusing on secondary data. According to Church (2001), secondary data is defined as data that people used without involving themselves in the collection of data and is used either to verify new research or justify previous findings. Secondary data is based on published or original data.

Quarterly data of a total of 4 independent variables and a single dependent variable data between year 1980 to 2013 are retrieved in this study, with consequently a total number of 34 observations. All of the data are retrieved and collected from World Bank. We collect the data until year 2013 because the data is available until that particular year.

CO₂ emission per capita is used as the dependent variable in Malaysia. Apart from the CO₂ emission, other time series used in this research domestic credit to private sector DCPS (proxy for financial development), GDP (proxy for income level), trade and energy consumption which believed to be the most relevant factors that affect CO₂ emission. The specific aspects of all collected data are as shown in table 3.1 below.

Table 3.1 Data Measurement

Variable	Proxy	Unit	Source
Carbon dioxide emission	CO2	Metric tonnes per capita	World Bank
Domestic credit to private sector	DCPS	Percentage of GDP	World Bank
Gross domestic product	GDP	Real US\$	World Bank
Trade	Trade	Percentage of GDP	World Bank
Energy consumption	Energy	Kg of oil equivalent per capita	World Bank

3.4 Flows of Methodology

Initially, this study has tested the stationary of all the 5 variables by using unit root test. Among all of the unit root tests, Phillips-Perron test will be employed to read the stationary conditions of each variable at both level stage and first difference stage. This research will proceed to Johansen & Juselius Co-integration test.

Next, in order to run Johansen and Juselius Co-integration test, this research will have to proceed to optimum lag length selection. This study will use trial and error method to find out whether the lag length is suitable or not and most importantly there will be no autocorrelation problem for the error term. Ljung-Box Q-statistics is used to check the autocorrelation of each of the residual regressions. After checking there is no autocorrelation, the next step will be proceeding to Johansen and Juselius Co-integration test. The study will use VECM model if there is found one or more than one co-integration. Conversely, VAR model will be used in this study if there is no co-integration vector.

Fourth, the study will then continue with the interpretation of results which include the sign, significant and long-run relationship between CO₂ and independent variable(s) that been selected. Granger Causality test is to elaborate and explain the short-run relationship and the direction of causality. After gone through the test, the stability of the model will then be tested. Ultimately, this paper will carry on to Variance Decomposition test and Impulse Response Function which are used to determine the shocks and impulse of the variables respectively.

3.5 Methodology

3.5.1 Unit Root Test

To ensure that the results are free from being spurious or invalid, unit root test is performed to investigate whether the series in the group are stationary.

In this paper, Phillips-Peron (PP) test which is under the category of unit root test will be conducted to examine whether the time series data is stationary or non-stationary.

Phillips-Perron test (PP) is non-parametric test for a unit root in time series data, which the test is similar to Augmented Dickey-Fuller test (ADF). However, in order to control serial correlation, the PP test does not consider the lagged difference terms but it makes a correction to the t statistic of the coefficient.

The advantage of PP test is, the data generated by an autoregressive model with known order does not need to be assumed (Breitung & Franses, 1998). Another advantage is PP test is a non-parametric test. So, it is not necessary to specify the model and lagged parameter in the test regression (Arltova & Fedorova, 2016).

Test regression for PP as below,

$$\Delta y_{t-1} = \alpha_0 + \gamma y_{t-1} + u_t$$

Hypotheses :

H₀: Unit root does exist.

H₁: Unit root does not exist.

Decision rule: Reject H₀ if the p-value is less than significance level α .

Otherwise, do not reject H₀.

3.5.2 Johansen & Juselius Co-integration Test

Before proceed to Johansen and Juselius test, Ljung-Box test has to be applied to determine the optimum lag length in order to determine the statistically significant of this model. Johansen and Juselius test is applied for the purpose of checking whether the long run equilibrium relationship exists between the dependent and independent variables (Patel, 2012). Based on the study of Box and Pierce (1970), Ljung-Box test has been used in a set of time series randomly and independently. Meaning that, the autocorrelation problem in the model can be determined Ljung-Box test. In addition, Burns (2002) further emphasized that Ljung-Box test can use to examine the time series model's quality of fit. The model by this test is stated to pass the test if there is no significant autocorrelation in the residuals of model.

The Q test statistic formula provided as below:

$$Q^* = T(T + 2) \sum_{k=1}^h (T - k)^{-1} r_k^2$$

From the equation above, the h is the number of lags needs to be tested. Meanwhile, T is the length of time series data.

Based on the studies by Magee and Winter (2013), the model will have an autocorrelation problem which its regression error terms are statistically significant by using Q test statistics. In order to whether the regression error

terms are statistically significant or not, there is a decision rule of $p < 0.05$ (autocorrelation occur) have to included. If the regression error terms in the model has no autocorrelation problem, the optimum lag length can be obtained.

Hypotheses:

H_0 = Autocorrelation does not exist in model

H_1 = Autocorrelation exists in model

After the optimum lag length is obtained, the next step will be the co-integration test. Johansen test was used in this research when there is more than two variables due to its multivariate tests natural (Alexander, 1999). This test can reduce the correlation problem and they have a better function which its linear combination can be inquired to its most stationary level.

Hypotheses:

H_0 = Rank ≤ 0 ; Rank ≤ 1 ; Rank ≤ 2 ; Rank ≤ 3 ; Rank ≤ 4

H_1 = Rank=1; Rank=2; Rank=3; Rank=4; Rank=5

The decision rule rejects the null hypothesis (H_0) when the test statistic value less than critical value. If happens to be not rejecting the H_0 , the number of co-integrating vector can be determined until the last value. After the co-integration test estimate has been determined, if the existence of any co-integrating vector happen, the model will proceed to Vector Error Correction Model (VECM) in order to examine the long-run relationship between CO₂ emission and selected independent variables. However, if there is no co-integrating vector to be found in the co-integration test, Vector Autoregressive Model (VAR) for determining the short run relationship will then be performed.

3.5.3 Vector Autoregressive Model (VAR)

The VAR is a model that affected by its own and other variables' past history which take into account of the linear interdependencies among multiple time series. In multivariate time series data, this model is flexible and simple (Lutkepohl 2005). This model is the advance or further extension of Autoregressive (AR) model with inclusion of multiple explanatory variables. The series must be covariance stationary in order to form the VAR model. In order to capture a dynamic effect, all of the series are treated as endogenous variables and determine between variables in short run. If there is a present of co-integration and absent of covariance stationary in the model, Vector Error Correction Model shall be used.

According to Gujarati and Porter (2009), if too much lags include in the model will affect the degree of freedom while autocorrelation problem and model misspecification problem will occur if the inclusion of lag in the model is too less. Therefore, the selection of optimum lag length is important in this model. Generally, VAR is expressed in first differenced form because all the economic time series are mostly non-stationary (Johansen & Juselius, 1990). Based on Asteriou and Hall (2007), there are 3 advantages in this model. First, the variables are all treated as endogenous variables and it is not a worriment for the researcher to identify there is any exogenous variables. Next, the estimation in this model can be practiced by OLS approach separately. Lastly, VAR has a better forecast result than any other complex models.

The VAR model can be written as,

$$y_t = x_1 y_{t-1} + x_2 y_{t-2} + \dots + x_n y_{t-n} + \varepsilon_t$$

Where,

y_t = Endogenous variable vector at time period (t)

X_i = Coefficient vectors; where (i= 1,2,3,4...)

n = Number of lags of the model

ε_t = Vector of error terms

3.5.4 Vector Error Correction Model (VECM)

The standard VECM, which is based on normality assumption of error term, is used to examine the real financial time series (Maekawa & Setiawan, 2014).

According to the study of Asari, Baharuddin, Jusoh, Mohamad, Shamsudin and Jusoff (2011), VECM is applied if there is any co-integration appeared between series in long run or short run relationship. Long-run equilibrium ($[Y_{t-1} - \alpha - \beta X_{t-1}]$) and short-run are representative of the VECM's difference term in order to analyse the long run and short run relationship.

VECM has provide a few advantages. In VECM model, when all the error terms model are remaining stationary, the standard OLS estimation tends to be valid. This model is suitable in determining the correction term from non-equilibrium compared to others. VECM able to solve the spurious regression problem in first difference when the models are co-integrated. Weaknesses of error term in VECM are stationary and can avoid the expansion of error term in long run (Asteriou & Hall, 2007). A clear picture can be shown on long term forecasting and any non-stationary series with the application of Vector Error Correction Model. However, Lastrapes (2001) stated that the VECM is not a powerful alternative because it is just a one tool among alternatives to forecast the economy.

Theoretical equation provided as below:

$$\Delta y_t = a_0 + \beta_1 \Delta x_t - \pi \hat{u}_{t-1} + y_t$$

β_1 = impact multiplier (measures immediate impact when a change in x will cause a change in y)

π = feedback effect (show how much of disequilibrium being corrected)

In this study, VECM is applying to study and determine the significance of explanatory variables between the macroeconomic variables and financial

development variables to the CO₂ emission. The error correction of the system in VECM model cannot be avoided if CO₂ emission increase simultaneously (Li, Li & Lu, 2017).

3.5.5 Granger Causality Test

Granger Causality test is carryin out for the purpose on testing the dynamic direction and existence of causality between all stationary variables in this research based on VECM (Li, Li & Lu, 2017).

Below is the estimation of the following VAR model,

$$y_t = a_1 + \sum_{i=1}^n \beta_1 x_{t-i} + \sum_{j=1}^m \gamma_j y_{t-j} + e_{1t}$$

$$x_t = a_2 + \sum_{i=1}^n \theta_1 x_{t-i} + \sum_{j=1}^m \delta_j y_{t-j} + e_{2t}$$

Four possible outcomes are as follows:

- i. y_t causes x_t
-the lagged y terms in equation 2 could, as a group, be statistically different from zero, while lagged x terms in equation 1 are not statistically different from zero.
- ii. x_t causes y_t
-the lagged x terms in equation 1 could, as a group, be statistically different from zero, while lagged y terms in equation 2 are not statistically different from zero.
- iii. A two-way feedback is found
-x and y terms, in equation 1 and equation 2, are both statistically different from zero.

- iv. Both variables are not dependent
-x and y terms, in equation 1 and equation 2, are both not statistically different from zero

Hypotheses:

H₀: X does not Granger-cause Y

H₁: X does Granger-cause Y

And

H₀: Y does not Granger-cause X

H₁: Y does Granger-cause X

Decision rule: Reject H₀ if Chi-Square test is greater than the critical value at 1%, 5% or 10% level of significance.

Granger (1969) introduced Granger Causality Test to determine the relationship of causality between two time series. Whether the current and lagged values of one variable affect another or not can be applied by Granger Causality test (Hussain, 2014). Granger Causality test is one of the famous approach in order to examine the causality relationship between CO₂ emission and its independent variables (Saboori, Sulaiman & Mohd, 2012).

In short, this test is adequate and efficient to identify which direction of the causality to be between all variables and also the detection of unidirectional causality, bi-directional causality of independent between variables (Asteriou & Hall, 2007). The presence of causality between dependent and independent variables will be carried out by VEC Granger Causality in this research.

3.5.6 Stability of AR (p) Processes

The aim of stability of AR (p) process is using to determine the dynamically stability of the VAR or VECM estimation. The result of impulse response will be invalid and incorrect if the estimation is unstable.

The theorem of AR (p) process as below,

$$Y_t = \mu + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \dots + \phi_p Y_{t-p} + \varepsilon_t$$

The AR roots table and graph that retrieve from E-views 8 report the inverse roots of the characteristics polynomial. According to Lutkepohl (1991), if all the roots have modulus with less than 1 and all of the dots are lie inside the circle, then the VAR estimation is dynamically stable. If VAR estimation is not stable, it will lead to the invalid of impulse response of standard errors. Not only this, the impulse response result will become not valid and the shock will not die out and keep accumulating continuously if the assumption is not valid. In the estimation of VAR, k is representing endogenous variables while p is the largest lag. For VECM, r will be representing as co-integration relation and the number of k-r roots has to equal to unity (E-views 8.1, 2014).

3.5.7 Variance Decomposition

Variance decomposition is also named as forecast error variance decomposition which identify the response of dependent variables that explained by the shock that caused by its 'own' shock and also shocks that transmitted from other variables in the model either in short run or in long run dynamics between variables in the system (Brooks, 2008). In addition, the amount of shocks of macroeconomic and financial development variables towards the emission of CO₂ can be measured by variance decomposition as well. This method enable the researchers to figure out how's the macroeconomic and financial variable affect each other individually in the vector autoregressive (VAR) model.

According to Brooks, the pros of using variance decomposition is, the movement of dependents variables can be shown because of their own impact and also other variables are affected on them at the meantime. In general, variance decomposition and impulse response give almost the similar statistic (Brooks, 2008). However, based on Watson (1994), he argued that, in the function of structural VAR parameters, the variance decomposition are different. Both variance decomposition and impulse response are hard to differentiate themselves and the confidence interval around variance decomposition and impulse response should be created all the time. Thus, this study applied variance decomposition with following hypotheses.

Hypotheses:

H₀: LGDP/LTRADE do not have an impact on LCO₂

H₁: LDCPS/ LENERGY have an impact on LCO₂

Note:

LCO₂= Natural Log of carbon dioxide (CO₂) emission

LDCPS = Natural Log of Domestic Credit to Private Sector

LGDP = Natural Log of Gross Domestic Product

LTRADE = Natural Log of Trade

LENERGY= Natural Log of Energy Consumption

3.5.8 Impulse Response Function

In order to measure the responsiveness of the dependent variables in VAR system towards macroeconomic shocks, impulse response function is used (Brooks, 2008). Furthermore, after passing the second difference, the impulse response function is said to be reliable only when the time series data become stationary. According to the study of Elder (2003), this function acts as an economic function to identify the impact caused to all variable in VAR model when the variable faces some impulses. Killian (2001) viewed impulse response function as curves well approximated by

high order polynomials. In impulse response function, misleading estimation and inference will occur if the lag order amount is under-fitting whereas if the lag order amount is over-fitting, the impulse response function will show a less accurate estimation. Besides, Lin (2006) states that the impulse response function can detect the implication from variable to variable.

