# OIL PRICE AND INFLATION: WHAT'S OLD, WHAT'S NEW?

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A research project submitted in partial fulfilment of the requirement for the degree of

BACHELOR OF BUSINESS ADMINISTRATION
(HONS) BANKING AND FINANCE

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF BUSINESS AND FINANCE
DEPARTMENT OF FINANCE

AUGUST 2018

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We hereby declare that:

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(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.
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## ACKNOWLEDGEMENT

First and foremost, we would like to take this opportunity to express our deepest appreciation and gratitude to our project's supervisor, Dr. Wong Chin Yoong, who was abundantly helpful and offered invaluable assistance, support and guidance, as well as inspires us by sharing his precious expertise and knowledge in order to enhance the research report quality. His patience and willingness to motivate us contributed tremendously to our project. Besides, we would like to extend our sincere gratitude to our project coordinator, Mr. Ahmad Harith Ashrofie bin Hanafi for coordinating everything pertaining to be completion undergraduate project and keeping us updated with the latest information.

On the other hand, we would like to thank the authorities of Universiti Tunku Abdul Rahman (UTAR) in providing the good facilities and study environment throughout the completion of this project. We truly appreciate with the online library system that UTAR has subscribed for the students. Indeed, it is so much convenient when accessing to the data and retrieving the favourable journals.

Furthermore, we would like to express our gratitude to all the lecturers and tutors who has been educating us during our university years as well as providing us with valuable information as guidance in our study. Finally, an honourable mention goes to our friends and family members for their understanding throughout the course of this study.

## TABLE OF CONTENTS

Page

Copyright Page …… ii

Declaration …… iii

Acknowledgement …… iv

Table of Contents …… v

List of Tables …… ix

List of Figures …… x

List of Abbreviations …… xi

List of Appendices …… xii

Abstract …… xiii

CHAPTER 1 RESEARCH OVERVIEW……

1.0 Introduction …… 1

1.1 Research Background …… 1

1.1.1 Evolution of Oil Price …… 1

1.1.2 Relationship between Oil Price and Inflation …… 3

1.1.3 Will the Relationship Last for Future? …… 4

1.2 Problem Statement …… 13

1.3 Research Objectives …… 14

1.4 Research Questions …… 14

1.5 Hypotheses of the Study ……. 14

1.6 Significance of Study ……..…… 15

1.7 Chapter Layout …… 15

CHAPTER 2 LITERATURE REVIEW ……

2.0 Introduction …… 16

2.1 Direct and Indirect Relationship between Oil Price and Inflation …… 16

2.2 Changing Inflationary Effect of Oil Price Overtime …… 20

2.3 The Effects of Oil Dependency Level ……..... 21

2.4 Does Policy Affect Oil Price Shock? ……..…… 22

2.5 Research Gaps …….…… 24

2.6 Chapter Layout …….…… 25

CHAPTER 3 METHODOLOGY ……..…

3.0 Introduction …… 26

3.1 Theoretical Model ……....… 26

3.2 Empirical Model ……..… 27

3.2.1 Baseline Model ……...…… 28

3.2.2 Proxy for Oil Price ……..…… 29

3.2.3 Investigating the Role of Corruption and Renewable Source …… 29

3.2.4 Investigating the Interaction between Oil Prices, Corruption and Renewable Sources…… 30

3.2.5 Investigating the Effects of Developed and Developing Countries …… 31

3.3 Panel Data Models…… 32

3.3.1 Pooled Ordinary Least Square Model …… 33

3.3.2 Fixed Effects Model …… 33

3.3.3 Random Effects Model ……33

3.3.4 Model Comparison ……..… 34

3.4 Data……...… 34

3.4.1 Sources of Data ……..…… 34

3.4.2 Countries …… 35

3.5 Model Discussion ……..……..…… 37

3.5.1 Inflation…….…… 38

3.5.2 Oil Price…….…… 38

3.5.3 Broad Money Growth…….…… 38

3.5.4 Output Growth…… 39

3.5.5 Financial Development…….……39

3.5.6 Trade Openness…… 40

3.5.7 Corruption Perception Index…….…… 40

3.5.8 Renewable Sources…… 41

3.6 Chapter Layout …… 41

CHAPTER 4 DATA ANALYSIS ……

4.0 Introduction …… 42

4.1 Descriptive Analysis ……42

4.2 Basic Model Analysis ……45

4.3 The Best Crude Oil ……48

4.4 Role of Corruption and Renewable Source Variable ……50

4.5 Interactive of Corruption and Renewable Source Variable ……52

4.6 Role of Level of Development …… 54

4.7 Chapter Layout …… 56

CHAPTER 5 DISCUSSION, IMPLICATION, CONCLUSION ……

5.0 Introduction …… 57

5.1 Major Findings…… 57

5.2 Implications of the Study…… 59

5.3 Limitations of the Study ……59

5.4 Recommendations …… 60

5.5 Conclusion …… 61

REFENRENCES…… 62

APPENDICES…… 68

## LIST OF TABLES


| | | Page |
|---|---|---|
| Table 1.1 | Correlation between oil price inflation and CPI inflation | 12 |
| Table 3.1 | Sources of Data | 35 |
| Table 3.2 | Developed and Undeveloped Countries | 36 |
| Table 4.1 | Descriptive Analysis from Year 1981 to Year 2014 | 43 |
| Table 4.2 | Basic Model Table | 46 |
| Table 4.3 | Comparison between WTI and Brent | 49 |
| Table 4.4 | Corruption and Renewable Source Included to Basic Model | 50 |
| Table 4.5 | Interaction between oil price with Corruption and Renewable Source | 52 |
| Table 4.6 | Role of Level of Development | 54 |

## LIST OF FIGURES


| | | Page |
|---|---|---|
| Figure 1.1: | Fluctuation of Crude Oil Prices (WTI) – Dollars Per Barrel, Monthly 1981M1 – 2017M12 | 2 |
| Figure 1.2: | Relationship between Oil Price Inflation and World CPI Inflation, 1987-2014. | 4 |
| Figure 1.3: | Trends of oil price inflation and CPI inflation, 1987-2014. | 7 |
| Figure 3.1: | Variables | 37 |

## LIST OF ABBREVIATIONS

| | |
|---|---|
| BRENT | Brent Spot Price |
| CP | Corruption Perception Index |
| CPI | Consumer Price Index |
| EIA | U.S. Energy Information Administration |
| FEM | Fixed Effects Model |
| GDP | Gross Domestic Product |
| INF | Inflation |
| LP | Labour Productivity |
| M2GDP | M2 over GDP |
| MARCAP | Market Capitalization over GDP |
| MG | Money Growth |
| OECD | The Organisation for Economic Co-operation and Development |
| OP | Oil Price |
| POLS | Pooled Ordinary Least Square Model |
| REM | Random Effects Model |
| RS | Renewable Source |
| TO | Trade Openness |
| WTI | West Texas Intermediate Spot Price |

## LIST OF APPENDICES


| | | Page |
|---|---|---|
| Appendix A: | Basic Model | 68 |
| Appendix B: | Model Comparison | 71 |
| Appendix C: | Comparison between WTI and BRENT | 73 |
| Appendix D: | Investigate Role of Corruption and Renewable Source | 75 |
| Appendix E: | Investigate Interactive between Crude Oil with Corruption and Renewable Source | 78 |
| Appendix F: | Investigate the Role of Level of Development | 80 |

## ABSTRACT

This research seeks to investigate the impact of oil price on inflation over the period of year 1986 to 2014. It also studies whether corruption perception index affects inflation larger than oil prices and whether renewable source will be a 'replacement' of oil price in inflation. Panel data model has been chosen as estimator to determine which model the most suitable by using Poolability test, Breusch and Pagan Lagrange Multiplier test, and Hausman test. The level of development added as a dummy variable to observe the relationship between oil price and inflation. The main result of impact of oil price on inflation is found to have a positive significant relationship. Besides, the result of the analysis shows that the corruption is insignificant after added the oil price as variable. It is proven that renewable sources and oil price have negative significant relationship.

# CHAPTER 1: RESEARCH OVERVIEW

## 1.0 Introduction

Over the years, inflation has long been studied by many researches. It always happened to be unpredictable as quoted by *Milton Friedman*, "Inflation is always and everywhere a monetary phenomenon." The main impact of inflation is the changes in oil price. Oil serves as the major energy in our daily lives – it is used in the form of gasoline and jet fuels for the fuelling transportation of automobiles and air transport as well as for the heating homes. Fluctuation in the changing in oil prices may lead to unstable economy, hence will affect the economic performance in overall (Sek, Teo and Wong, 2015; Salisu et al., 2017; Sek, 2017). Throughout the chapter, our motives are to put an insight on the relationship between oil price and inflation, the potential causes that break in the relationship with the aids of graphs and tables to perform clearer and understandable picture. Last but not least, this chapter is divided by few parts which namely the research background, followed by problem statement, research objective, research question, significance of the study and chapter layout.

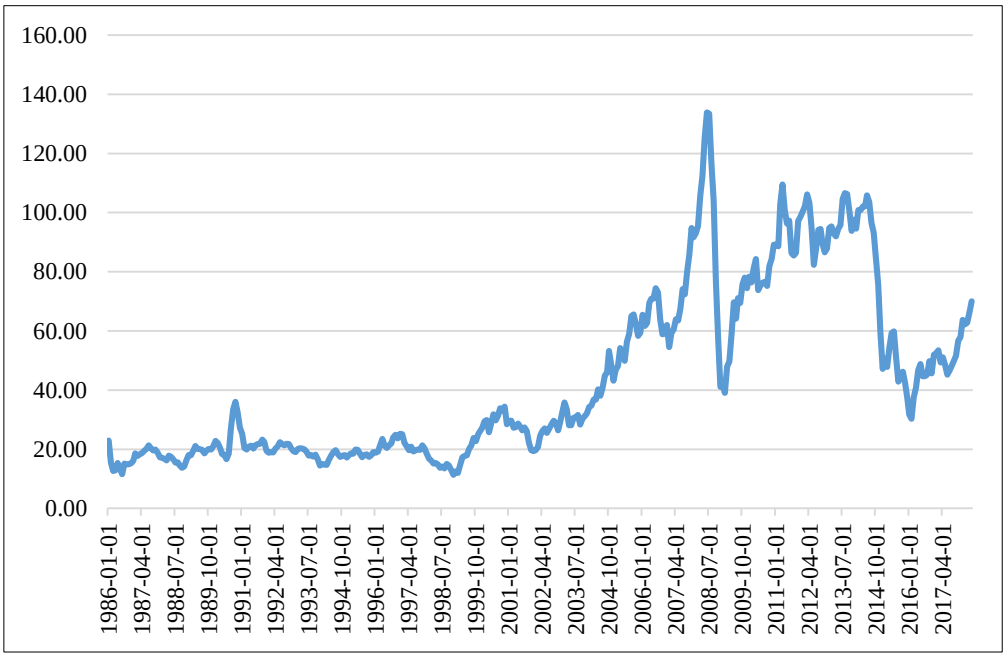
## 1.1 Research Background

### 1.1.1 Evolution of oil prices

Oil played a significant role in the economic downturns. The cycle of the oil prices behaved based on the supply and demand of oil production. The forecast of global oil demand in the domestic and international market are growing with the level of 880,000 barrel per day. Figure 1.1 shows the fluctuations in global crude oil prices from the year 1986 to 2018. Prior to 1980, oil price has a downward trend as the eight years' war between Iraq and Iran lead to the dropped in world production. Falling in the oil demand cause serious loss in revenue which is

coincided with the beginning of Great Moderation[1]. Next, with the arrival of the Iranian Revolution and the unrest in Venezuela as well as Persian Gulf crisis[2], a sudden sharp increase in 1990s. The expansion in price is nearly doubling the levels and expectations. The oil price reached $40 from $20 per barrel. In the 2000s, the oil price rose in a steady manner until it reached the peak of $132.55 per barrel in the year 2008. Following the year, it experienced a large drop in value to $40 per barrel. The major factor is due to the over-whelming demand from the Asian countries yet shortage of the supply of oil which lead to the increase in oil price. However, very soon oil price rebound again. Between the year of 2008 and 2009, there is a quick fluctuate caused by the Global Financial crisis where the world's financial system started to collapse. From 2014 to 2016, oil price experienced a sharp decline due to the work extracting by countries such as U.S, Canada, and Saudi Arabia where they cut down their import of oil.

Figure 1.1 Fluctuation of crude oil prices (WTI) – Dollars per Barrel, Monthly, 1986M1-2017M12.




Source: Fred Economic Data

[1] The significant decline in macroeconomic volatility that began in the mid-1980s. Decline in volatility both in real GDP growth and in inflation.

### 1.1.2 Relationship between oil prices and inflation

According to the previous studies, the results are shown that oil price acts as a connected cause and effect relationship with inflation. As increase or decrease in oil prices, the trend of inflation will follow the direction (Apere, 2017; Mallik and Chowdhury, 2011; Lee, n.d.). For instance, when oil plays the role of intermediate product, increase in oil price will then cause the transportation fees to gain, hence cost of the end outputs will increase. There are a lot of oil exporting countries such as Nigeria and Malaysia that dependent on the oil price as their major income. Therefore, the fluctuation in oil price may cause the revenue of the countries to be increased and decreased since oil price and inflation has the direct relationship between each other. Figure 1.2 shows that the relationship between oil price inflation and world inflation CPI in the period of 1987 to 2014.

As reviewed from the relationship graph shown between oil price and inflation, we realized that inflation does not co-move with oil price all the time. This may be different with what the previous researchers believe in: oil price has a direct relationship with the inflation. For instance, in the year 1999, oil price increased, world inflation decreased as well as in 2001 and 2011 the relationship happened to be not correlated. Since then, we can observe that the co-movement is stronger from the year 2007 to 2010. When the oil price runs up a bit, the world inflation will increase to a great extent. Thus, in this research, we wish to reveal that what factors that cause inflation fluctuates largely together with oil price, whether it is due to the volatility of oil price? Also, what factors that inflation rate do not co-move with the volatility of oil prices.

[2] The crisis, in particular the period of higher oil prices, has adversely affected world growth and hence growth in developing countries.

Figure 1.2 Relationship between OPINF and world CPIINF, 1987-2014.


Sources: Fred Economic Data, World Bank

### 1.1.3 Will the relationship last in the future?

To provide a further insight for the positive correlated relationship between oil price inflation and consumer price index (CPI), it can be judged in Figure 1.3. Keeping in mind that oil price inflation fluctuates in the path of CPI, more detailed of modelling of other possible factors might provide important perceptions and add precision in the future. We divided the countries into developed, non-developed, and countries from non-developed turned into developed from 1987 to 2014. This is to determine whether level of development will affect the relationship between oil price inflation and CPI over the time. Meanwhile, we propose Table 1.1 in order to provide clearer picture of the relationship by viewing at the changes of co-movement between oil price inflation and CPI.

Based on the developed countries, oil price inflation co-moved with CPI in a weaker manner at the beginning but the relationship gradually grew stronger afterwards which can be seen in Figure 1.3. Compared to Switzerland, United States follows the same trend which is slight co-movement between oil price inflation and

CPI, however after 2000s, the relationship seems to be tighten together. As it is shown that a tiny decrease in oil price inflation causes the CPI to fall greater. For Switzerland, oil price inflation poses a significant relationship with CPI after 2007s. Besides, the relationship between oil price inflation and CPI in Australia does not exist as there is only 0.0010 differences before and after 2000s. Rather, there is a split-off relationship during the year 2000 to 2005 due to the implementation of Government Service Tax (GST). It causes the oil prices to appreciate sharply whereas the inflation remain low (Morris, 2013). Moreover, since feed-in tariff system was introduced in Japan to enhance the usage of renewable sources like solar power, electric, and nuclear, the movement of CPI had less controlled by the volatility of oil price inflation. Oil price was not the major influencer of CPI as shown from 1999 to 2005. However, since 2007s onwards, CPI poses a great fluctuation with oil price inflation. (JFS Japan for Sustainability, 2017; The Japan Times, 2018).