Next, the reaction of endogenous variable is referring to the macroeconomic variables through times by using generalized impulse response function. Therefore, this function detect the changes in macroeconomic variables separately according to period with the existence of shock happened in a specific time. But, there is a possibility that the macroeconomic variables might be or might not be affecting the CO₂ emission. In this study, impulse response function is generated in long run to help for a better understanding and characterization to increase its emission size (Lord, Ridgwell, Thorne & Lunt, 2016).

Furthermore, impulse response function has to emphasize on the ordering of variables because it may affect the outcome from the test even though the data used is similar. In this study, generalized impulse function is not sensitive to the ordering of variables will be applied.

3.6 Conclusion

In brief, all sources of data together with the methods of collection has been discussed. While of all data are sourced from World Bank, this chapter has elaborated and explained clearly in terms of proxy and the description of each variable. Moreover, the methodologies and approaches in this study also been defined and illustrated. All of the test mentioned above will be carried out by using the software of E-views 8. Later in Chapter 4, all methodology's empirical results will be explained.

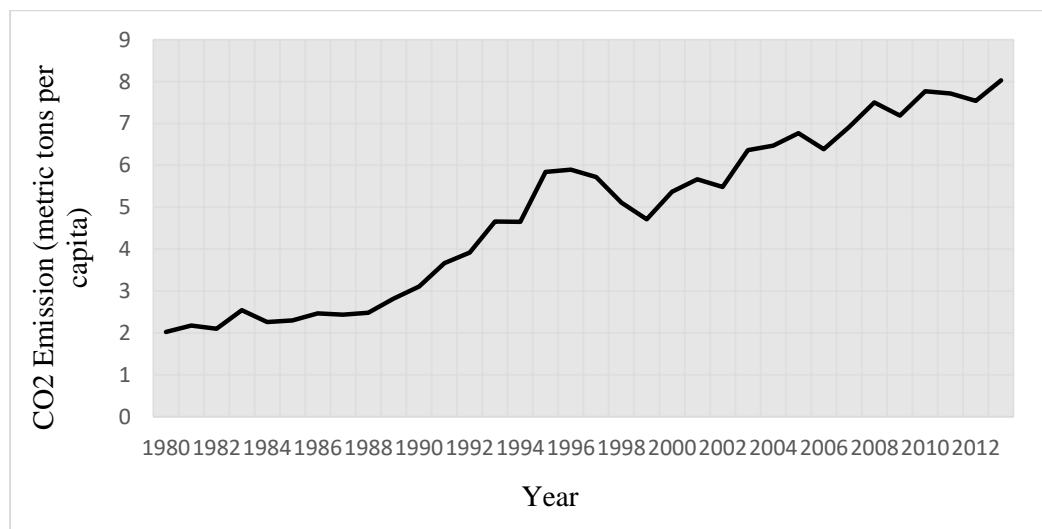
CHAPTER 4: DATA ANALYSIS

4.0 Introduction

This chapter will target on interpreting, reporting, and analyzing the empirical result by using the methodology in Chapter 3. Section 4.1 presents the trends of each variable by using line graphs. Section 4.2 shows the descriptive statistics of both the dependent and independent variables. Next, Section 4.3 explains the Unit Root Test by using the Phillips Perron (PP) test. Section 4.4 to Section 4.7 will discuss the empirical results that are conducted based on Johansen & Juselius Co-integration test, Vector Error Correction Model (VECM), Granger Causality test and Inverse Roots of AR Characteristic Polynomial test. After that, we will discuss on the Variance Decomposition and Impulse Response Function. After each of the empirical test's results, a throughout explanation will be done.

4.1 Graph Lines

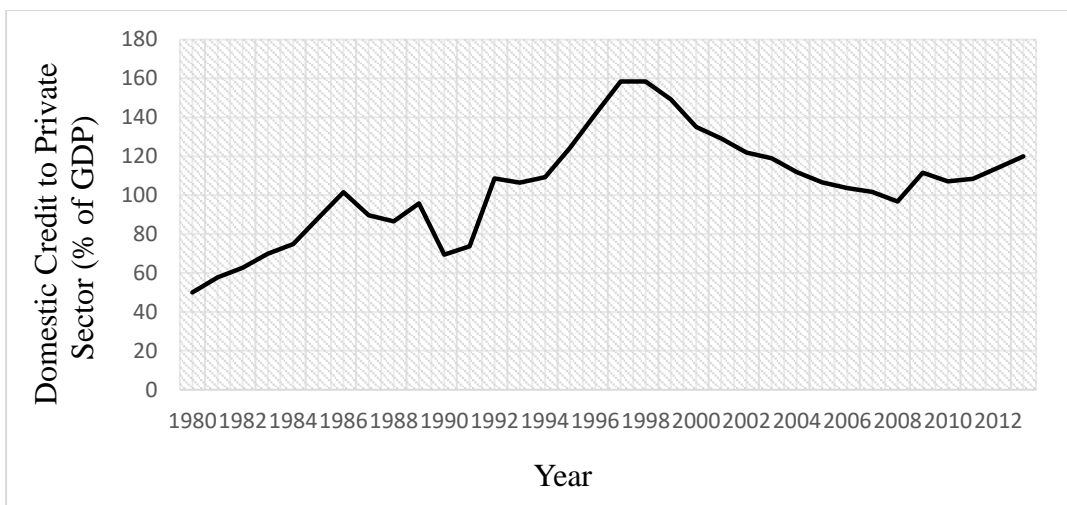
Figure 4.1: CO₂ Emissions



source: Developed from the research

Figure 4.1 shows CO₂ emissions (metric tons per capita) from 1980 to 2013 in Malaysia. It is a well-known fact that the effect of the CO₂ emission is influenced by few variables, such as domestic credit to private sector, GDP, energy consumption and trade. It can be clearly seen that CO₂ emission was fluctuating between 2.024 metric tons per capita to 2.440 metric tons per capita from 1980 to 1987. However, in 1988 to 1996, the CO₂ emission metric tons per capita rose dramatically from 2.484 metric tons per capita to 5.897 metric per capita respectively. This was due to a rapid change in economic from agricultural based to industrial based (Wee, 2008). Furthermore, the CO₂ emission dropped dramatically from 1997 to 1999 and increased steadily afterward till 2013. The rise in CO₂ emission from 2000 onward was because the increase of the income level, living standard, and the number of vehicles that resulting from the growth in energy consumption will lead to increase in the CO₂ emission metric per capita (Wee, 2008).

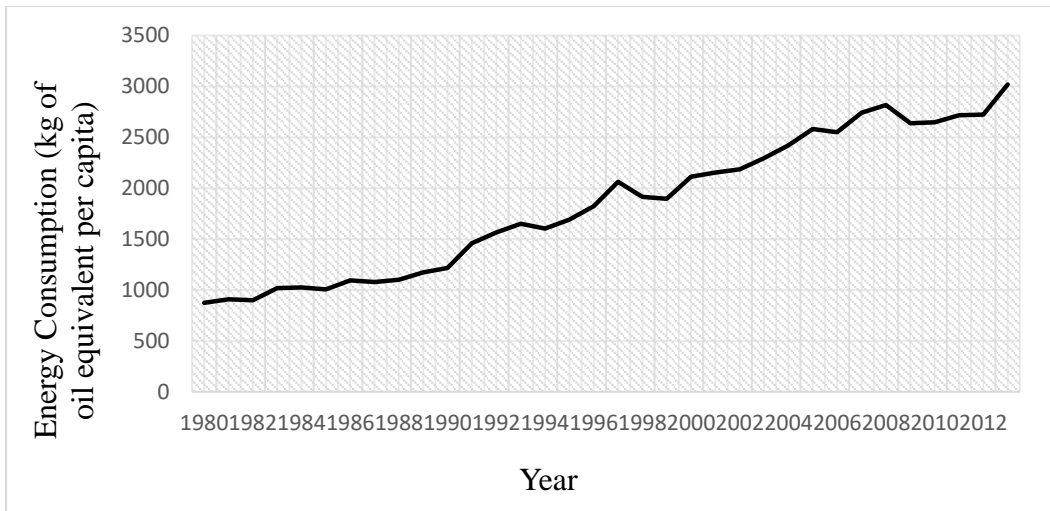
Figure 4.2: Domestic Credit to Private Sector



source: Developed from the research

Figure 4.2 shows the domestic credit to private sector (% of GDP) from 1980 to 2013 in Malaysia. It can be clearly seen that the domestic credit to private sector showed an increasing trend from 1980 to 1986. Unfortunately, it was reached a trough in 1990 which recorded as 69.41 % of GDP. However, it was increasing back from 73.76 % of GDP to 158.50 % of GDP in 1991 to 1998 respectively. Yet, it was dropped dramatically since 1999 onward.

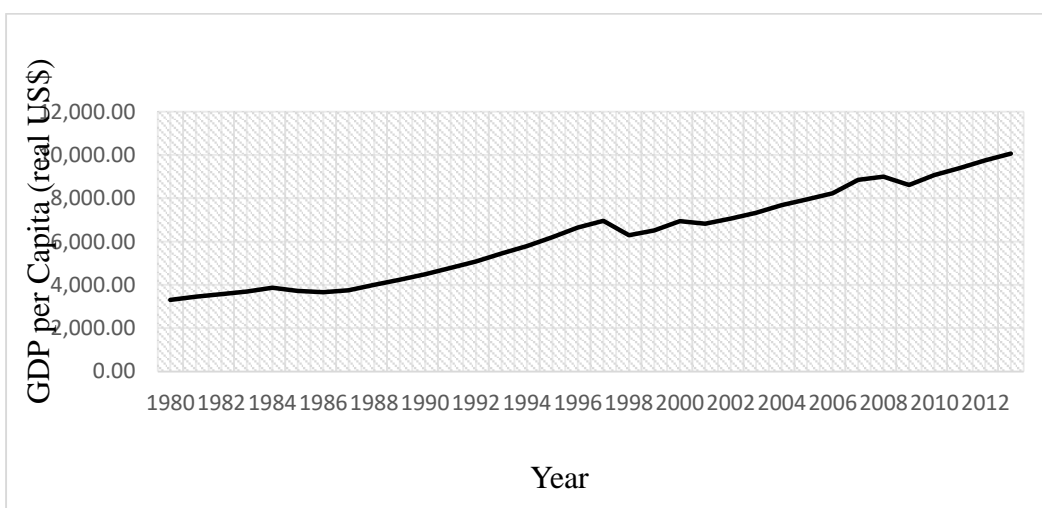
Figure 4.3: Energy Consumption



source: Developed from the research

Figure 4.3 shows the energy consumption (kg of oil equivalent per capita) from 1980 to 2013 in Malaysia. It can be clearly seen that the trend of the energy consumption has increased steadily from 1980 to 1997 which recorded as 872.88 kg of oil equivalent per capita to 2,063.53 kg of oil equivalent per capita. It has slightly dropped within two years (1997-1999) due to the global financial crisis and afterward increase dramatically until it was reached the peak, which recorded as 3,019.82 kg of oil equivalent per capita in 2013.

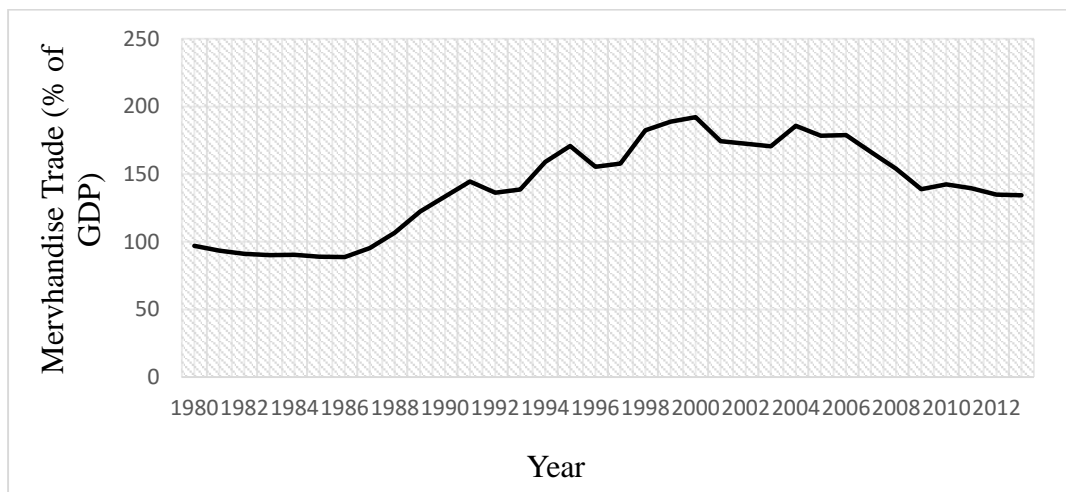
Figure 4.4: GDP per capita



source: Developed from the research

Figure 4.4 shows the GDP (real US\$) from 1980 to 2013 in Malaysia. It can be clearly seen that the GDP per capita increase gradually to an average level of 304.1% during 1980 to 2013. It was achieved with the lowest amount at 3308.77 real US\$ to the highest amount at 10,062.91 real US\$. Only in 1998 and 2009 was recorded a fall slightly trend. In 1997, the Asian financial crisis is one of the largest impact toward the economic recession around the Asian's countries including Malaysia. In 2009, the share price in Malaysia fell sharply after the global economic system slowdown lead to the trading volume in the country decline to a certain point. In fact, it has decreased the GDP (real US\$) (Athukorala, 2010).

Figure 4.5: Merchandise Trade



source: Developed from the research

Figure 4.5 shows the merchandise trade (% of GDP) from 1980 to 2013 in Malaysia. There has been a constant fall in merchandise trade during the period of 1980 to 1986. Malaysia total merchandise trade at 97.10% of GDP in 1980 and dropped constantly in 1986 which at 88.62% of GDP with the differences of 8.73% during the period of 1980-1986 due to Malaysia had established the export oriented development strategy in beginning of the 1980s which transformed the primary commodity based economy to an industrial based economy (Yusoff, 2008). However, the merchandise trade was increased significantly from 98.21% of GDP to 144.471% of GDP in 1987 to 1991 respectively. Furthermore, it shows

fluctuated from 1992 to 2006 before falling dramatically. The merchandise trade was reached the peaked in 2000 and recorded as 192.12% of GDP. Interestingly, the merchandise trade was falling significantly during the period 2007-2009 because the share prices in Malaysia fell sharply around 20% after the crisis. (Athukorala, 2010).