On the other hand, Norway and Denmark violate the conventional relationship which oil price inflation always moved along with the CPI whether appreciate or depreciate. Despite both countries showed the positive relationship between oil price inflation and CPI, yet they sometimes split-off like when oil price inflation increases, CPI decreases. It might be due to the less corrupted issues in Norway, as we can revised in (Larsen, 2001), the neat and progressive implementation of policies as well as the habits of sharing wealth in the country drive the economy to be well-performed. Therefore, when the oil prices inflation increase or decrease, it doesn't affect the CPI inflation which stated in Table 1.1.

The pattern of developing countries such as Malaysia, China, Brazil and Jamaica is nearly similar. They have direct positive relationship however oil price inflation does not co-move with CPI all the time. Nevertheless, it does not match with the traditional view that stated CPI always follows the movement of oil price inflation. It has few periods that both variables do not co-move together. As illustrated in Malaysia, between 1996 to 2001 oil price inflation and CPI fluctuates in vary direction. After 2007s, the motion of CPI fluctuates greater that oil price inflation. It might be caused by the removal of fuel subsidy by the government of

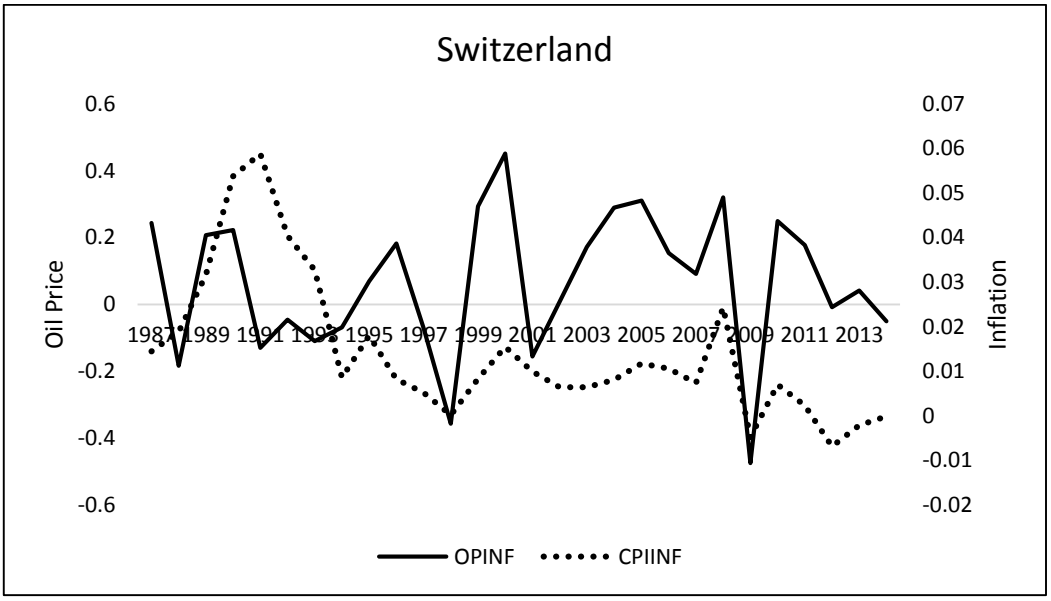
Malaysia or other possible factors (Hakim, Ismail and Razak, 2016). Before 1995s, China is mainly dependant on oil as their fuelling transportation and industrial sector due to their large population. Hence, CPI is affected extremely due to the volatility of oil price inflation. In 2009, the consumption of oil has fallen dramatically from 64% to 37%. Government of China encourages conservation by carrying out more research and development to reduce the reliant upon oil. (Leung, Li and Low, 2018).

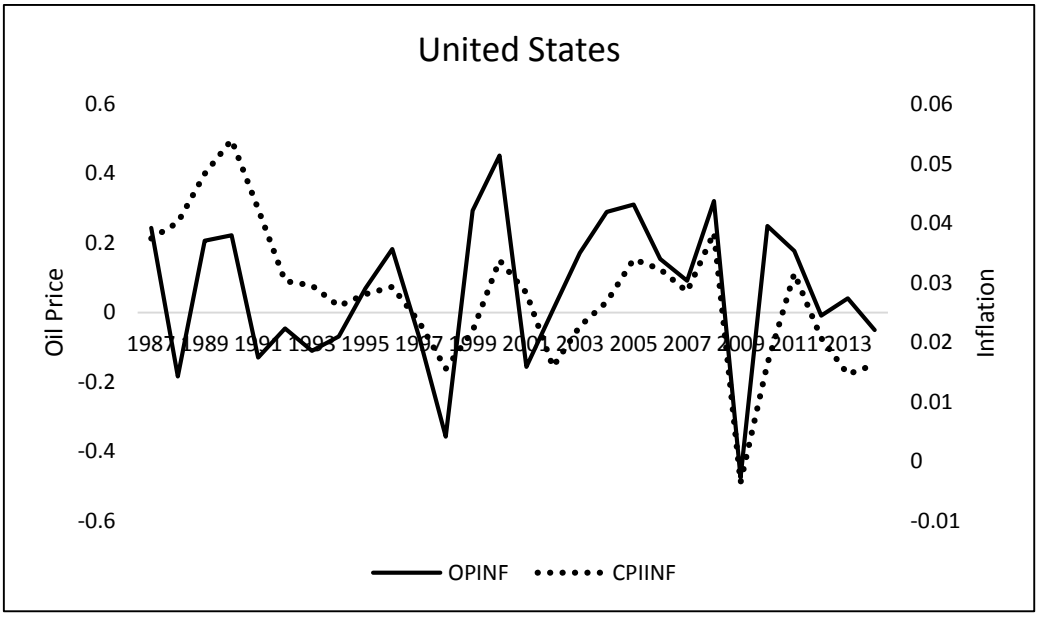
Regarding to Central African Republic which is the oil importing country, it has the opposite CPI-oil price inflation result. Figure 1.3 shows the relationship has gone weaker after 2000s compared to other non-developed countries. CPI does not co-move in the trend which oil price inflation poses. This phenomenon is the reason as we keen to study why CPI is no longer move in the way of oil price inflation either is due to the availability of renewable source or the influence of corruption index.

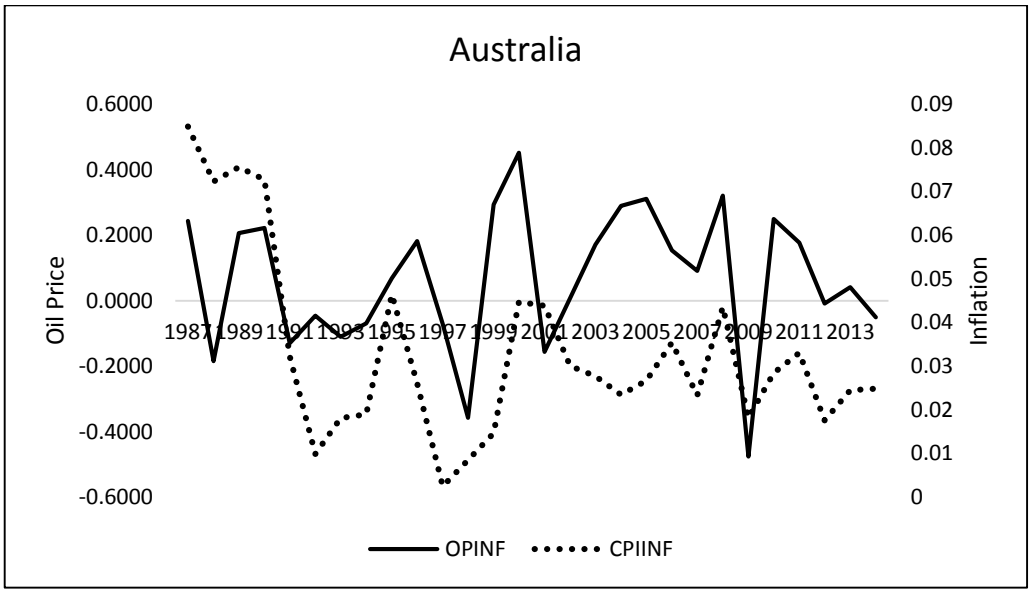
From the outlook of developing countries turned into developed, they share mostly equal pattern of forming the relationship from negative to positive. CPI and oil price inflation co-move gradually close to each other. Equatorial Guinea, Singapore, Russian Federation, United Kingdom and Turkey are the examples of this scenario. For Equatorial Guinea, CPI inflation does not fluctuates largely with oil price as we can see in Figure 1.3. It does sometimes co-move with oil price but not largely affected. When the oil price depreciated, CPI inflation was just fallen a little bit such as the year from 2009 to 2011. Meanwhile, Singapore displayed the similar trend with Japan. In the case of Russian Federation, it could be classified into two scenarios which firstly oil price inflation did not move prior to CPI, yet it was proven that under the second scenario, oil price inflation and CPI moved tightly with each other. Indeed, oil price has been one of the considerable importance factors that influencing the economy (Benedictow, Fjærtoft and Løfsnæs, 2013).

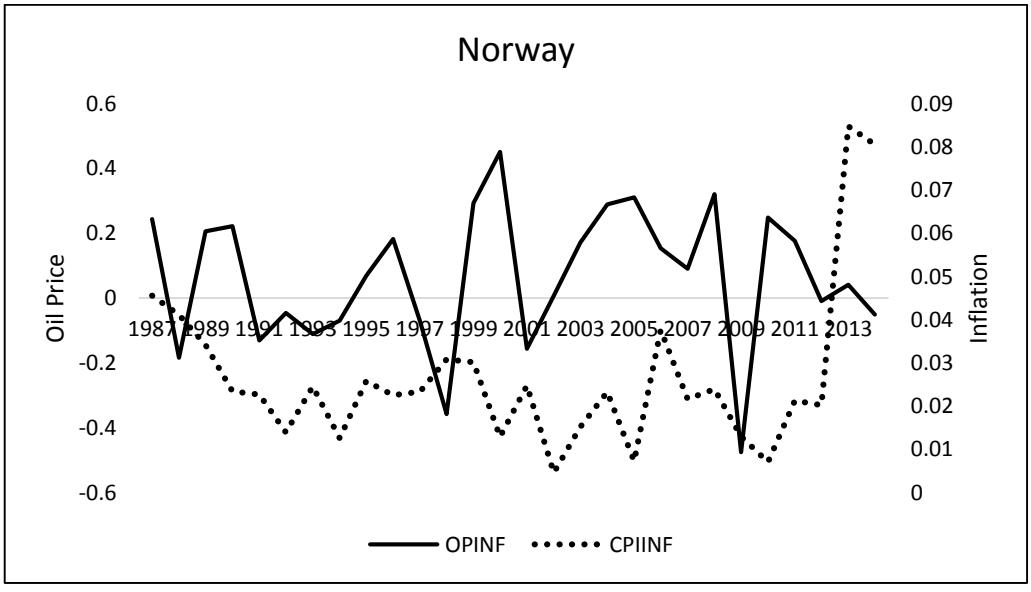
Figure 1.3 Trends of oil price inflation and CPI inflation, 1987-2014.

**(1) Developed countries**

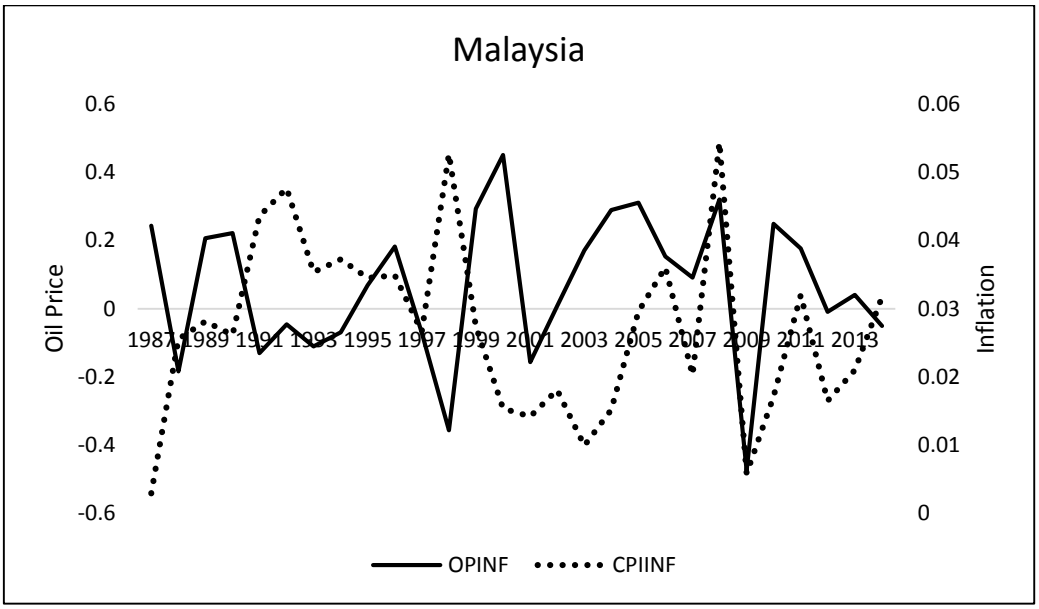


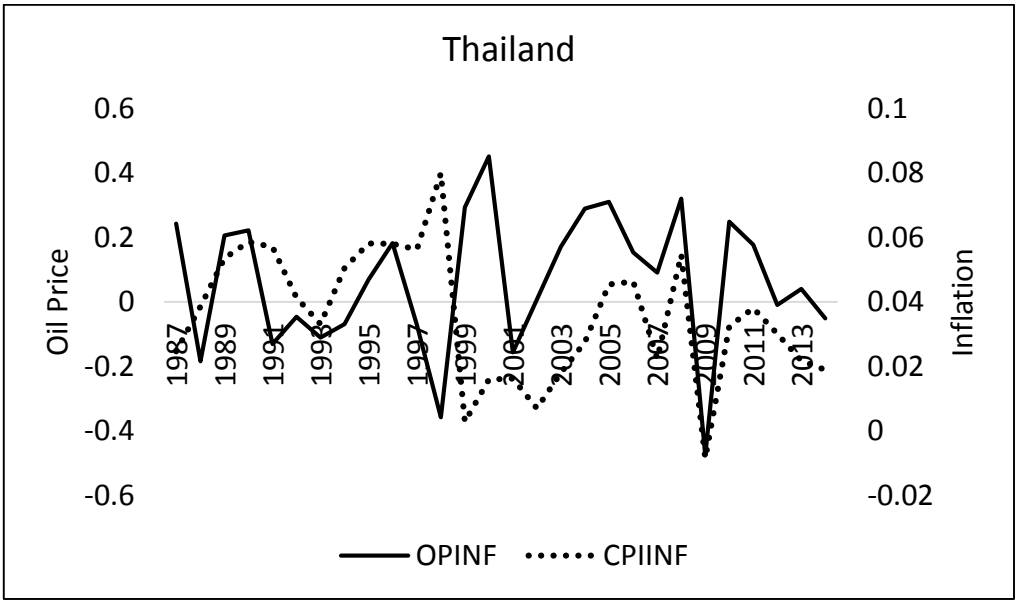



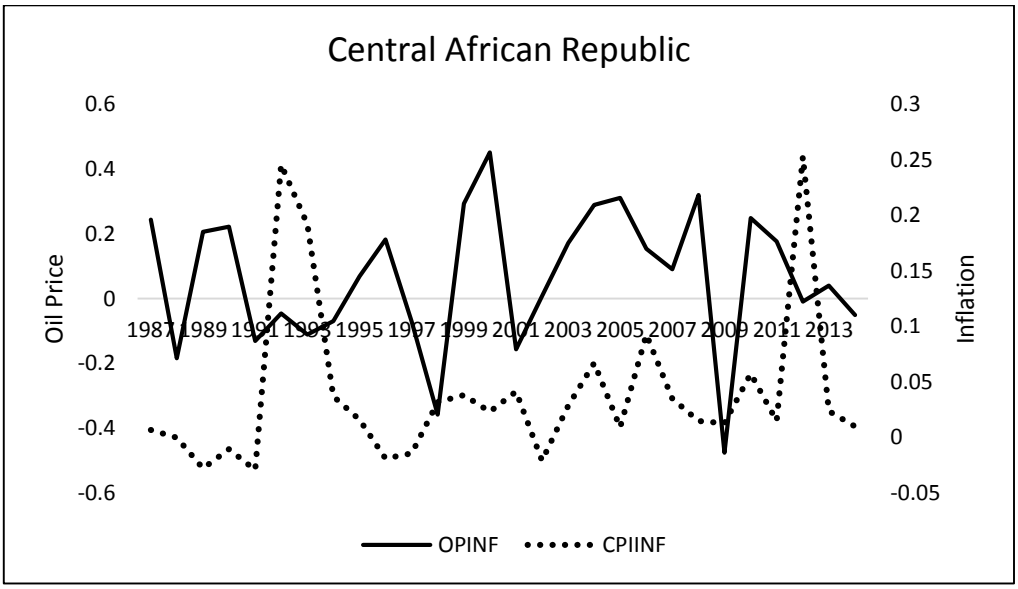

Australia
0.6000
0.4000
0.2000
0.0000
-0.2000
-0.4000
-0.6000
Oil Price
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Inflation
1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
OPINF
CPIINF