4.2 Descriptive Statistics

Descriptive statistics are used to summarize and organize data in a study. Eviews 8 is used to calculate the mean, median, maximum, minimum, standard deviation, skewness and kurtosis. Table 4.1 shows the descriptive statistics of LCO₂, LDCPS, LENERGY, LGDP and LTRADE in Malaysia from the year 1980 to the year 2013.

Table 4.1: Descriptive Statistic

Dependent Variable	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis
LCO ₂	1.4883	1.6556	2.0828	0.7050	0.4682	-0.4153	1.6400

Independent Variables	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis
LDCPS	4.6162	4.6712	5.0658	3.9102	0.2793	-0.6485	3.0222
LENERGY	7.4448	7.5280	8.0130	6.7720	0.4025	-0.2825	1.6449
LGDP	8.6794	8.7648	9.2166	8.1043	0.3570	-0.1832	1.6399
LTRADE	4.9178	4.9484	5.2581	4.4843	0.2595	-0.5263	1.9051

source: Developed from the research

All of the variables are transformed and expressed into natural logarithm term to make the data conform to normality and reduce data variability (Feng, Wang, Lu, Chen, He, Lu, and Tu, 2014). According to Lind, Marchal and Wathen (2012), empirical model results will become inconsistent if there are noisy or outliers observations.

The skewness values of LCO₂, LDCPS, LENERGY, LGDP and LTRADE are -0.4153, -0.6485, -0.2825, -0.1832 and -0.5263 respectively. These show that all of the variables are negatively skewed or in other words, skewed to the left. There is an alternative way to determine the skewness of the variable, which is by comparing values of both mean and median. A negatively-skewed variable can be seen if the value of mean is lower than median (Lind et al., 2012). For instance, the mean of CO₂ (1.4883) is lower than the median (1.6556), therefore it is negatively skewed. The same situation goes for the rest of the variables.

There are three types of distributions which are Leptokurtic, Mesokurtic and Platykurtic. Lind et al. (2012) states that Leptokurtic distribution has positive excess kurtosis, Mesokurtic distribution has an excess kurtosis of zero while Platykurtic distribution has negative excess kurtosis. Based on Table 4.1, the distribution of LCO₂, LDCPS, LENERGY, LGDP and LTRADE are tall and thin or peaked when compared to the standard normal distribution, namely Leptokurtic since all of the kurtosis value of our variables are positive.

4.3 Unit Root Tests

H₀: There is unit root.

H₁: There is no unit root.

Decision rule: Reject H₀ if the p-value is less than significance level α . Otherwise, do not reject H₀.

Table 4.2: Unit Root Tests

Unit Root Tests		
	Phillips Perron (PP)	
	Level	
Variable	Constant Without Trend	Constant With Trend
LCO ₂	-1.134537 [1]	-1.729522 [2]

LDCPS	-2.683383 [3]	-2.234090 [3]
LENERGY	-1.052378 [6]	-1.998131 [1]
LGDP	-0.594293 [1]	-1.918119 [2]
LTRADE	-1.372499 [1]	-0.380948 [3]
First Difference		
LCO ₂	-6.337365*** [2]	-6.325296*** [2]
LDCPS	-5.118105*** [3]	-5.214477*** [3]
LENERGY	-6.200191*** [4]	-6.404050*** [6]
LGDP	-4.736395*** [0]	-4.664162*** [0]
LTRADE	-3.914544*** [7]	-5.029243*** [25]
<p>Note: *** and ** denotes significant at 1%, and 5% significance level, respectively. The figure in bracket [...] represents the Bandwidth used in the PP test selected based on Newey-West Bandwidth criterion.</p>		

source: Developed from the research

Based on the table above, all of the variables which are LCO₂, LDCPS, LENERGY, LGDP and LTRADE are unable to reject the H₀ at the level form since the p-value of these five variables are more than 1% or 5% significance level. This shows that all of the variables are not stationary and contain of a unit root.

However, when it comes to the first difference, all of the variables are able to reject the H₀ of the unit root test since the p-value of all of the variables is lower than 5% level of significance. Therefore, it can say that all of the variables are stationary and do not contain a unit root after the first difference.

In this unit root test, all of the variables must unable to reject the H_0 and not stationary at the level form. Thus, Johansen & Juselius Co-integration test is used to analyze the presence of long-run equilibrium relationship since the test can capture both short run and long run effects.

4.4 Johansen & Juselius Co-integration Test

In order to decide the optimum lags, Ljung-Box Q-statistic method was applied. When the lag length is equal to one, there are some p-values of the residual are less than 0.05. Hence, lag length is increased from one to two. When it is increased to two, all of the p-values of the residuals are greater than 0.05. Therefore, the optimum lag length of this research is two.

Based on Johansen & Juselius (1990), Johansen and Juselius Co-integration test is enforced to determine the amount of the cointegrating vector between the macroeconomic variables and to determine the cointegrating relationship. There are two statistics that can refer to which are the trace statistic and maximum eigenvalue statistics. By referring to co-integrating vector, the number of co-integrating relations can be determined. With the help of the trace statistics and maximum eigenvalue, decision order on hypothesis can be made by comparing the critical values with the 5% significance level.

Table 4.3: Johansen & Juselius Co-integration Test

Hypothesized No. of CE(s)	Trace	Max-Eigen	Critical Values (5%)	
	Statistic	Statistic	Trace	Max-Eigen
$r = 0$	103.7398**	51.59513**	69.81889	33.87687
$r \leq 1$	52.14469**	25.01712	47.85613	27.58434
$r \leq 2$	27.12758	14.55718	29.79707	21.13162
$r \leq 3$	12.57040	12.27832		

			15.49471	14.26460
$r \leq 4$	0.292082	0.292082	3.841466	3.841466

*denotes rejection of the hypothesis at the 0.05 level

source: Developed from the research

H_0 : Rank ≤ 0 ; Rank ≤ 1 ; Rank ≤ 2 ; Rank ≤ 3 ; Rank ≤ 4 .

H_1 : Rank = 1; Rank = 2; Rank = 3; Rank = 4; Rank = 5.

Decision rule: Reject H_0 if the p-value is less than significance level, $\alpha = 0.05$.
Otherwise, do not reject H_0 .

Based on Table 4.3, trace test indicates two cointegrating vector at the 5% significance level. However, the maximum eigenvalue indicates only one cointegrating vector at the 5% significance level. According to Lutkepohl, Saikkonen and Trenkler (2001), trace statistics is more superior compared to maximum eigenvalue test. Dao and Wolters (2008) also shows that in term of smallest value, trace statistics is better than maximum eigenvalue test.

Therefore, we can conclude that there are two cointegrating relationship between all of the 5 variables in this model after applying the Johansen and Juselius Co-integration test. The H_0 was rejected with the 5% significance level performed in the test.

4.5 Vector Error Correction Model

According to Asari, Baharuddin, Jusoh, Mohamad & Jusoff (2011), Vector Error Correction Model (VECM) is used to determine the long-run cointegrating relationship. The VECM equation is summarized as below:

$$LCO_{2t} = -9.7543 + 0.02902 LDCPS_t + 0.2635 LENERGY_t + 0.8906 LGDP_t + 0.2879 LTRADE_t$$

s.e	(0.03335)	(0.1413)
(0.1529)		
(0.04313)		
t-stat	(0.8701)	(1.8647)
(5.8264)		
(6.6757)		

The value of the intercept will be -9.7543 when all the independent variables are zeros.

For domestic credit to private sector, its t-statistics is 0.8701 which is not significant at 5% significance level. The coefficient of 0.02902 shows that if domestic credit to private sector increases by 1%, on average, the CO₂ will increase by 0.02902%, holding all variables constant.

For energy, the t-statistics is -1.8647 which is not significant at 5% significance level. The coefficient of 0.2635 indicates that if energy increases by 1%, CO₂ will increase by 0.2635%, ceteris paribus.

For GDP, 5.8264 is its t-statistics, which is significant at 5% significance level. The coefficient of 0.8906 means that when GDP increases by 1%, CO₂ will increase by 0.8906%, ceteris paribus.

For trade, its t-statistics is 6.6757 which is significant 5% significance level. The coefficient of 0.2879 suggests that if trade increases by 1%, CO₂ will increase by 0.2879%, holding other variables constant.

4.6 Granger Causality Test

Granger Causality Test is conducted in this research to study the causal direction and the lead lag relationships between the dependent variable (CO₂) and the independent variables (DCPS, ENERGY, GDP and TRADE).

H₀: There is no Granger cause relationship between dependent variable and independent variable in the short run.

H₁: There is a Granger cause relationship between dependent variable and independent variable in the short run.

Decision rule: Reject H₀ if the p-value is less than significance level, α . Otherwise, do not reject H₀.

Table 4.4: Granger Causality Results based on VECM

Dependent Variable	Independent Variables					ECT _{t-1} Coefficient (t-ratio)
	Δ LCO ₂	Δ LDCPS	Δ LENERGY	Δ LGDP	Δ LTRADE	
Δ LCO ₂	--	6.39** [0.041]	12.73*** [0.002]	2.20 [0.333]	3.11 [0.211]	-0.946** (-2.421)
Δ LDCPS	4.77* [0.092]	--	0.68 [0.711]	3.58 [0.168]	0.65 [0.723]	1.825*** (2.800)
Δ LENERGY	0.65 [0.723]	0.04 [0.980]	--	0.64 [0.727]	6.99** [0.030]	-0.035 (-0.114)
Δ LGDP	4.50 [0.105]	1.90 [0.387]	10.60*** [0.005]	--	6.05** [0.049]	0.081 (0.466)
Δ LTRADE	1.32 [0.518]	0.98 [0.613]	1.72 [0.423]	0.77 [0.681]	--	0.527 (1.320)

Note: ***, ** and * denotes significant at 1%, 5% and 10% significance level, respectively. The figure in the parenthesis (...) denotes as t-statistic and the figure in the squared brackets [...] represent as p-value.

source: Developed from the research

The table above shows the Granger Causality results of our research. The H₀ states that the explanatory variables do not granger cause on the response variables. At the 10% significance level, the H₀ of LCO₂ does not cause on

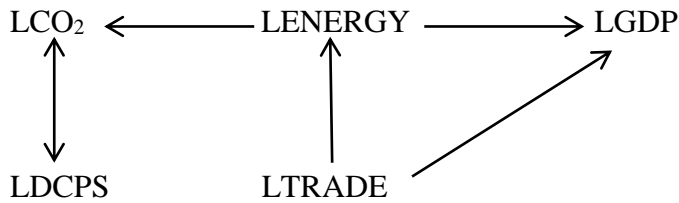
LDCPS is rejected since the p-value (0.092) is less than α . Therefore, it has sufficient evidence to conclude that there is a uni-directional Granger Causality running from LCO₂ to LDCPS in the short run at the 10% significance level. LENERGY and LTRADE do not granger cause LDCPS at any significance level and hence, these two variables are not granger causal for LDCPS. At the same time, the H₀ of LDCPS does not granger cause LCO₂ is also rejected since the p-value (0.041) is less than 5% significance level. It has sufficient evidence to conclude that there is a uni-directional Granger Causality running from LDCPS to LCO₂ in the short run at the 5% significance level. Therefore, we can conclude that there is a bidirectional relationship between LCO₂ and LDCPS.

Next, the H₀ of LENERGY does not granger cause LCO₂ and LENERGY does not granger cause LGDP are rejected since the p-value of LENERGY (0.0002) and (0.0005) respectively are less than 1% significance level. It has enough evidence to conclude that there is a uni-directional Granger Causality running from LENERGY to LCO₂ and LENERGY to LGDP in the short run at 1% significance level.

Besides that, the H₀ of LTRADE does not granger cause LENERGY and LTRADE does not granger cause LGDP are rejected since the p-value of LENERGY (0.030) and (0.049) respectively are less than 5% significance level. It has enough evidence to conclude that there is a uni-directional Granger Causality running from LTRADE to LENERGY and LTRADE to LGDP in the short run at 5% significance level.

In conclusion, all of the dynamic causal interactions among the variables are reported and summarized in a table (Table 4.4). There is no granger cause relationship for the rest of the variables since the p-value is more than the significance level. The H₀ cannot be rejected.

The causal channels can be summarized as below:



Based on the results of the error correction term of t-ratio, it shows that CO₂ has a significant negative coefficient of the error correction term because its t-statistic (-2.421) is greater than the 5% significance level. It shows that the adjustment of LCO₂ seems to be constant that 94.6% of the disequilibrium is corrected by CO₂ changes in the long run and converge towards equilibrium.

Next, the results also indicate that domestic credit to private sector has a significant positive coefficient of the error correction term since its t-statistics (2.800) are greater than the 1% significance level. It shows that domestic credit to private sector is not able to diverge from equilibrium and not able to adjust to correct for any deviations from the long-run relationship. Besides that, the remaining variables which are energy (LENERGY), GDP (LGDP) and trade (LTRADE) have insignificant coefficients of the error correction term since its t-statistics are within the rejection area.

4.7 Inverse Root of AR Characteristics Polynomial

Figure 4.6: Inverse Roots of AR Characteristic Polynomial

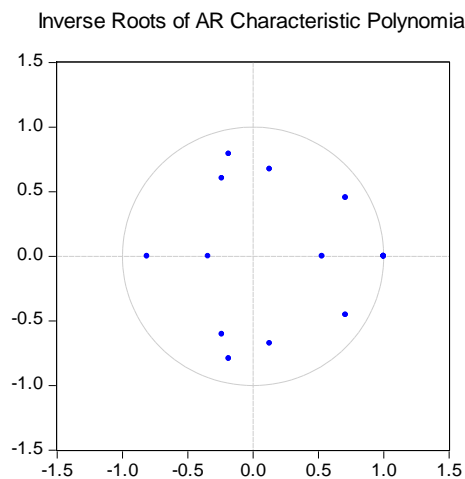


Table 4.5: Inverse Roots of AR Characteristic Polynomial

Root	Modulus
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
1.000000	1.000000
0.707824 - 0.453244i	0.840503
0.707824 + 0.453244i	0.840503
-0.185135 - 0.792123i	0.813470
-0.185135 + 0.792123i	0.813470
-0.810989	0.810989
0.127330 - 0.674419i	0.686334
0.127330 + 0.674419i	0.686334
-0.237164 - 0.602542i	0.647537
-0.237164 + 0.602542i	0.647537
0.527836	0.527836
-0.344726	0.344726

source: Developed from the research

Figure 4.1 shows that the VECM is dynamic stability since all dots are inside the circle. Table 4.5 indicates that there are 4 unit roots that equal to the unity. Giles (2013) says that the model is not stationary and an invalid impulse response will occur if the dots lie outside the circle. The shock will accumulate continuously and it will not die out.