Norway
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
Oil Price
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Inflation
1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
OPINF
CPIINF

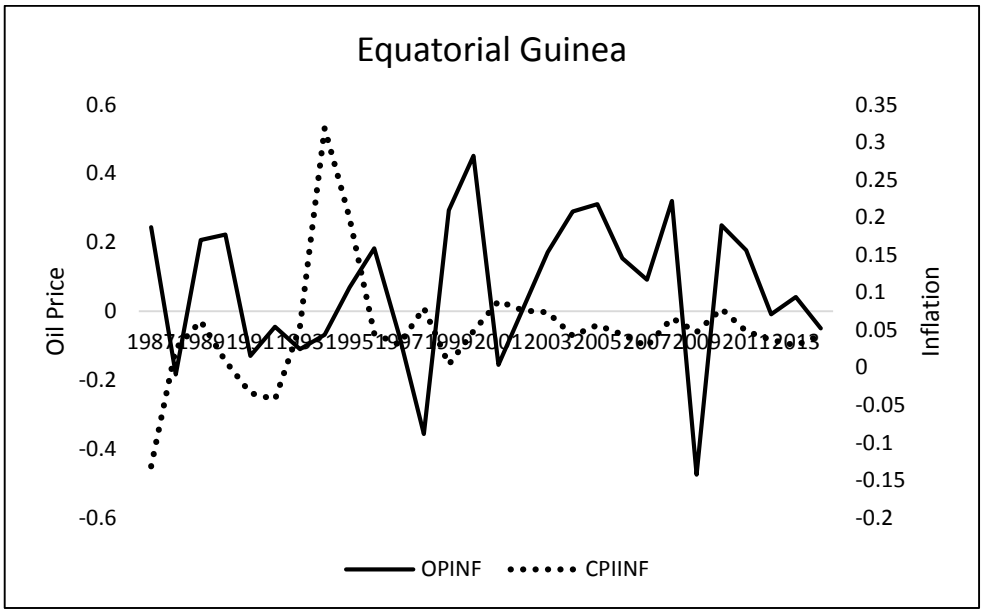
## (2) Developing countries

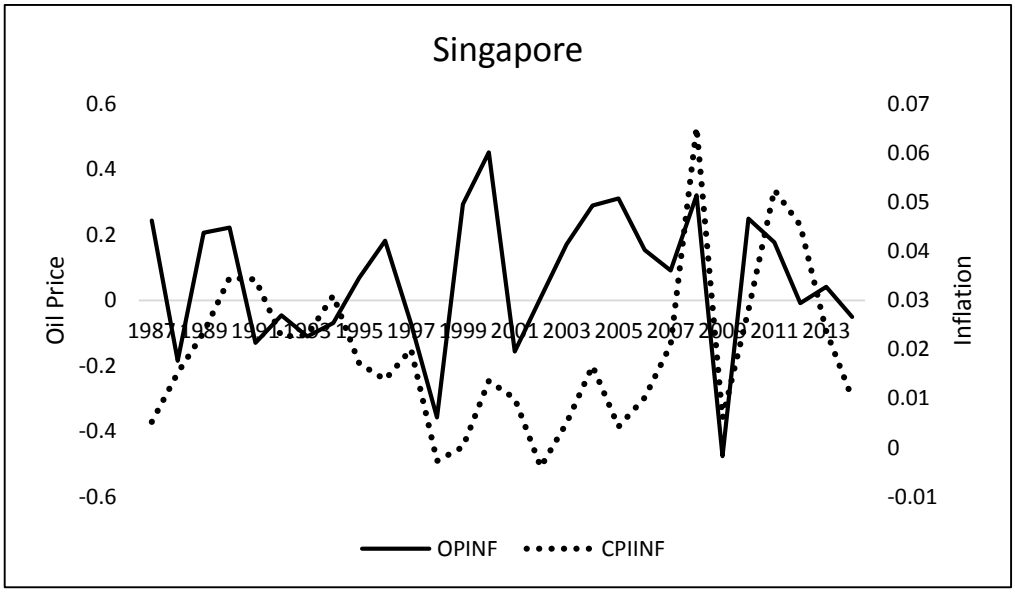


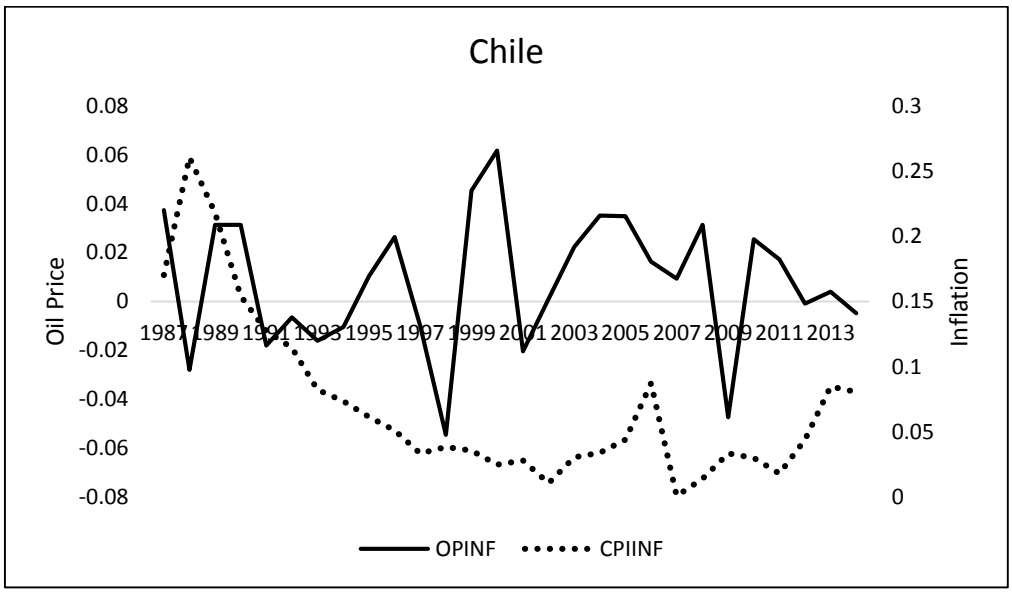






**(3) Developing countries turned into developed**






Sources: Fred Economic Data, World Bank

Table 1.1 Correlation between oil price inflation and CPI inflation

| No | Country | Year | | | Level of development |
|---|---|---|---|---|---|
| | | 1987-2014 | 1987-2000 | 2000-2014 | |
| 1 | Central African Republic | -0.1180 | -0.2239 | -0.0352 | 0 |
| 2 | Australia | 0.3156 | 0.4123 | 0.4307 | 1 |
| 3 | Dominican Republic | 0.1373 | -0.0127 | 0.3434 | 0 |
| 4 | Brazil | -0.0556 | -0.0331 | 0.1467 | 0 |
| 5 | Canada | 0.2787 | 0.2417 | 0.6237 | 1 |
| 6 | Switzerland | 0.1156 | 0.0149 | 0.6639 | 1 |
| 7 | Argentina | 0.1650 | 0.2791 | -0.0627 | 0 |
| 8 | Denmark | 0.2563 | 0.3030 | 0.4120 | 1 |
| 9 | Egypt | 0.0183 | -0.0484 | 0.0138 | 0 |
| 10 | Maldives | -0.2140 | -0.3735 | -0.0728 | 0 |
| 11 | Mexico | -0.0257 | 0.0229 | 0.1646 | 0 |
| 12 | Myanmar | -0.2484 | -0.7536 | -0.0068 | 0 |
| 13 | Malaysia | -0.1149 | -0.6922 | 0.4027 | 0 |
| 14 | Qatar | 0.3769 | -0.1143 | 0.4724 | 1 |
| 15 | Norway | 0.0499 | 0.1586 | 0.0949 | 1 |
| 16 | New Zealand | 0.2535 | 0.3045 | 0.3933 | 0-1 |
| 17 | Philippines | -0.2093 | -0.4336 | 0.2674 | 0 |
| 18 | Russian Federation | -0.1979 | -0.2833 | 0.1020 | 0-1 |
| 19 | Morocco | -0.0967 | -0.2455 | 0.3242 | 0 |
| 20 | Israel | -0.1059 | -0.0905 | -0.1458 | 0-1 |
| 21 | India | -0.4682 | -0.6822 | -0.3059 | 0 |
| 22 | Pakistan | -0.0748 | -0.4758 | 0.0462 | 0 |
| 23 | Peru | 0.1585 | 0.2607 | 0.2172 | 0 |
| 24 | Japan | -0.0810 | -0.3084 | 0.1574 | 0-1 |
| 25 | Nigeria | -0.1964 | -0.2772 | -0.0548 | 0 |
| 26 | Korea | -0.3110 | -0.6183 | 0.1881 | 0-1-0-1 |
| 27 | Mauritius | 0.0557 | -0.1293 | 0.3021 | 0 |
| 28 | Sri Lanka | 0.1351 | -0.1239 | 0.2737 | 0 |
| 29 | Iran, Islamic Rep. | -0.0547 | -0.1036 | -0.0017 | 0 |
| 30 | Equatorial Guinea | -0.1323 | -0.2022 | 0.0197 | 0-1 |
| 31 | Vietnam | 0.1670 | -0.7392 | 0.2052 | 0 |
| 32 | United States | 0.4628 | 0.3405 | 0.7735 | 1 |
| 33 | Sweden | 0.0503 | -0.0011 | 0.3138 | 1 |
| 34 | Thailand | -0.0042 | -0.5925 | 0.6634 | 0 |
| 35 | Turkey | -0.2502 | -0.5410 | 0.0704 | 0-1 |
| 36 | Poland | 0.1270 | 0.2312 | 0.2515 | 0-1 |
| 37 | Saudi Arabia | -0.0008 | -0.2574 | -0.0430 | 1-0-1 |

| | | | | | |
|---|---|---|---|---|---|
| 38 | Singapore | 0.1904 | -0.0687 | 0.2729 | 0-1 |
| 39 | South Africa | -0.1552 | -0.0999 | -0.2227 | 0 |
| 40 | Panama | 0.2162 | 0.2565 | 0.1569 | 0-1 |
| 41 | Chile | -0.0090 | -0.0289 | 0.3842 | 0-1 |
| 42 | China | -0.0739 | -0.1973 | 0.4409 | 1 |
| 43 | Colombia | -0.1900 | -0.4244 | 0.2806 | 0 |
| 44 | Hong Kong | -0.2237 | -0.4319 | -0.0737 | 0-1 |
| 45 | Iceland | -0.1059 | -0.0905 | -0.1458 | 1-0-1 |
| 46 | Indonesia | -0.3271 | -0.4898 | -0.0018 | 0 |
| 47 | Jamaica | -0.1194 | -0.2554 | 0.4482 | 0 |
| 48 | Paraguay | 0.0195 | -0.0184 | 0.4041 | 0 |
| 49 | United Kingdom | 0.0310 | -0.0651 | 0.0855 | 0-1 |
| 50 | Uruguay | -0.0858 | -0.0827 | -0.0337 | 0-1 |

Sources: Fred Economic Data, World Bank

**Notes:**

1=developed country

0=developing country

0-1=developing country turned into developed

1-0=developed country turned into developing

## 1.2 Problem Statement

Notwithstanding, there are plenty of researchers studied on the impacts of oil price on inflation, still we believe that there are potential factors which will result in different outcomes in the future. Oil seems to behave as a vital role in the economy. It has direct positive relationship with inflation as inflation rises when increase in oil price. However, in the recent year, oil does not play the major factor to affect inflation anymore. Therefore, the researchers are yet to analyse the structural break in for the current trends of the relationship. In our paper, we would like to study what is the possible elements that cause the break in of the direct positive relationship between oil price inflation and CPI. On the other hand, we will take into consideration whether level of development, renewable sources and corruption perception index bring different outcome towards inflation.

## 1.3 Research Objectives

In this paper, the general objective of this research is to examine the impact of oil price on inflation over the period of 1986 to year 2014 using panel data. The general research objectives can be narrowed down to 1. to investigate impact of oil price on inflation. 2. to study the mechanisms or factors that influence to the impact of oil price on inflation. 3. to observe the outcome of inflation when renewable source replaces oil price is better, worse off or remain unchanged. 4. to identify level of development will result in different outcome.

## 1.4 Research Questions

The main research question is what are the impacts of changes in oil price on inflation? Secondly, what are the mechanisms or factors that influence to the impact of oil price on inflation? Thirdly, is corruption perception index influences inflation larger than the oil prices do? On the other hand, is renewable source a 'replacement' of oil price on inflation? Lastly, does the level of development affects the relationship of oil price inflation and CPI?

## 1.5 Hypotheses of the study

Oil price acts as the independent variable that is studied in this research which determine how other factors like the level of development of country effects on inflation. The other independent variables like money growth, output growth, financial development and trade openness are to control the relationship between oil price and inflation. Besides, corruption perception index and renewable sources serve as expanded variables to shape the volatility between oil price and inflation.

## 1.6 Significance of the Study

This research provides empirical evidence about the roles of renewable source and corruption perception index, especially on how their presence would reshape the impact of oil price on inflation. Comparing to previous studies with this study, level of development, renewable sources and corruption perception index are taken into account for the impact of oil price towards inflation. Apart from that, it contributes to the researches and government body whether actions should be taken depending on the outcomes from renewable sources and corruption perception index respond to inflation are better, worse off or remain unchanged. Furthermore, it also makes a comparison between the different levels of development countries on the effects of oil price towards inflation.

## 1.7 Chapter Layout

In order to investigate the level of development, impact of renewable sources and corruption perception index response towards oil price on inflation, we identify and estimate using panel data technique. We conclude and compare the estimates consisting of different countries across time. Using annual sample data of varies level of development countries which comprise of 50 countries from Africa, Asia, Europe, North America, Oceania and South America ranging from 1986 to 2014 in our study is due to the purpose that we would like to take into consideration for the impacts of the level of development, 'replacement' of renewable sources and corruption perception index over the year that may be blamed for the differential response of oil price to inflation. Next, this paper is organized as follows, Chapter 2 discusses the review of the past researches and how our study fits in the literature. Following by Chapter 3 to explain the methodology. Chapter 4 discusses and explains the data as well as our findings. Lastly, Chapter 5 will be the conclusion.

# CHAPTER 2: LITERATURE REVIEW

## 2.0 Introduction

This chapter will provide the literature review of the exogenous variables such as oil price, money growth, output growth, financial development, trade openness and renewable source that effect on the inflation. The impact of oil price and other control variables influence on inflation had been classified and well-defined by the past researches as literature review.

## 2.1 Direct and Indirect Relationship between Oil Price and Inflation

During the period of oil price shock, it has direct and indirect dual effects on the inflation. The fluctuation in oil price can directly cause inflation. Besides, it also indirectly leads to the inflation through various channels such as the exchange rate, imports, exports, outputs, gross domestic product, consumer price index. Firstly, Choi, Furceri, Loungani, Mishra and Ribeiro (2018) suggested to use monthly data from 2000 to 2015 which generated the result of 10% rises in world oil inflation will lead to 0.4 percentage point rises in domestic inflation. However, it is shown that the effects become insignificant and irrelevant two years after the oil price shock. Meanwhile, this is not agreed as Choi et al. (2018) proposed that the relationship becomes weaker from time to time is generally due to the policy of less dependent on the oil import.