4.8 Variance Decomposition

The Forecast Error Variance Decomposition is used to determine the dynamic interaction of the variables which is outside the sample period. Variance Decomposition is a tool that is used to determine how the CO₂ is affected by the other variables in the percentage form. The purpose of using this test is to capture

how important is the LDCPS shocks, LENERGY shocks, LGDP shocks and LTRADE shocks that affects the CO₂ in Malaysia.

Table 4.6.1: Variance Decomposition of LCO₂ in Malaysia

Percentage of Forecast Variance explained by Innovations					
Period	LCO ₂	LDCPS	LENERGY	LGDP	LTRADE
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	69.53072	0.049658	7.267158	16.31119	6.841270
3	60.62681	3.776183	14.66277	13.07236	7.861883
4	57.66113	7.231068	12.34070	11.00536	11.76174
5	59.30747	7.540026	10.84665	9.670269	12.63559
6	57.57539	8.492827	9.696434	9.495767	14.73958
7	56.73207	10.21423	8.846432	8.973478	15.23379
8	56.21979	10.96094	8.110363	8.447322	16.26159
9	56.59284	11.02251	7.707498	8.022141	16.65501
10	56.68782	11.13984	7.357673	7.793095	17.02157

source: Developed from the research

Table 4.6.1 tabulates the variance decomposition of each variable for ten periods, and the results are reported based on short run towards long run. Based on the table above, all the independent variables do not spread any shocks from each of them to LCO₂ in the first period. However, the shock to LCO₂ account for 69.53% variation of the fluctuation of LCO₂. Besides that, in period two, the shock to LDCPS can cause 0.0497% of fluctuation towards LCO₂, which is considered as low impact. The percentage of LENERGY to the variation of LCO₂ is 7.267%, while the impulse to LTRADE to LCO₂ hits at 6.842% variation of the fluctuation in LCO₂.

Next, it is observed that in the period 10, LDCPS and LTRADE in explaining the variability of LCO₂ has increased significantly in the long run. For instance, LDCPS has increased from 0.0496% in the period 2 to 11.140% in the period 10, and LTRADE has increased from 6.841% in the period 2 to 17.022% in the period 10. However, LGDP shows the opposite direction. It has been decreased from

16.311% in the period 2 to 7.793% in the period 10. LENERGY's percentage of influence shows a fluctuation situation. It has been increased from the period 2 (7.267%) to the period 3 (14.663%) and decrease to 7.358% in the period 10.

In a nutshell, the volatility of LCO₂ is mainly affected by its own discrepancy followed by LTRADE, LDCPS, LGDP and LENERGY.

Table 4.6.2: Variance Decomposition of LDCPS in Malaysia

Percentage of Forecast Variance explained by Innovations					
Period	LCO ₂	LDCPS	LENERGY	LGDP	LTRADE
1	13.72969	86.27031	0.000000	0.000000	0.000000
2	16.61540	78.84835	0.001782	0.105175	4.429297
3	23.41813	69.73320	0.312086	0.074620	6.461965
4	29.36472	60.27514	5.379133	0.529554	4.451454
5	32.66573	52.42673	9.912876	1.892647	3.102023
6	36.93824	47.19533	10.87705	2.298146	2.691233
7	39.65356	44.78097	10.91937	2.316030	2.330074
8	40.33813	43.69956	11.33379	2.583564	2.044958
9	40.86903	42.92619	11.44904	2.863458	1.892282
10	41.60278	42.59282	11.17801	2.807189	1.819202

source: Developed from the research

Based on Table 4.6.2, in the period 10, we can see that LCO₂, LENERGY and LGDP in explaining the variability of LDCPS has risen significantly in the long run. For example, the percentage of influence to LDCPS by LCO₂ has increased dramatically from 13.730% in the period 1 to 41.603% in the period 10. However, LTRADE contributes the least percentage of impact towards LDCPS when compare with the other independent variables, which is not more than 2.5% in the long run. The volatility of LDCPS is mainly affected by its own discrepancy in the long run.

Table 4.6.3: Variance Decomposition of LENERGY in Malaysia

Percentage of Forecast Variance explained by Innovations					
Period	LCO ₂	LDCPS	LENERGY	LGDP	LTRADE
1	41.47222	0.187815	58.33996	0.000000	0.000000
2	35.99702	0.136479	62.01782	1.718139	0.130541
3	42.19245	5.776620	44.80841	1.934652	5.287864
4	45.78921	9.713802	32.51797	1.990497	9.988519
5	51.79224	8.721936	27.76341	1.521773	10.20064
6	55.26042	7.844854	25.51072	1.238896	10.14512
7	57.81225	7.687614	23.09657	1.119455	10.28411
8	60.33142	7.471436	20.48191	1.100088	10.61515
9	63.00075	7.084960	18.17690	1.032394	10.70500
10	64.99111	6.776418	16.48204	0.988250	10.76218

source: Developed from the research

From Table 4.6.3, we can conclude that the influence of LCO₂ and LTRADE to LENERGY are the most significant which are from 41.472% and 0% in the first period to 64.991% and 10.762% respectively in the period 10. The volatility of LENERGY is mainly affected by LCO₂ follow by LENERGY, LTRADE, LDCPS and LGDP in the long run.

Table 4.6.4: Variance Decomposition of LGDP in Malaysia

Percentage of Forecast Variance explained by Innovations					
Period	LCO ₂	LDCPS	LENERGY	LGDP	LTRADE
1	3.220923	8.699560	14.49740	73.58212	0.000000
2	11.72195	8.629055	9.786984	69.70769	0.154326
3	25.18094	12.10116	13.79870	41.03963	7.879570
4	28.99335	13.93836	12.03769	34.85337	10.17722
5	31.84652	14.13536	10.20839	33.03705	10.77267
6	33.10916	15.14097	9.083976	31.34534	11.32054
7	32.88017	16.45112	8.312500	30.29424	12.06197
8	33.02470	17.07746	7.800121	29.54793	12.54979
9	33.61572	17.38055	7.368481	28.77997	12.85528

10	34.28287	17.54384	7.038767	28.14896	12.98556
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source: Developed from the research

Based on Table 4.6.4, the influence of LCO₂ to LGDP is the most significant, which is, increase from 3.221% in the first period to 34.283% in the tenth period. There are 2 independent variables (LDCPS and LTRADE) that increase in terms of percentage of the variance, that is, from 8.7% to 17.544% and 0% to 12.986% respectively in the first period and the tenth period. However, the percentage of variance of LDCPS and LGDP have decreased from the first period to the tenth period. The shock on LCO₂ cause the highest impact to LDCPS in the long run while the volatility of LDCPS is mainly affected by its own discrepancy in the short run.

Table 4.6.5: Variance Decomposition of LTRADE in Malaysia

Percentage of Forecast Variance explained by Innovations					
Period	LCO ₂	LDCPS	LENERGY	LGDP	LTRADE
1	7.089361	41.18332	6.143107	0.032162	45.55205
2	9.439085	44.83272	5.680363	0.243278	39.80455
3	18.38506	35.54229	4.446106	1.953298	39.67325
4	26.21538	28.94089	4.167082	3.240658	37.43599
5	31.99190	24.76104	4.887476	3.135133	35.22445
6	37.84130	20.47789	6.990585	2.640269	32.04995
7	42.33182	16.84838	9.167716	2.093352	29.55873
8	45.55609	14.54051	10.58914	1.692765	27.62149
9	47.53326	13.17384	11.33793	1.419019	26.53595
10	48.61616	12.37185	11.79755	1.229401	25.98503

source: Developed from the research

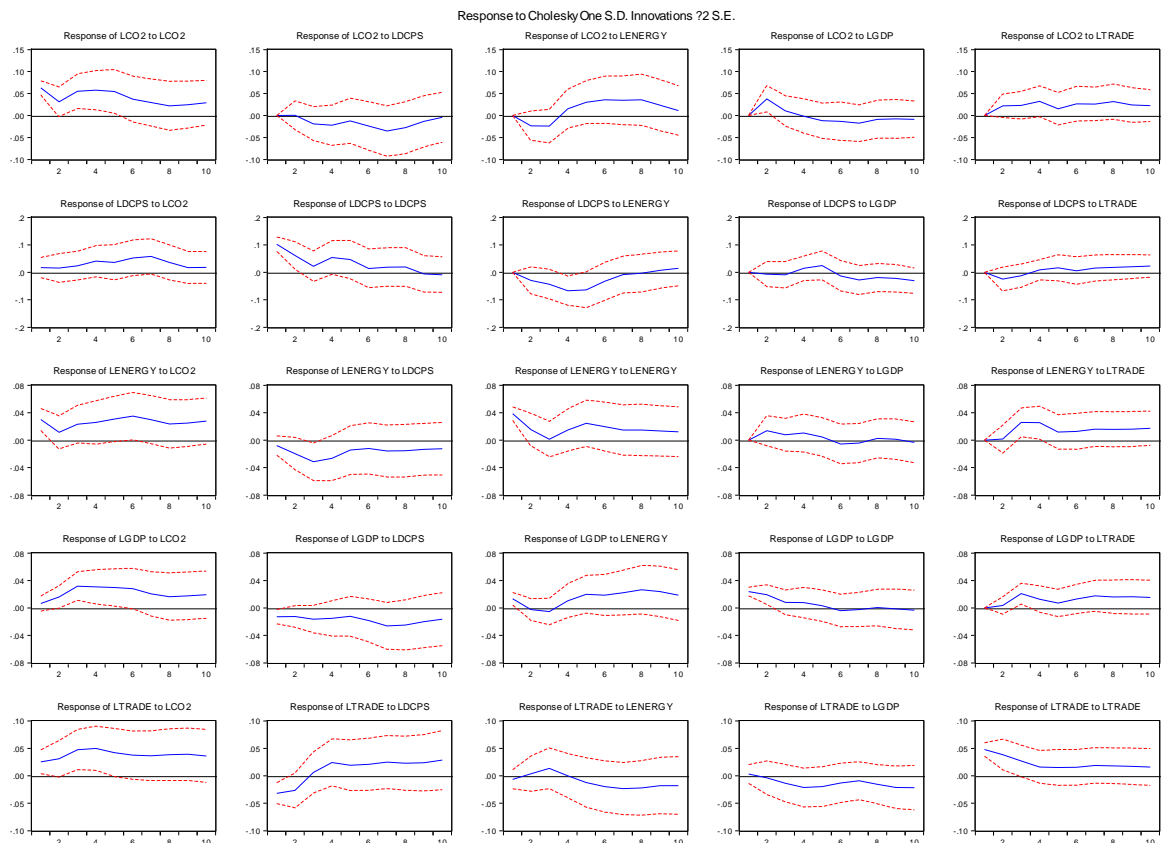
Based on Table 4.6.5, it can be concluded that in the period 10, LCO₂ and LENERGY are the variables that have increased significantly in explaining the variability of LTRADE. However, shock to LCO₂ provides the highest percentage of impact towards LTRADE compare with LENERGY, which is more than 48% in the long run. For LDCPS, the percentage of influence to LTRADE has

decreased start from the first period (41.183%) and end up with 12.372% in the tenth period. LGDP has a fluctuate influence towards LTRADE. It starts to increase from the first period to the fifth period and start to decline until the period 10.

4.9 Generalized Impulse Response Function

Impulse response analysis from unrestricted VAR that was suggested by Pesaran and Shin (1997) has been chosen to study the impulse response. The outcomes generated from the variance decomposition and generalized impulse response functions are frequently found to be highly depended on the selected lag length and the ordering type in the variables. So, the purpose to use generalized impulse response function because it reacts differently from the standard impulse response function. However, the generalized impulse response function does not affect the outcomes if the independent variables' order is randomly inserted into the equation and do not assume that when one variable is shocked, all the other variables are switched off. According to Sims (1980), there is limitations in the output depend on the variable order in the standard impulse response function if there is no contemporaneous correlations among the independent variables.

Figure 4.7: Generalized Impulse Response Functions for Ten Periods



source: Developed from the research

According to the Figure 4.7, generalized IRFs from shock by one standard deviation to individually of four independent variables (LDCPS, LENERGY, LGDP, and LTRADE) are traced out.

First and foremost, it can be clearly seen that the response of one standard deviation of LCO2 to LCO2, LENERGY to LENERGY and LTRADE to LTRADE show the positively impact, while LDCPS to LDCPS , LGDP to LGDP show the positively impact at the beginning and dropped to negative impact at the end of the period. Yet, LDCPS records fluctuation trend from the first period to the eighth period and has a slightly fall to negative interval until the end of the period. LGDP shows the positive interval at the beginning period and fall gradually to negative interval starting from the middle of the period.

Next, the response of one standard deviation of LCO₂ levels off at the first and second period toward LDCPS. Then, there is a slightly curve in negative area; yet, the line decreases steadily from fourth period to seventh period and increases at the following period until it close vicinity to zero. The response of LCO₂ shows a slightly negative curve in the first three period toward LENERGY and slightly increase to a positive curve in the following period. The response of LCO₂ reaches the peaked positively at the second period towards the LGDP. Yet, it is declining to the zero before falls steadily to the negative area. Last but not least, the response of LCO₂ shows the positive impact toward LTRADE. It has increased steadily from the first period until it reached the peaked around fourth period. In additional, it drops slightly at fifth period and increase back until the end of the period.

Inevitably, the response of one standard deviation of LDCPS recorded fluctuation trend at the positive area towards LCO₂. The response of LDCPS shows a downward curve at the negative area towards LENERGY at the first eighth period and slightly increase to the positive area for the following period. The response of LDCPS shows the negatively curve toward LGDP at the first three period, and then increase to the positive curve until fifth period, and unfortunately fall gradually for the following period. Yet, the response of LDCPS shows the negative impact towards LTRADE at the first three period and increase to the positive impact for the following period.

Eventually, the response of LENERGY shows the positively trend towards LCO₂ and LTRADE, while it shows negatively trend towards LDCPS. On the other hand, LENERGY shows the positively trend towards LGDP at the beginning of the middle period, and then records a slightly negative curve for the following two period; yet, slightly increase back to positive trend at the following period.