By using the model of Autoregressive Distributed Lag (ARDL) to examine the impacts of oil price on inflation. The results suggested that oil price has indirect relationship with inflation. As oil price serves as the intermediate products to cause the final output to increase in price. This is proven when the increase in oil prices will cause the production fees on the exporters to rise. When the production fees

increase, expenses increase, savings lesser therefore inflation happens (Sek, Teo and Wong, 2015). In addition, there is other evidence to show the impact oil price towards inflation is indirect and positive. Appreciation in oil prices leads to rise in inflation. Through the channel of increasing expenses on the imports as oil is the major transportation for the products, prices for manufacturing products increase as well as the exchange rate will be affected (Saleem and Ahmad, 2015; Al-Ameri, 2012; Sek, 2017; Tshepo, 2015). On the other hand, Asghar and Naveed (2015) verified that relationship between oil price and inflation not necessary to be positive. It showed a negative co-movement between oil price and inflation in Pakistan.

Furthermore, we found that inflationary is affected by the oil supply shock and oil demand shock. However, the oil supply shock poses large effects than the oil demand shocks on the movement of inflation (Sek and Lim, 2016). A significant result examined that oil price shock has greater effects on inflation in 1970s, but it was getting weaker after 1986s. The influence of oil price shock towards inflation has gradually declined due to the large consumption of energy-conserving products that replaced the oil usage (Bachmeier and Cha, 2011; Chou and Tseng, 2011; Schneide, 2004). Since Sweden is an oil-importer, oil price will affect the inflation indirectly. As if oil price appreciates, the firm will be charged more on the production costs, lastly consumers have to bare the final output costs which consequently cause inflation in the economy (Kinnefors and Wribe, 2006).

In the point of a stable economy view, when appreciates in crude oil price relatively it will lead to lower inflation rate and short-term effect of oil supply shock. Government of China carried out a policy to determine the variables of aggregate shock and demand shock on the long-term effects on China's output and inflation. Hence, the main issues that impact on China's output and inflation are the manufacturing products and services such as investments and exports. The demand of investment and exports will control and tend to affect the long run. The economic growth in China will be thereupon influenced by the global oil prices. It is concluded the various categories of oil price shock will generate different outcomes on the output and inflation (Zhao, Zhang, Wang and Xu, 2016). Moreover, there is an asymmetric linkage between oil price and inflation. Oil price does not affect the inflation all the time. It might be other factors that influence the inflation.

Meanwhile, inflation is significantly affected by the oil price shock when expressed in the term of local currency (Cunado and Gracia, 2005; Malik, 2016).

The studies showed that the inflation in countries of United States, Japan and Europe is affected by the current oil prices. It shows the positive relationship between oil price and inflation. For United States and Europe, when the consumption energy rose up to 10 percentage points, the inflationary grow from 0.1 to 0.8 percentage point (LeBlance and Chinn, 2004). Besides, by using the Vector auto-regression model (VAR) to examine the relationship between oil price and inflation, it indicates a negative relationship between oil price and inflation. This is because the fluctuation of oil prices is a part of oil shocks that brings impacts on the inflation (Apere, 2017). In Kazakhstan, it is projected that the channel of cost is a part to affect the energy shock to inflation. The cost channel is where they are conducting energy price shocks imaginary to analyse whether it will become strong or weak. It has become weaker when extra modification is added to the economy thus will improve the approaches of imports replacement (Karimli, Jafarova, Aliyeva and Huseynov, 2016).

Moreover, the result is shown that fluctuation of oil price is just influence partially on the inflation where the oil price rises with 10%, the consumer price index inflation will rise from 0.20 to 0.25 percentage point over the year in Spain (Álvarez, Hurtado, Sánchez and Thomas, 2009).The journal is proven an evidence of the crude oil price and government expenditure are the factors that affect the inflation in Saudi Arabia. For instance, when the increasing cost of production which is the high import fee will cause the inflation rate to appreciate (Al-Qenaie, 2016). In India, the economy changes due to the high dependency on the imports, rises in the oil energy price leads to increase in inflation. For the suggestion to improve the India's economy, government should provide subsidy on oil price, induce the exports production, thus will lead to decline in investment portfolio and reduce the effects on GDP (Soundarapandiyan and Ganesh, 2017).

Additionally, the author Koç Yurtkur, Halıcı Tülüce and Bahtiyar (2016) and Abounoori, Nazarian and Amiri (2014) suggested the result that the oil shock has a positive impact on inflation. Using the SVAR method with monthly data from

the period January 1995 to December 2014, it inspected the oil price changes will influence on inflation. It will then result a decrease in oil price and inflation as a positive relationship between each other (Koç Yurtkur et al., 2016). Furthermore, a developed country like Ghana, it has proposed that the oil price has direct positive relationship with inflation. The rises in oil price will direct influence the movement of inflation and indirect affects the changes of exchange rates on inflation (Kpogli, 2014). In addition, to investigate the oil price affects the inflation, it used quarterly data from 2000 to 2014. The result of using dynamic panel data model suggested the linkage between oil price and inflation is significant positive in long run. Oil price has a greater causes and effects on inflation for the net importer countries (Salisu, Isah, Oyewole and Akanni, 2017).

Moreover, as the population of Kenya is expanding larger yet the slower production rate does not match the growth rate and since it is the oil importing country, therefore, residents of Kenya have to import goods from the outside to ensure the supply is sufficient. In short run, it found that rises in money supply and oil prices cause an increase in inflation (Odongo, 2012; Moazam and Kemal, 2016). The study is also found that oil price has an asymmetric impact on consumer price inflation. For example, an approximately increase of 0.27% in consumer price level is controlled by the rises of 1% in oil price (Lacheheb and Sirag, 2016). This is agreed in another journal as when expressed in the term of local currency, inflation is significant affected by the oil shock (Cunado and Gracia, 2005; Malik, 2016). The growth of GDP declines directly when it reacts with the negative oil supply at the same time rises in the aggregate demand. In overall, the expected result shows the energy shock has important effects towards the inflation in United Kingdom (Lorusso and Pieroni, 2015). Besides, the investigation using vector error correction model to analyse the relationship of oil price impact on inflation is taken to show the inflation (CPI) has correlated with oil price. Oil price has widely used in the area of transportation, agriculture and production and strongly influence the inflation (Çelik and Akgul, 2011).

According to the researcher Kargi (2014), it has certified that inflation in the importing and exporting countries was caused by the changes in oil price. This is due to the direct positive relationship between oil price and inflation which

consequently appreciates the merchandise expenses. Oil acts as the major and effective tools in influencing the output growth. In Turkey, it showed the oil imports will affect the GDP and indirectly causes inflation (Kargi, 2014). The study of Kiptui (2009) is using Philips curve framework to conclude that the relationship between oil price and inflation which it is founded that they are positively correlated. The oil pass-through inflation relationship was fallen and getting weaker in the early of 1990s but then rose back after the trade liberalization. It mean a slight increase in the oil price inflation will lead to appreciation of 0.5% in inflation in the short run while 1% in long term (Kiptui, 2009).

## 2.2 Changing Inflationary Effect of Oil Price Overtime

Since 1970 oil price has heavily been a major factor that affects CPI inflation. A 10% increase in the oil price causes 0.4 % increase in inflation. Most countries economy will be affected by the fluctuation in oil price. Many economist will focus on the price of the crude oil per barrel. Oil price played an important role that affect the world economy. However, Choi et al. (2018) found that impact of oil price shock on domestic inflation has gradually declined over time which indicates that oil price shock is less important to the economy and no longer acts as the major effect of inflation. This is due to the higher creditable monetary policy implemented by the central bank as well as most of the countries are developing without the reliance on energy imports. Policymaker expects to have a stable oil price and low inflation to reach a stable economy. Therefore, monetary policy has become an effective tool to control oil price hence produce a stable and low inflation country (Sek et al., 2015). This suggestion has provided by most of the researchers in order to solve the impact of the oil price towards the inflation.

Choi et al. (2018) pointed out that impact of oil price shock on inflation are reducing over time, which is violate with most of the studies that proven the significant positive relationship between inflation and oil price. This is supported by another author Kinnefors and Wribe (2006) whom proposed that renewable sources can be replaced crude oil in the future. It showed that renewable source has

a less influencing power than the crude oil on the inflation yet there is still unknown for the upcoming economy.

## 2.3 The Effects of Oil Dependency Level

Changes in oil prices have different effects to both high oil dependency countries and low oil dependency countries. High oil dependency countries include Singapore, South Korea, Philippines, Greece, Belgium, Italy, Pakistan, India, Portugal and Spain. Low oil dependency countries include Norway, Denmark, United Kingdom, Canada, Mexico, Malaysia, Brazil, Venezuela, Ecuador and Bulgaria. Sek et al. (2015) found that the main two factors which could indirectly affect the oil price changes on domestic inflation in high oil dependency countries which re real exchange rate and exporter's production cost. Higher production cost will lead to higher inflation by importing raw materials and unfinished goods and later sell to the domestic market. However, low oil dependency countries generate oil themselves then export to other countries. Therefore, higher oil price may lead to higher inflation as increase in oil price will lead to increase income, hence more consumption could lead to inflation. Real exchange rate also poses some effect towards inflation in low dependency countries. Appreciation of real exchange rate will lower the inflation rate in the long run.

Since Sweden is a net oil importing countries and it spent 43.3 billion SEK to buy crude oil in 2004. Kinnefors and Wribe (2006) concluded that increase in oil price by 10%, inflation is estimated to be increase around 0.15% to 0.20%. Although natural gas used as fuelling cars and other renewable sources used in motor vehicles, crude oil still acts as important input for the Sweden that generally depend on the energy consumption. Sek and Lim (2016) pointed out that the inflation in the exporting countries does not have any response to both supply shock and demand shock. They are able to influence the oil supply and the price since they are oil producer. Researcher also further studied the relationship between oil price and macroeconomic factors such as interest rate, inflation, industrial production, wages and unemployment. Koç Yurtkur et al. (2016) examined that rise in oil price

causes low productivity and increase in the production cost, this will lead to decrease in the output. Lower productivity rate in the industry will increase the unemployment rate and slower down the improvement.

## 2.4 Does Policy Affect Oil Price Shock?

In the past researches, monetary policy is an effective instrument to control various factors that may lead the inflation to fluctuate. The policymakers are to alert the effect of oil prices, real exchange rate and the exporter manufacturer costs on inflation and it will affect the stabilize of price and marketplace trade. The researcher also suggest the monetary policy is the best way to control these shocks (Sek et al., 2015). The policy should strict on organizing the money supply in order to coordinate with the real productivity rate as well as it is essential to control the exchange rate on the import of oil, oil products and the equipment. (Saleem and Ahamad, 2015). The counter-cyclical fiscal policy is mandatory fiscal guideline that will assist the monetary authorities to establish the development of economic and stabilize the inflation (Karimli et al., 2016).

Furthermore, there is an evidence showing the effects of oil price is mainly related to the inflation. Therefore, in the end of this research, monetary policymakers of South Africa are suggested to contribute more concerns towards the fluctuation of oil price in order to maintain inflation rate in a control manner (Niyimbanira, 2013; Tshepo, 2015). In the recent years, the relationship between oil price and inflation have become weaker in South Africa. Due to this reason, the Reserve Bank obliged to pay more attention with oil price shocks and maintain the movement of inflation with the existence shocks (Balcilar, Uwilingiye and Gupta, 2018). As known that Kenya is an oil importing country, demand of the crude oil price will be higher since oil is the imported goods. Residents have to bare a higher cost to enjoy the consumption of oil. It is suggested that government should make adjustments on the tax for those imported oil to decrease the effects on the public (Odongo, 2012).

On the other hand, the decrease in output growth and rise in inflation will lead the energy price to be unpredicted. Intentionally, the monetary policymakers conduct the contractionary policies to combat the inflation and make adjustment in order to respond on the interest rates (Cologni and Manera, 2005; Lacheheb and Sirag, 2016). Research stated that most of the countries conduct contractionary monetary policies to control the inflation. In 1990s, the impact of oil price shock has become part of the influencing effects towards the oil shock from the reaction of monetary rules (Cologni and Manera, 2005). To avoid the economy downturns, the government adopted the expansionary monetary policy for the period when positive oil price shock arrived. According to the relationship of oil shocks towards inflation, the policymaker tends to implement the energy policy to minimize the usage of energy intensity and encourage conservations in the country (Herath, 2015).

To overcome the large impact of oil price shock on the inflation, central bank has to stay alert with the policies introduced. The monetary policymakers can counterweight the portion or total of the effects on the outputs. However, it is only suitable for the short term with high inflation of expenses while in long run with high prices. For example, they can split the short term outcome of the outputs and induce the inflationary gaps by the monetary authorities (Barrell and Pomerantz, 2004; Hooker, 1999). The studies on Brown, Oppedahl and Yucel (1995) reviewed the rise in oil price will consequence increase the perpetual growth of nominal GDP. In short term, velocity of money growth (M2) accounts appreciate will lead the nominal GDP to rise. In long term, the money supply will continue expand while velocity will remain constant. In the end, monetary authorities have the adaptability to control inflation with the fuel price shocks (Brown, Oppedahl and Yucel, 1995).

Over the time, result of the oil prices effect on inflation through various approaches. To carry out further modification on the Nigeria economy and improvement of the imports replacement, there are several approaches that suggested to decline the fees of channels transmission. This is because oil is the intermediate product that will affects the final outputs. To decrease the inflation rate by the changes of oil prices, the monetary policymaker applied a fiscal rules to make the economic stabilize and well-managed (Apere, 2017). The decline in oil price is the causal effect that the monetary authority have to survey on to make decision in

Nigeria. As the oil exporting country, the monetary authorities have the obligation to make the inflation rate and currency of Nigeria at the stable level to increase the confidence level of investors (Kelikume, 2017). The empirical results stated the oil price has large effects on the inflation. In this way, the policymakers implemented the policy to manage oil price shock and stabilize the inflation. This is also to reduce the pass-through impacts of oil price to manufacturer prices, exchange rate and the global inflation (Tshepo, 2015).

In addition, the major factor that effects inflation is the money growth in long run. As we know that the fluctuation in oil price is an important role that impacts on price. In long run, the changes in currency supply effect the changes in overseas exchange rate due to the reason of changes in crude oil price to decline the domestic price affect by oil price (Moazam and Kemal, 2016). Since the oil shock through diminishing energy intensity, the policy of energy dedicates a protection of economy (Herath, 2015). To implement a policy that permits to decrease the dependent on the oil branch through diversification of profits. On the other hand, it also improved real GDP and lowered down the burden of inflation (Bouchaour and Al-Zeaud, 2012). Therefore, the result showed that the oil price is directly effects on inflation. To refrain from inflation, the government applied a policy to control the petrol prices in Malaysia (Shaari, Hussain and Abdullah, 2012).

## 2.5 Research Gaps

In the previous studies, it showed the direct relationship of oil price and inflation, the policy implemented to control the inflation caused by the fluctuation in oil price. Rather, they didn't investigate any impacts of corruption perception index instead of oil on inflation as well as there are just limited journals studied the effects of renewable sources as the 'replacement' of oil on inflation. Therefore, in our research, we classify our countries based on the level of development and study both of the corruption perception index and renewable sources that effect on the inflation is better or worse-off. The trends of the oil price and inflation might be different as a lot of countries are carrying out research and development on other

sources to replace the oil. Meanwhile, the pattern of oil price and inflation is getting weaker and stronger varies by the countries whether caused by the corruption index or other possible factor like subsidies that provided by the government. Lastly, due to the past researches did not take level of development into account as this can also be one of the factors that influences relationship of oil price and inflation. Indeed, we will further investigate the possible factors which might influence inflation despite oil price in