Intestingly, the response of LGDP shows the positively trend toward LCO₂ and LTRADE, while it shows negatively trend towards LDCPS. On the other hand, the response of LGDP shows the positively trend towards LENERGY at the first period, and it decreases significantly towards the negative area at second period;

yet, it increases dramatically to the positive area since third period until the end of the period.

Last but not least, the response of LTRADE recorded positively trend towards LCO₂. Invervely, the response of LTRADE shows a negatively trend towards LGDP. Furthermore, the response of LTRADE records negatively trend towards LDCPS at the first two period, and then increase dramatically to positive trend until the end of the period. Yet, LTRADE reaches a peak at around 2.5 period toward LENERGY and decreases positively until it reaches zero at around 3.5 period; then falls dramatically to the negative area until the end of the period.

4.10 Conclusion

Firstly, the graph patterns of all the variables have been analyzed and discussed. Next, we review the descriptive statistics of each variable. Instead of using Ordinary Least Squares estimation, unit root tests are carried out in this research to test whether the variables are stationary or not. Based on the Phillips Perron (PP) test. All of the variables are not stationary at the level stage, but are stationary after the first difference.

Johansen & Juselius Co-integration test has been performed. Based on the Ljung-Box test, a suitable lag length has been selected. During the first lag length, some of the residuals' p-values are less than 5% significance level. Therefore, we increase the lag length to two. When the lag length is equal to two, all of p-values of the residual are more than 5% significance level. So, the appropriate lag length is two.

Once the lag length has been confirmed, we proceed with the co-integration test. Based on the trace statistics, there are two cointegrating vectors, however, maximal eigenvalue statistics only show one cointegrating vector. Previous studies have been done by researchers saying that the trace statistics is much more powerful than the maximal eigenvalue statistics. Therefore, we can conclude that

there are two cointegrating vectors and there is a long run relationship in our model. Next, we continue with the VECM approach.

The VECM results indicate that only domestic to private sector and energy are significant to CO₂ while the rest of the variables are not significant to CO₂. All of the signs of the variables show that they are positively related to CO₂.

In order to determine the short run and causality direction of the model, we use the Granger Causality test has been used. It shows that trade has uni-directional towards energy and GDP. Energy has uni-directional to GDP and CO₂. In the meantime, CO₂ and DCPS have bi-direction, which means that they cause each other. Therefore, we can say that DCPS and Energy have granger causality and short run relationship towards CO₂.

Next, to test the dynamic stability of the empirical model, the inverse root of AR characteristic polynomial has been used. The empirical model is dynamically stable based on the result shows that with the VECM approach. Furthermore, the volatility of CO₂ is mainly affected by its own shocks, follow by Trade, DCPS, GDP and Energy based on the variance decomposition results. According to the generalized impulse response function, the shocks effects of all the independent variables are not significant towards CO₂.

In conclusion, all of the empirical results have been simplified in diagram, table and figure form. The findings, suggestions and limitations of the whole research will be discussed and explained in Chapter 5.

CHAPTER 5: DISCUSSION, CONCLUSION, AND IMPLICATIONS

5.0 Introduction

This chapter is to summarize all the chapters that have been done in previous chapters by discussing and explaining all the data analysis, interpretations, and major findings that have been conducted prior to the topic selected. Such discussion includes suggestions, limitations and policy implications of the whole research, not to mention further suggestions for future research purpose.

5.1 Summary of Statistical Analyses

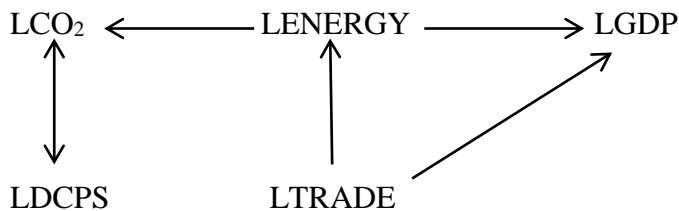
From the results we got from chapter 4, the empirical results managed to reach its research objective and found a solution for the research questions. Generally, these study overviews all the variables with descriptive statistics. Along with graph line, this brings clearer picture by explaining the graph moving pattern and discussing the phenomenon of each variable's fluctuation. Unit root test is being carried out to ensure macroeconomic variables are in stationary form in a way to avoid spurious regressions. Based on the results, all of the variables which are LCO₂, LDCPS, LENERGY, LGDP and LTRADE are unable to reject the H₀ at the level form since the p-value of these five variables are more than 1% or 5% significance level. This shows that all of the variables are not stationary and contain of a unit root. However, when it comes to the first difference, H₀ of the unit root test are rejected for all the variables as the p-values are lesser than the significance level of 5% for all variables. Therefore, it can say that all of the variables are stationary and do not contain a unit root after the first difference.

When all variables are stationary at first difference, the test can be proceed to Johansen & Juselius Co-integration test to analyze the presence of long-run equilibrium relationship since the test can capture both short run and long run

effects. It is concluded that there are two co-integrating relationship between all of the 5 variables (GDP, Trade, DCPS, Energy, and CO₂) in this model after applying the Johansen and Juselius Co-integration test. The H₀ was rejected with the 5% significance level performed in the test.

Upon completion of Johansen & Juselius Co-integration test, the study proceeds to Vector Error Correction Model (VECM) test, which is used to determine the long-run cointegrating relationship. For DCPS, its t-statistics is 0.8701 which was significant at 5% significance level, GDP showed t-statistics of 5.8264 in 5% significance level, and trade showed t-statistics of 6.6757 in 5% significance level. However, only energy variable showed insignificance with t-statistics of -1.8647 at 5% significance level.

Following by Granger Causality Test to study the causal direction and the lead lag relationships between the dependent variable (CO₂) and the independent variables (DCPS, ENERGY, GDP and TRADE). The summary of granger causality between all 5 variables can be concluded as below.



In conclusion, there is a uni-directional Granger Causality running from LTRADE to LENERGY and LTRADE to LGDP in the short run at 5% significance level. All of the dynamic causal interactions among the variables are reported and summarized in table form. There is no granger caused relationship for the rest of the variables since the p-value is more than the significance level. The H₀ cannot be rejected.

Soon after, Inverse Root of AR Characteristics Polynomial (AR) test is being carried out as well. The result shows that the VECM is dynamic stability since all

dots are inside the circle and hence, the results of impulse response are valid. Variance decomposition is a tool to find out on how other variables affect CO₂ in percentage form. Whereas generalized impulse response function will be tested and concluded that the response of one standard deviation of LDCPS and LGDP has the negative impact at the end of the period toward LCO₂. Consequently, the response of one standard deviation of LENERGY and LTRADE has the positive impact at the end of the period toward LCO₂. Hence, the overall results show that shocks of LDCPS, LGDP, LENERGY and LTRADE are insignificantly towards LNHPI.

5.2 Analysis of Major Findings

For domestic to private sector, its t-statistics is 0.8701 which is not significant at 5% significance level. The coefficient of 0.02902 shows that if domestic to private sector increases by 1%, on average, the CO₂ will increase by 0.02902%, holding all variables constant. Granger Causality test results also concluded that it has sufficient evidence to conclude that there is a uni-directional Granger Causality test running from LCO₂ to LDCPS in the short run at the 10% significance level. This statement is supported by Shahbaz, Qazi, Tiwari, et.al (2013), Jalil and Feridun (2011), and MA Boutabba (2014), confirming that there is a long run relationship between CO₂ emissions and financial development. They found that the impact of financial development is negative and it is statistically significant at 1% significance level. It implies that a 0.2071% decline in CO₂ emissions is linked with a 1% increase in financial development. According to MA Boutabba (2014), the researcher found that financial development has a long-run positive impact on CO₂ emissions. A 1% increase in domestic credit to private sector will lead to about 0.182% rise in CO₂ emissions, which is significant at the 1% level. Furthermore, based on Jalil and Feridun (2011), they found that an increase in financial development leads to an improvement in the environmental performance in China. In addition, it is concluded that there is a bidirectional relationship between LCO₂ and LDCPS.

For energy, the t-statistics is -1.8647 which is not significant at 5% significance level. The coefficient of 0.2635 indicates that if energy increases by 1%, CO₂ will increase by 0.2635%, *ceteris paribus*. This statement is supported by Christophe, R (2012) and Tang and Tan (2012), who found that there is a positive relationship between energy consumption and CO₂ emissions. Similarly, Dritsaki (2014) found that there is a strong positive relationship between energy consumption with CO₂ emission where recorded as 98.2%. In Granger Causality test, the H₀ of LENERGY does not granger cause LCO₂ and LENERGY does not granger because LGDP are rejected since the p-value of LENERGY (0.0002) and (0.0005) respectively are less than 1% significance level. Therefore, it has enough evidence to conclude that there is a uni-directional Granger Causality running from LENERGY to LCO₂ and LENERGY to LGDP in the short run at 1% significance level.

For GDP, 5.8264 is its t-statistics, which is significant at 5% significance level. The coefficient of 0.8906 means that when GDP increases by 1%, CO₂ will increase by 0.8906%, *ceteris paribus*. In 2009, the share price in Malaysia fell sharply after the global economic system slowdown lead to the trading volume in the country decline to a certain point and has decreased the GDP (real US\$) (Athukorala, 2010). Supporting authors such as Shahbaz, Solarin, Mahmood and Arouri (2013), Ang, Tamazian et al. and Apergis & Payne (n.d), Mitic, Ivanovic & Zdravkovic (2017) found that there is a relationship between GDP and CO₂ emission. When it comes to Granger Causality test, it has enough evidence to conclude that there is a uni-directional Granger Causality running from LTRADE to LENERGY and LTRADE to LGDP in the short run at 5% significance level. This test is also supported by Kuo, C.K., Kanyasathaporn, P. & Lai, S (n.d) who found that there is a unidirectional Granger causality between CO₂ emission and GDP in Hong Kong. Saboori, Sulaiman & Mohd (2012) also concluded that there is an inverted U shaped relationship between CO₂ emission and GDP, confirming the carbon Kuznets Curve in Malaysia.

For trade, its t-statistics is 6.6757, which is significant at 5% significance level. The coefficient of 0.2879 suggests that if trade increases by 1%, CO₂ will increase by 0.2879%, holding other variables constant. Consequently, AKIN, Cemil Serhat

(2014) and Shahbaz & Leitão (2013) states that the increase of trade openness affects the CO₂ emission positively in short term, matching the results obtained from this study. Not only that, Opoku et al. (2014) concluded that, in the long run, the results indicate that per capita CO₂ emissions is positively related to real GDP per capita. In Granger causality, it is concluded that there is a uni-directional Granger Causality running from LTRADE to LENERGY and LTRADE to LGDP in the short run at 5% significance level.

5.3 Implication of Study

As the focus of this study is on the relationship between the effects of GDP, Trade, Energy and DCPS towards CO₂ emissions, it provides useful knowledge for community such as government, investors, and policy makers. Reasons because the results that have been tested can reflect the future action that should be taken in order to reduce CO₂ emissions. Based on the results, its t-statistics for domestic to private sector is 0.8701 which is not significant at 5% significance level. The coefficient of 0.02902 shows that if domestic to private sector increases by 1%, on average, the CO₂ will increase by 0.02902%. Having that knowledge in mind, it helps government and policy makers to be aware of the current environmental condition in Malaysia and if actions were to be taken, implementation of rules and regulations towards financial corporation from providing financial resources to private sectors can be made. Besides, investors who knew about such facts may use their financial resources on environmental projects to avoid CO₂ emissions despite knowing the fact that an increase in DCPS will increase CO₂ emission.

Next, the t-statistics for energy is -1.8647 which is not significant at 5% significance level. The coefficient of 0.2635 indicates that if energy increases by 1%, CO₂ will increase by 0.2635%. Knowing that fact that energy and CO₂ emission has inverse relationship, it helps Malaysia government into consideration in cooperating with renewable energy sectors, be it locally or globally. For instance, Malaysia government cooperating with Germany on windmill projects as a mean to generate electricity by nature. By doing so, government may attract

more investors by investing on their projects towards establishment of renewable energy and CO₂ emission in Malaysia as such projects would be highly beneficial and profitable to both government sectors and private sectors. Besides, government will get the idea to implement policy like feed-in-tariff, a long term agreement and guaranteed on pricing towards energy production such as solar battery. One way it helps users on reducing energy consumption, another way it helps government on maximizing energy resources in order to enhance environmental friendly as well as economic growth in Malaysia. In addition, the results shown also help to create public awareness on the importance of being environmental friendly while having decent income into their pocket.

For GDP, 5.8264 is its t-statistics, which is significant at 5% significance level. The coefficient of 0.8906 means that when GDP increases by 1%, CO₂ will increase by 0.8906%. In short, there is an inverse relationship between GDP and CO₂. With the results attained, government can get a better understanding towards the exact impact of an increase in GDP towards CO₂ emission and start taking action in reducing the CO₂ emission. As GDP grows mainly due to economic and human activities, policy makers may implement restrictions towards any investment or establishment which would give negative impact towards CO₂ in Malaysia. For example, government should investigate and study the background and objective of a company to estimate the impact towards CO₂ in Malaysia before licensing a new startup company.

For trade, its t-statistics is 6.6757 which is significant 5% significance level. The coefficient of 0.2879 suggests that if trade increases by 1%, CO₂ will increase by 0.2879%, holding other variables constant. Moreover, imports and exports also affect GDP in overall and its transportation would cause air pollution in long run. Knowing that, government may reregulate the existing trade barriers by focusing on reducing CO₂ emission in Malaysia.

In a nutshell, this study provides additional knowledge to related parties such as government, policy makers, and public in understanding the effects of macroeconomic and financial development towards CO₂ emissions in Malaysia. By doing so, all parties can react promptly make necessary actions to change their point of view and take CO₂ emission in Malaysia into a deeper concern.

5.4 Limitation of Study

Throughout the whole research, several limitations can be found which prevented the research from furthering its study. Of course, a perfect research does not exist as there is always limitation in this reality. First and foremost, this study can be considered as insufficient of independent variables. 5 independent variables were supposed to be taken into the study to investigate their relationship with the response variable, CO₂ emission in Malaysia. Such that GDP, Energy Consumption, Trade, and Domestic Credit to private sectors. Anyhow, relying on just 4 independent variables in the research will not be enough to completely identify the CO₂ emissions in Malaysia because it causes the possibility whereby other significant variables might be omitted relative to this research.

Secondly, this research only considers secondary data as its overall data; primary data is being neglected. Secondary data consists of journals, articles, news, and any other news that can be found related to this study in Malaysia which has limited sources. Moreover, there are plenty of arguments and opinions between those researches attained from secondary data such that every author seemed to have difference point of view or different perspective for a particular variable. The differences would be time consuming and create the possibility that proving the facts would be worthless. At the same time, future researcher would get confused over excessive opinions available in secondary data, resulted them to lose their focus on the main objective.

Furthermore, insufficient of variables theories are part of the limitations as well. For example, the theories that we found for domestic credit to private sector are very limited as not many researchers have included such variable into their study. Most of the theories were only found in secondary data rather than primary data the data that can be obtained from secondary data is limited. Such limitation has minimized the scope of study as this study failed to carry out an adequate results due to its inability to support the selected variables with reasonable theories. Also, the study is unable to advance any further due to limited knowledge of econometrics tests. Therefore, the relationship between independent variables and dependent variable can only be examined as a fragment rather than a whole.

Similarly, the consistency and enhancement of empirical results will be obstructed with its limitation.

Lastly, this research and its findings are only applicable for researchers who wish to further study in Malaysia and become useless for Malaysians and policy makers. Reason because this research is mainly focus in one country itself which is Malaysia. All the data retrieved may be from different countries but only as a reference. The primary data was all attained from Malaysia source known as World Bank. Even so, the observation used in this research is only 24, which only consists a tiny part of the overall observations. Researchers who wish to further study on other countries might not find this research to be useful as every country has its own historical background, government policy, economic trends, cultural and more. Unfortunately, such differences can only act as a reference for other countries as its findings may vary from country to country.

5.5 Recommendation for Future Study

As far as it may be, research recommendations are essentially useful for every future researcher as it shows predicted expectation as well as what could be done in future studies to produce a better research. As it creates an overall view about the research, it helps to avoid repetitive mistakes that have been made previously which could save the effort and time into better use. The importance of recommendation enlighten future researcher to study on something which has not been discovered. With that, the accuracy of the results may be increased in a way that significant variables or advanced test statistics may be discovered far earlier than we expected. Upon completion of any new research, it is encouraged that researcher verify the outcome of the research by specifying the pros and cons of the methods used to pass down the knowledge for other researchers.

Firstly, the data of this research is 34 years, up to the latest year 2013. With the new data attained from new sources, this research will be done in a manner where the test results are up to date and it improves accuracy with its latest data given as compared to other researches. Technically, this research will help the future

researches to gain an updated outcome and it is suggested that future researchers to conduct their research with latest data available on new sources from time to time. Besides, it is suggested that future research can conduct their tests with a more systematic and advanced method to produce higher accuracy and reliable results or consider using primary data to make comparison. Reason because this research is only done with Eview system and there are more options that can be chosen to run a more accurate data. Future researchers can determine the factor of CO₂ emissions by using other method than Eview to enhance the reliability of results gain since Eviews has its own limitation.

Aside from that, it is recommended that future researchers can consider putting more variables or lengthen the number or years in their researches. For example, Foreign Direct Investment (FDI) variable can be added into their studies as a new variable. Reason because this study could not include FDI variable into this study due to incomplete data or lack of data, resulting the variable to fail in unit root test. Therefore, researchers may include FDI more data by lengthening the number of years to produce a better results. The relationship between FDI and CO₂ emission are not significant yet. Many researchers could not attain a significant result due to its data.

Finally, every research is conducted from different sources, whether it is sources from years ago or current sources. With the existence of such differences, every research seems to have its own argumentative theories. Some of the researchers concluded a positive relationship between 2 specific variables whereas another researcher might conclude the other way round due to different test methods. For instance, Kuo, C. K., Kanyasathaporn, P. & Lai, S. showed that there is a unidirectional Granger causality between CO₂ emission and GDP in Hong Kong. However, the results from the study are conflicted with the researches by Ho & Siu (2007) and Chiou et al (2008). Therefore, various researches were being used into future research to conduct a more identical result. This is the reason why this research is being conducted to determine its accuracy by collecting all kind of supportive sources that the past researchers might not cover. It is suggested that future researches can improve their research by collecting undiscovered sources to

support their research as such effort might help to identify new discovery which have not been found yet.

5.6 Conclusion

CO₂ has become the main concern for the cause of global warming. Therefore, it is crucial to study the behavior of the existence of CO₂ and how it is affected by all sorts of factors. This study is looking at both macroeconomic and financial development factors (GDP, Trade, Energy, and DCPS) in a way that how they affect or increase the CO₂ emission. Based on the test results obtained from chapter 4, major findings were found. It shows that Trade and GDP variables are significant to CO₂ emission whereas DCPS and Energy variables are insignificant towards CO₂ at 5% significance level. In other words, GDP, and Trade variables have positive relationship with CO₂ whereby DCPS and Energy variables have negative relationship with CO₂. It is also found that previous researches done by other researchers have proven the outcome of this study to be positive. Upon attaining the results, further findings were tested by using Granger Causality test and found that there is a uni-directional Granger Causality test running from LCO₂ to LDCPS in the short run at the 10% significance level. Not only that, there is a uni-directional Granger Causality running from LENERGY to LCO₂ and LENERGY to LGDP in the short run at 1% significance level as well

. In short, it is concluded that there is a uni-directional Granger Causality running from LTRADE to LENERGY and LTRADE to LGDP in the short run at 5% significance level.

Next, this study includes implication of study to provide knowledge for future researchers on the usefulness of this study in order for them to fully utilize the usage of this research when it comes in need. The main parties involved are government sectors, policy makers, and public investors in Malaysia. In terms of DCPS, it helps government and policy makers to be aware of the current environmental condition in Malaysia and if actions were to be taken, implementation of rules and regulations towards financial corporation from

providing financial resources to private sectors can be made. Besides, investors who knew about such facts may use their financial resources on environmental projects to avoid CO₂ emissions despite knowing the fact that an increase in DCPS will increase CO₂ emission. Furthermore, this study also encourages government to participate in renewable energy projects with other countries to reduce the energy consumption, reducing the CO₂ emission in general. For GDP, government may make good use of the results obtained from this study to determine the possible requirement and restrictions that can be implemented in order to prevent excessive of overly polluted companies such as factories. Reasons behind is to provide clearer understanding to all parties involved regarding the seriousness of CO₂ emission if either one of the variables were to be increased or decreased. At the same time, it is encouraged that involved parties can react rationally by prioritizing the environment condition in Malaysia.

Moving on, limitation and recommendation are discussed in this chapter too. In terms of limitation, this study lacks of variables as it only consists of 4 variables in total. Having just 4 variables testing on effects of CO₂ emission are never enough to prove any decent results as there are more than 4 variables that could have affected CO₂ emission in Malaysia more significantly than the 4 variables used in this study. Besides, the sources of this study are attained from secondary data such as web sources, articles and journals. No comparison can be made between primary data and secondary data. This is bad because secondary data has plenty point of views from different authors, confusing the future researcher to determine the exact answer. Other than that, sources obtained from secondary data have limited theories to support the variables as well as the data analysis, leaving certain results in doubt. This research mainly focuses only in Malaysia; researcher who wants to study further in other countries may not find this study to be useful but only as a reference. As for recommendation, it is suggested that future researchers to conduct this study with latest data or expand the number of data into their studies. Also, using a more advanced systems or collect primary data to enhance the accuracy of data, and collecting undiscovered journals or latest journals to expand the scope of study.

REFERENCES

- Ahmada, R., Zulkiflib, S. A. M., Hassanc, N. A. A. N., & Abdohd, W. M. Y. M. (2016). The impact of economic activities on CO₂ emission. *International Academic Research Journal of Social Science*, 2(1), 81-88.
- AKIN, C. S. (2014). The impact of foreign trade, energy consumption and income on CO₂ emissions. *Energy Economics and Policy*, 4(3), 465-475.
- AKIN, C. S. (2014). The impact of foreign trade, energy consumption and income on CO₂ Emissions. *Energy Economics and Policy*, 4(3), 465-475.
- Alexander. (1999). Optimal Hedging Using Co-integration. *Philosophical Transactions of Royal Society, London, Series A 357*, 2039-2058.
- Ali, Waqas & Ahmad. (2015). Analyzing the dynamics of energy consumption, liberalization, financial development, poverty and carbon emissions in Pakistan. *Journal of Applied Environmental and Biological Sciences*, 5(4), 166-183.
- Ang, J. (2008). Economic development, pollutant emissions and energy consumption in Malaysia. *Journal Of Policy Modeling*, 30(2), 271-278. <http://dx.doi.org/10.1016/j.jpolmod.2007.04.010>
- Arltova & Fedorova. (2016). Selection of Unit Root Test on the Basis of Length of the Time Series and Value of AR (1) Parameter. *Statistika*, 96(3).
- Arouri, M. E. H., Youssef, A. B., Henni, H. M. & Rault, C. (2012). Energy consumption, economic growth and CO₂ emissions in Middle East and North African countries. *Energy Policy*, 45, 342-349.
- Asari, Baharuddin, Jusoh, Mohamad, Shamsudin & Jusoff. (2011). Vector Error Correction Model (VECM) approach in explaining the relationship between interest rate and inflation towards exchange rate volatility in Malays. *World Applied Sciences Journal 12 (Special Issue on Bolstering Economic Sustainability)*, 49-56.
- Asari, F. F. A. H., Baharuddin, N.S., Jusoh, N., Mohamad, Z., & Jusoff, N. S. K. (2011). A Vector Error Correction Model (VECM) approach in explaining the relationship between interest rate and inflation towards exchange rate volatility in Malaysia. *World Applied Science Journal*, 12, 49-56.
- Asteriou, D., & Hall, S. G. (2007). *Applied Econometrics: A Modern Approach Using Eviews and Microfit*, Revised Edition. Palgrave Macmillan.
- Athukorala, P. -C. (2010). *Malaysian Economy in Three Crises*.

- Boopen & Vinesh. (n.d.). On the Relationship between CO₂ Emissions and Economic Growth: The Mauritian Experience. *University of Mauritius*.
- Boutaba, M. A. (2014). The impact of financial development, income, energy and trade on carbon emissions: evidence from the Indian economy. *Economic Modelling*, 40, 33-41
- Boutabba, M. A. (2014). The impact of financial development, income, energy and trade on carbon emissions: Evidence from the Indian economy. *Economic Modelling*, 40, 33- 41.
- Box & Pierce. (1970). Distribution of residual autocorrelations in autoregressive-integrated moving average time series models. *Journal of the American Statistical Association*, 65(332), 1509- 1526.
- Breitung & Franses. (1998). On Philips-Perron-Type tests for seasonal unit roots. *Econometric Theory*, 14, 200–22.
- Brooks, C. (2008). *Introductory Econometric for Finance*. (2nd.ed.). Cambridge University Press.
- Burns, P. (2002). Robustness of the Ljung-Box test and its rank equivalent.
- Cederborg, J. & Snobohm, S. (2016). Is there a relationship between economic growth and carbon dioxide emissions? *Economics*.
- Cheng, N. (2016). Malaysia to ratify climate change accord soon. Retrieved from <http://www.thestar.com.my/news/nation/2016/09/19/malaysia-to-ratify-climate-change-accord-soon/#7a6p3EVQUAJ07brW.99>
- Chik, N., Rahim, K., Radam, A., & Shamsudin, N. (2013). Co₂ emissions induced by households lifestyle in Malaysia. *International Journal Of Business And Society*, 14(3), 344-357. Retrieved from <http://www.ijbs.unimas.my/repository/pdf/Vol14No3paper1.pdf>
- Church. (2001). The Effective Use of Secondary Data. *Learning and Motivation* 33, 32-45.
- Dao, C. M., & Wolters, J. (2008). Common stochastic volatility trends in international stock returns. *International Review of Financial Analysis*, 17, 431-445.
- Dellachiesa, A., & Yu, T.H.E. (2009). The long-run impact of energy use, income and trade on carbon dioxide emissions in Mercosur member states: A panel co-integration analysis.
- Elder. (2003). An Impulse-Response Function for a Vector Autoregression with Multivariate GARCH-in-Mean. *Forthcoming Economics Letters*.
- Eviews 8. (2013). Eviews 8 user's guide 2. Retrieved from www.eviews.com

- Feng, C., Wang, H., Lu, N., Chen, T., He, H., Lu, Y., Tu & X. M., (2014). Log-transformation and its implications for data analysis. *Shanghai Archives of Psychiatry*, 26(2), 105-109.
- Giles, D. (2013). When is an autoregressive model dynamically stable? [Blog post]. Retrieved from <http://davegiles.blogspot.com/2013/06/when-is-autoregressive-model.html>
- Granger, C. W. J. (1969). Investigation Causal Relationship by Econometric Models and Cross-spectral Methods. *Econometrica*, 37(3), 424-438.
- Grossman G. & Krueger, A. (1995). Economic environment and the economic growth. *Quarterly Journal of Economics*, 110(2), 353–377.
- Guan, D., Peters, G. P., Christopher L. Weber, C. L. & Hubacek, K. (2009). Journey to world top emitter: An analysis of the driving forces of China's recent CO₂ emissions surge. *Geographical Research Letter*, 36(4).
- Gujarati, D. N., & Porter, D. C. (2009). Basic econometrics (5th ed). USA: McGraw- Hill. Boston, MA: McGraw-Hill/Irwin.
- Halicioglu F. (2009). An econometric study of CO₂ emissions, energy consumption, income and foreign trade in Turkey, *Energy Policy*, 37(3), 1156–1164.
- Hussain. (2014). Economic Growth, Exports and Imports in Pakistan: Granger Causality Analysis.
- Hye, Q. M. A., Shabaz, M., Tiwari, A. K. & Leita, N. C. (2013). Economic growth, energy consumption, financial development, international trade and CO₂ emissions in Indonesia, *Renewable and Sustainable Energy Reviews*, 25, 109-121.
- IPCC. (2007). Climate Change 2007: The Physical Science Basis. Geneva: Intergovernmental Panel on Climate Change.
- Johansen, S. & Juselius, K. (1990). Maximum likelihood estimation and inference on co-integration with applications to the demand for money. *Oxford bulletin of Economics and statistics*, 52(2), 0305-9049.
- Killian. (2001). Impulse Response analysis in Vector Autoregressions with unknown lag order. *Journal of Forecasting*, 20, 161-179.
- Kuo, C. K., Kanyasathaporn, P., Lai & S. L. (2014). The causal relationship between GDP, energy consumption and CO₂ emissions in Hong Kong. 46-47.
- Lastrapes. (2001). A Vector Error-Correction Forecasting Model of the U.S. Economy: Comment.

- Li, H., Li, B., & Lu, H. (2017). Carbon Dioxide Emissions, Economic Growth, and Selected Types of Fossil Energy Consumption in China: Empirical Evidence from 1965 to 2015. School of Economy and Management & North China Electric Power University.
- Lin, J. L. (2006). Teaching notes on impulse response function and structural VAR.
- Lind, D. A., Marchal, W. G., & Wathen, S. A. (2012). Statistical technique in business and economics (4th ed.). *New York: McGraw – Hill*.
- Lord, Ridgwell, Thorne & Lunt. (2016). An impulse response function for the “long tail” of excess atmospheric CO₂ in an Earth system model. *Global Biogeochemical Cycles*.
- Lutkepohl, H. (1991). Vector autoregressive models for multivariate time series.
- Lutkepohl, H., Saikkonen, P. & Trenkler, C. (2001). Maximum eigenvalue versus trace tests for the cointegrating rank of a VAR process. *The Econometrics Journal*, 4(2), 287-310.
- Maekawa & Setiawan. (2014). Estimation of Vector Error Correction Model with Garch Errors: Monte Carlo Simulation and Application.
- Magazzino, C. (2016). The relationship between real GDP, CO₂ emissions, and energy use in the GCC countries: A time series approach. *Cogent Economic & Finance*, 4(1).
- Magee, L. & Winter. (2013). Unit Roots, Co-integration, VARs and VECMs.
- Malaysia committed in reducing CO₂ emissions to curb global warming. (2016). Retrieved from <http://www.thesundaily.my/news/1732860>
- Masood, Butt, Ali, Bellalah, Teulone & Levyne. (2011). Sensitivity analysis of domestic credit to private sector in Pakistan: A variable replacement approach applied with con-integration. *International Journal of Business*, 16(3).
- Menyah, K. & Rufael, Y. W. (2010). Energy consumption, pollutant emissions and economic growth in South Africa. *Energy Economics*, 32(6), 1374-1382.
- Mitic, P., Ivanovic, O. M. & Zdravković, A. (2017). A co-integration analysis of real GDP and CO₂ emissions in transitional countries. *Sustainability*, 9(4), 568.
- Mohiuddin, O., Sarkodie, S. A., Obaidullah, M. & Dubey, S. (2016). The relationship between carbon dioxide emissions, energy consumption, and GDP: A recent evidence from Pakistan. *Cogent Engineering*, 3(1).

- Morancho, A. B., Tamarit, F. H., Zarzoso & I. M. (2001). Economic growth and CO₂ emissions in the European Union. *Environmental and Resources Economics*, 19(2), 165-172.
- M'sia re-pledges to achieve 45% CO₂ emission by 2030. (2016). Retrieved from <http://www.thesundaily.my/news/1775529>
- Muftaul, Iyoboyi & Ademola. (2014). An empirical analysis of the relationship between CO₂ emission and economic growth in West Africa. *American Journal of Economics*, 4(1), 1-17.
- Olowofeso, Adeleke & Udoji. (2015). Impact of private sector credit on economic growth in Nigeria. *CBN Journal of Applied Statistics*, 6(2).
- Opoku, Osei, E. E., Amoako, Samuel, Amankwa & Isaac. A. (2014). Trade openness, economic growth and the environment the case of Ghana. *Economics, Commerce and Management*, 2(8).
- Overview. (2017). Retrieved from <http://www.worldbank.org/en/country/malaysia/overview>
- Pao, H. T., Tsai & C. M. (2011). Multivariate granger causality between CO₂ emissions, energy consumption, FDI (foreign direct investment) and GDP (gross domestic product): Evidence from a panel of BRIC (Brazil, Russian Federation, India, and China) countries. *Energy*, 36(1), 685-693.
- Patel. (2012). The effect of Macroeconomic Determinants on the Performance of the Indian Stock Market.
- Pesaran, M. H., & Shin, Y. (1997). Generalized Impulse Response Analysis in Linear Multivariate Models.
- Phoon, K. Y., Bak K. M., Chong P. X., Ho L. P. & Teng, S. Y. (2016) Relationship between renewable energy, economic growth and carbon dioxide (CO₂) in Malaysia. Final Year Project, UTAR.
- Saboori, B., Sulaiman, J., & Mohd, S. (2012). Economic growth and CO₂ emissions in Malaysia: A co-integration analysis of the Environmental Kuznets Curve. *Energy Policy*, 51, 184-191.
- Saboori, Sulaiman & Mohd. (2012). Economic growth and CO₂ emissions in Malaysia: A co-integration analysis of the Environmental Kuznets Curve. *Energy Policy*, 51, 184-191.
- Saidi & Hammami. (2015). The effect of energy consumption and economic growth on CO₂ emissions: Evidence from 58 Countries. *Bulletin of Energy Economics (BEE)*, 3(3), 91-104.
- Saidi, K. & Hammami, S. (2015). The impact of CO₂ emissions and economic growth on energy consumption in 58 countries. *Energy Report*, 1, 62-70.

- Sato, M. (2013). Embodied carbon in trade: A survey of the empirical literature. *Economic Survey*, 28(5), 831-861.
- Shahbaz, M., Hye, Q. M. A. & Tiwari, A. K. (2013). Economic growth, energy consumption, financial development, international trade and CO₂ emissions in Indonesia. *Renewable and Sustainable Energy Reviews*, 25, 109-121.
- Shahbaz, M., Leitao & N. C. (2013). Portuguese Carbon Dioxide Emissions and Economic Growth: A Time Series Analysis.
- Shahbaz, M., Solarin, S. A., Mahmood, H. & Arouri, N. (2013). Does financial development reduce CO₂ emissions in Malaysian economy? A time series analysis. *Economic Modelling*, 35, 145-152.
- Shahbaz, M., Tiwari, A. K. & Nasir, M. (2013). The effects of financial development, economic growth, coal consumption and trade openness on CO₂ emissions in South Africa. *Energy Policy*, 61, 1452-1459.
- Sims (1980). Vector Auto Regression. Retrieved from http://www2.bc.edu/~iacoviel/teach/0809/EC751_files/var.pdf
- Solarin, S. A., Shabaz, M., Mahmood, H. & Arouri, M. (2013). Does financial development reduce CO₂ emissions in Malaysian economy? A time series analysis, *Economic Modelling*, 35, 145-152.
- Talukdar, D. (2001). Does the private sector help or hurt the environment? Evidence from carbon dioxide pollution in developing countries. *World Development* 29(5), 827-840.
- Tiwari, A. K., Shahbaz, M. & Nasir, M. (2013). The effects of financial development, economic growth, coal consumption and trade openness on CO₂ emissions in South Africa. *Energy Policy*, 61, 1452-1459.
- UNDP (n.d.). Sustainable development goals. Retrieved from <http://www.my.undp.org/content/malaysia/en/home/sustainable-development-goals.html>
- Watson. (1994). Vector Autoregressions and Co-integration. *Northwestern University and Federal Reserve Bank of Chicago*, 47.
- Wee, K. F. (2008). Energy Consumption and Carbon Dioxide Emission Considerations in the Urban Planning Process in Malaysia.
- Yusoff, M. (2008). Export, Education, and Growth in Malaysia.

Appendices

Appendix 1: Philips Perron Test

Carbon Dioxide (CO₂)

Level, Constant Without Trend

Null Hypothesis: LCO2 has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-1.134537	0.6901
Test critical values: 1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006929
HAC corrected variance (Bartlett kernel)	0.005868

Phillips-Perron Test Equation
Dependent Variable: D(LCO2)
Method: Least Squares
Date: 06/15/17 Time: 21:59
Sample (adjusted): 1981 2013
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCO2(-1)	-0.036843	0.032770	-1.124305	0.2695
C	0.095922	0.050449	1.901383	0.0666
R-squared	0.039179	Mean dependent var		0.041751
Adjusted R-squared	0.008184	S.D. dependent var		0.086239
S.E. of regression	0.085886	Akaike info criterion		-2.012906
Sum squared resid	0.228667	Schwarz criterion		-1.922209
Log likelihood	35.21295	Hannan-Quinn criter.		-1.982389
F-statistic	1.264062	Durbin-Watson stat		2.298858
Prob(F-statistic)	0.269514			

Level, Constant With Trend

Null Hypothesis: LCO2 has a unit root
Exogenous: Constant, Linear Trend

Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-1.729522	0.7152
Test critical values: 1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006501
HAC corrected variance (Bartlett kernel)	0.006892

Phillips-Perron Test Equation

Dependent Variable: D(LCO2)

Method: Least Squares

Date: 06/15/17 Time: 22:00

Sample (adjusted): 1981 2013

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCO2(-1)	-0.189700	0.113356	-1.673486	0.1046
C	0.190792	0.083761	2.277823	0.0300
@TREND("1980")	0.007640	0.005431	1.406647	0.1698
R-squared	0.098629	Mean dependent var	0.041751	
Adjusted R-squared	0.038537	S.D. dependent var	0.086239	
S.E. of regression	0.084561	Akaike info criterion	-2.016171	
Sum squared resid	0.214519	Schwarz criterion	-1.880125	
Log likelihood	36.26683	Hannan-Quinn criter.	-1.970396	
F-statistic	1.641312	Durbin-Watson stat	2.099637	
Prob(F-statistic)	0.210647			

First Difference, Constant Without Trend

Null Hypothesis: D(LCO2) has a unit root

Exogenous: Constant

Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-6.337365	0.0000
Test critical values: 1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.007244
HAC corrected variance (Bartlett kernel)	0.008088

Phillips-Perron Test Equation

Dependent Variable: D(LCO2,2)

Method: Least Squares

Date: 06/15/17 Time: 22:01

Sample (adjusted): 1982 2013

Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCO2(-1))	-1.149060	0.180363	-6.370823	0.0000
C	0.046946	0.017215	2.726965	0.0106
R-squared	0.574995	Mean dependent var	-0.000262	
Adjusted R-squared	0.560828	S.D. dependent var	0.132642	
S.E. of regression	0.087902	Akaike info criterion	-1.964727	
Sum squared resid	0.231803	Schwarz criterion	-1.873119	
Log likelihood	33.43563	Hannan-Quinn criter.	-1.934362	
F-statistic	40.58739	Durbin-Watson stat	1.920796	
Prob(F-statistic)	0.000000			

First Difference, Constant With Trend

Null Hypothesis: D(LCO2) has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-6.325296	0.0001
Test critical values: 1% level	-4.273277	
5% level	-3.557759	
10% level	-3.212361	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.007120
HAC corrected variance (Bartlett kernel)	0.007856

Phillips-Perron Test Equation

Dependent Variable: D(LCO2,2)

Method: Least Squares
Date: 06/15/17 Time: 22:02
Sample (adjusted): 1982 2013
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LCO2(-1))	-1.167305	0.183684	-6.354974	0.0000
C	0.068975	0.035574	1.938930	0.0623
@TREND("1980")	-0.001216	0.001714	-0.709475	0.4837
R-squared	0.582246	Mean dependent var	-0.000262	
Adjusted R-squared	0.553435	S.D. dependent var	0.132642	
S.E. of regression	0.088639	Akaike info criterion	-1.919435	
Sum squared resid	0.227848	Schwarz criterion	-1.782023	
Log likelihood	33.71096	Hannan-Quinn criter.	-1.873887	
F-statistic	20.20941	Durbin-Watson stat	1.914522	
Prob(F-statistic)	0.000003			

Domestic Credit to Private Sector (DCPS)

Level, Constant Without Trend

Null Hypothesis: LDCPS has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-2.683383	0.0876
Test critical values: 1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.011146
HAC corrected variance (Bartlett kernel)	0.011903

Phillips-Perron Test Equation
Dependent Variable: D(LDCPS)
Method: Least Squares
Date: 06/15/17 Time: 22:09
Sample (adjusted): 1981 2013
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
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LDCPS(-1)	-0.184293	0.068286	-2.698823	0.0112
C	0.876345	0.315443	2.778139	0.0092
R-squared	0.190255	Mean dependent var	0.026559	
Adjusted R-squared	0.164134	S.D. dependent var	0.119145	
S.E. of regression	0.108929	Akaike info criterion	-1.537541	
Sum squared resid	0.367834	Schwarz criterion	-1.446844	
Log likelihood	27.36943	Hannan-Quinn criter.	-1.507024	
F-statistic	7.283648	Durbin-Watson stat	1.851170	
Prob(F-statistic)	0.011162			

Level, Constant With Trend

Null Hypothesis: LDCPS has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-2.234090	0.4562
Test critical values: 1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.011127
HAC corrected variance (Bartlett kernel)	0.012226

Phillips-Perron Test Equation

Dependent Variable: D(LDCPS)

Method: Least Squares

Date: 06/15/17 Time: 22:09

Sample (adjusted): 1981 2013

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LDCPS(-1)	-0.197451	0.089649	-2.202501	0.0355
C	0.926724	0.387223	2.393256	0.0232
@TREND("1980")	0.000606	0.002614	0.231635	0.8184
R-squared	0.191700	Mean dependent var	0.026559	
Adjusted R-squared	0.137814	S.D. dependent var	0.119145	
S.E. of regression	0.110631	Akaike info criterion	-1.478722	
Sum squared resid	0.367178	Schwarz criterion	-1.342676	
Log likelihood	27.39891	Hannan-Quinn criter.	-1.432947	
F-statistic	3.557476	Durbin-Watson stat	1.830756	

Prob(F-statistic) 0.041076

First Difference, Constant Without Trend

Null Hypothesis: D(LDCPS) has a unit root

Exogenous: Constant

Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-5.118105	0.0002
Test critical values: 1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.013640
HAC corrected variance (Bartlett kernel)	0.012955

Phillips-Perron Test Equation

Dependent Variable: D(LDCPS,2)

Method: Least Squares

Date: 06/15/17 Time: 22:10

Sample (adjusted): 1982 2013

Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LDCPS(-1))	-0.918145	0.179071	-5.127257	0.0000
C	0.020707	0.021819	0.949031	0.3502
R-squared	0.467034	Mean dependent var	-0.003023	
Adjusted R-squared	0.449268	S.D. dependent var	0.162537	
S.E. of regression	0.120621	Akaike info criterion	-1.331872	
Sum squared resid	0.436480	Schwarz criterion	-1.240264	
Log likelihood	23.30996	Hannan-Quinn criter.	-1.301507	
F-statistic	26.28877	Durbin-Watson stat	1.991236	
Prob(F-statistic)	0.000016			

First Difference, Constant With Trend

Null Hypothesis: D(LDCPS) has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

Adj. t-Stat Prob.*

Phillips-Perron test statistic	-5.214477	0.0010
Test critical values: 1% level	-4.273277	
5% level	-3.557759	
10% level	-3.212361	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.013141
HAC corrected variance (Bartlett kernel)	0.011964

Phillips-Perron Test Equation
Dependent Variable: D(LDCPS,2)
Method: Least Squares
Date: 06/15/17 Time: 22:10
Sample (adjusted): 1982 2013
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LDCPS(-1))	-0.970650	0.185638	-5.228730	0.0000
C	0.066035	0.048372	1.365148	0.1827
@TREND("1980")	-0.002513	0.002394	-1.049495	0.3026

R-squared	0.486536	Mean dependent var	-0.003023
Adjusted R-squared	0.451124	S.D. dependent var	0.162537
S.E. of regression	0.120417	Akaike info criterion	-1.306650
Sum squared resid	0.420508	Schwarz criterion	-1.169237
Log likelihood	23.90639	Hannan-Quinn criter.	-1.261101
F-statistic	13.73955	Durbin-Watson stat	1.981720
Prob(F-statistic)	0.000063		

Trade

Level, Constant Without Trend

Null Hypothesis: LTRADE has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-1.372499	0.5836
Test critical values: 1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.004359
HAC corrected variance (Bartlett kernel)	0.005813

Phillips-Perron Test Equation
Dependent Variable: D(LTRADE)
Method: Least Squares
Date: 06/15/17 Time: 22:24
Sample (adjusted): 1981 2013
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTRADE(-1)	-0.061289	0.045696	-1.341212	0.1896
C	0.311269	0.225061	1.383039	0.1765
R-squared	0.054845	Mean dependent var		0.009833
Adjusted R-squared	0.024356	S.D. dependent var		0.068967
S.E. of regression	0.068122	Akaike info criterion		-2.476331
Sum squared resid	0.143860	Schwarz criterion		-2.385634
Log likelihood	42.85946	Hannan-Quinn criter.		-2.445814
F-statistic	1.798850	Durbin-Watson stat		1.297532
Prob(F-statistic)	0.189596			

Level, Constant With Trend

Null Hypothesis: LTRADE has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-0.380948	0.9842
Test critical values:		
1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.004230
HAC corrected variance (Bartlett kernel)	0.005197

Phillips-Perron Test Equation
Dependent Variable: D(LTRADE)

Method: Least Squares
Date: 06/15/17 Time: 22:25
Sample (adjusted): 1981 2013
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTRADE(-1)	-0.012028	0.068781	-0.174873	0.8624
C	0.099558	0.315428	0.315627	0.7545
@TREND("1980")	-0.001798	0.001875	-0.959239	0.3451
R-squared	0.082971	Mean dependent var	0.009833	
Adjusted R-squared	0.021836	S.D. dependent var	0.068967	
S.E. of regression	0.068210	Akaike info criterion	-2.445936	
Sum squared resid	0.139579	Schwarz criterion	-2.309889	
Log likelihood	43.35794	Hannan-Quinn criter.	-2.400160	
F-statistic	1.357178	Durbin-Watson stat	1.405599	
Prob(F-statistic)	0.272737			

First Difference, Constant Without Trend

Null Hypothesis: D(LTRADE) has a unit root
Exogenous: Constant
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-3.914544	0.0052
Test critical values:		
1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.004129
HAC corrected variance (Bartlett kernel)	0.004355

Phillips-Perron Test Equation
Dependent Variable: D(LTRADE,2)
Method: Least Squares
Date: 06/15/17 Time: 22:26
Sample (adjusted): 1982 2013
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LTRADE(-1))	-0.659720	0.170209	-3.875932	0.0005
C	0.007876	0.011861	0.663995	0.5118

R-squared	0.333672	Mean dependent var	0.001109
Adjusted R-squared	0.311461	S.D. dependent var	0.079978
S.E. of regression	0.066364	Akaike info criterion	-2.526861
Sum squared resid	0.132126	Schwarz criterion	-2.435253
Log likelihood	42.42978	Hannan-Quinn criter.	-2.496496
F-statistic	15.02285	Durbin-Watson stat	1.918161
Prob(F-statistic)	0.000536		

First Difference, Constant With Trend

Null Hypothesis: D(LTRADE) has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 25 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.029243	0.0015
Test critical values:	1% level	-4.273277	
	5% level	-3.557759	
	10% level	-3.212361	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.003827
HAC corrected variance (Bartlett kernel)	0.000600

Phillips-Perron Test Equation

Dependent Variable: D(LTRADE,2)

Method: Least Squares

Date: 06/15/17 Time: 22:26

Sample (adjusted): 1982 2013

Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LTRADE(-1))	-0.735923	0.174100	-4.227024	0.0002
C	0.043082	0.025998	1.657111	0.1083
@TREND("1980")	-0.001967	0.001300	-1.513597	0.1410

R-squared	0.382457	Mean dependent var	0.001109
Adjusted R-squared	0.339868	S.D. dependent var	0.079978
S.E. of regression	0.064981	Akaike info criterion	-2.540395
Sum squared resid	0.122452	Schwarz criterion	-2.402983
Log likelihood	43.64632	Hannan-Quinn criter.	-2.494847
F-statistic	8.980147	Durbin-Watson stat	1.937656
Prob(F-statistic)	0.000922		

Gross Domestic Product (GDP)

Level, Constant Without Trend

Null Hypothesis: LGDP has a unit root

Exogenous: Constant

Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-0.594293	0.8586
Test critical values: 1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001392
HAC corrected variance (Bartlett kernel)	0.001595

Phillips-Perron Test Equation

Dependent Variable: D(LGDP)

Method: Least Squares

Date: 06/15/17 Time: 22:19

Sample (adjusted): 1981 2013

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.011501	0.019470	-0.590738	0.5590
C	0.133344	0.168801	0.789948	0.4356
R-squared	0.011132	Mean dependent var		0.033705
Adjusted R-squared	-0.020767	S.D. dependent var		0.038094
S.E. of regression	0.038488	Akaike info criterion		-3.618258
Sum squared resid	0.045921	Schwarz criterion		-3.527561
Log likelihood	61.70126	Hannan-Quinn criter.		-3.587741
F-statistic	0.348972	Durbin-Watson stat		1.707570
Prob(F-statistic)	0.558979			

Level, Constant With Trend

Null Hypothesis: LGDP has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

Adj. t-Stat	Prob.*
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Phillips-Perron test statistic	-1.918119	0.6226
Test critical values: 1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001276
HAC corrected variance (Bartlett kernel)	0.001570

Phillips-Perron Test Equation
Dependent Variable: D(LGDP)
Method: Least Squares
Date: 06/15/17 Time: 22:19
Sample (adjusted): 1981 2013
Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGDP(-1)	-0.190558	0.110270	-1.728107	0.0943
C	1.572869	0.888645	1.769963	0.0869
@TREND("1980")	0.006569	0.003985	1.648331	0.1097
R-squared	0.093253	Mean dependent var		0.033705
Adjusted R-squared	0.032803	S.D. dependent var		0.038094
S.E. of regression	0.037464	Akaike info criterion		-3.644350
Sum squared resid	0.042107	Schwarz criterion		-3.508303
Log likelihood	63.13177	Hannan-Quinn criter.		-3.598574
F-statistic	1.542648	Durbin-Watson stat		1.564707
Prob(F-statistic)	0.230300			

First Difference, Constant Without Trend

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-4.736395	0.0006
Test critical values: 1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001418
HAC corrected variance (Bartlett kernel)	0.001418

Phillips-Perron Test Equation
 Dependent Variable: D(LGDP,2)
 Method: Least Squares
 Date: 06/15/17 Time: 22:19
 Sample (adjusted): 1982 2013
 Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.854954	0.180507	-4.736395	0.0000
C	0.028532	0.009192	3.103890	0.0041

R-squared	0.427846	Mean dependent var	-0.000365
Adjusted R-squared	0.408774	S.D. dependent var	0.050584
S.E. of regression	0.038894	Akaike info criterion	-3.595475
Sum squared resid	0.045383	Schwarz criterion	-3.503866
Log likelihood	59.52760	Hannan-Quinn criter.	-3.565109
F-statistic	22.43343	Durbin-Watson stat	1.943295
Prob(F-statistic)	0.000049		

First Difference, Constant With Trend

Null Hypothesis: D(LGDP) has a unit root
 Exogenous: Constant, Linear Trend
 Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-4.664162	0.0039
Test critical values:		
1% level	-4.273277	
5% level	-3.557759	
10% level	-3.212361	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.001416
HAC corrected variance (Bartlett kernel)	0.001416

Phillips-Perron Test Equation
 Dependent Variable: D(LGDP,2)
 Method: Least Squares
 Date: 06/15/17 Time: 22:20
 Sample (adjusted): 1982 2013

Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGDP(-1))	-0.856910	0.183722	-4.664162	0.0001
C	0.031268	0.016493	1.895757	0.0680
@TREND("1980")	-0.000153	0.000758	-0.201288	0.8419
R-squared	0.428644	Mean dependent var	-0.000365	
Adjusted R-squared	0.389240	S.D. dependent var	0.050584	
S.E. of regression	0.039532	Akaike info criterion	-3.534371	
Sum squared resid	0.045320	Schwarz criterion	-3.396958	
Log likelihood	59.54993	Hannan-Quinn criter.	-3.488822	
F-statistic	10.87823	Durbin-Watson stat	1.942862	
Prob(F-statistic)	0.000299			

Energy

Level, Constant Without Trend

Null Hypothesis: LENERGY has a unit root

Exogenous: Constant

Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-1.052378	0.7224
Test critical values: 1% level	-3.646342	
5% level	-2.954021	
10% level	-2.615817	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.002933
HAC corrected variance (Bartlett kernel)	0.001379

Phillips-Perron Test Equation

Dependent Variable: D(LENERGY)

Method: Least Squares

Date: 06/15/17 Time: 22:13

Sample (adjusted): 1981 2013

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LENERGY(-1)	-0.023282	0.024955	-0.932980	0.3580
C	0.210541	0.185608	1.134334	0.2654

R-squared	0.027312	Mean dependent var	0.037611
Adjusted R-squared	-0.004065	S.D. dependent var	0.055765
S.E. of regression	0.055878	Akaike info criterion	-2.872589
Sum squared resid	0.096794	Schwarz criterion	-2.781892
Log likelihood	49.39772	Hannan-Quinn criter.	-2.842072
F-statistic	0.870451	Durbin-Watson stat	2.203947
Prob(F-statistic)	0.358041		

Level, Constant With Trend

Null Hypothesis: LENERGY has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-1.998131	0.5809
Test critical values: 1% level	-4.262735	
5% level	-3.552973	
10% level	-3.209642	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.002638
HAC corrected variance (Bartlett kernel)	0.002678

Phillips-Perron Test Equation

Dependent Variable: D(LENERGY)

Method: Least Squares

Date: 06/15/17 Time: 22:13

Sample (adjusted): 1981 2013

Included observations: 33 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LENERGY(-1)	-0.252699	0.127441	-1.982874	0.0566
C	1.751964	0.859691	2.037900	0.0505
@TREND("1980")	0.009563	0.005217	1.833137	0.0767

R-squared	0.125291	Mean dependent var	0.037611
Adjusted R-squared	0.066977	S.D. dependent var	0.055765
S.E. of regression	0.053865	Akaike info criterion	-2.918155
Sum squared resid	0.087044	Schwarz criterion	-2.782109
Log likelihood	51.14955	Hannan-Quinn criter.	-2.872379
F-statistic	2.148560	Durbin-Watson stat	1.954867
Prob(F-statistic)	0.134262		

First Difference, Constant Without Trend

Null Hypothesis: D(LENERGY) has a unit root

Exogenous: Constant

Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-6.200191	0.0000
Test critical values: 1% level	-3.653730	
5% level	-2.957110	
10% level	-2.617434	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.003065
HAC corrected variance (Bartlett kernel)	0.002174

Phillips-Perron Test Equation

Dependent Variable: D(LENERGY,2)

Method: Least Squares

Date: 06/15/17 Time: 22:14

Sample (adjusted): 1982 2013

Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LENERGY(-1))	-1.122952	0.185404	-6.056790	0.0000
C	0.041933	0.012068	3.474620	0.0016
R-squared	0.550122	Mean dependent var		0.001992
Adjusted R-squared	0.535126	S.D. dependent var		0.083858
S.E. of regression	0.057176	Akaike info criterion		-2.824918
Sum squared resid	0.098071	Schwarz criterion		-2.733310
Log likelihood	47.19869	Hannan-Quinn criter.		-2.794553
F-statistic	36.68471	Durbin-Watson stat		1.989968
Prob(F-statistic)	0.000001			

First Difference, Constant With Trend

Null Hypothesis: D(LENERGY) has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-6.404050	0.0000

Test critical values:	1% level	-4.273277
	5% level	-3.557759
	10% level	-3.212361

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.003012
HAC corrected variance (Bartlett kernel)	0.001627

Phillips-Perron Test Equation

Dependent Variable: D(LENERGY,2)

Method: Least Squares

Date: 06/15/17 Time: 22:14

Sample (adjusted): 1982 2013

Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LENERGY(-1))	-1.146917	0.189972	-6.037289	0.0000
C	0.056730	0.024123	2.351703	0.0257
@TREND("1980")	-0.000797	0.001122	-0.710452	0.4831

R-squared	0.557818	Mean dependent var	0.001992
Adjusted R-squared	0.527323	S.D. dependent var	0.083858
S.E. of regression	0.057653	Akaike info criterion	-2.779673
Sum squared resid	0.096394	Schwarz criterion	-2.642261
Log likelihood	47.47477	Hannan-Quinn criter.	-2.734125
F-statistic	18.29192	Durbin-Watson stat	1.992689
Prob(F-statistic)	0.000007		
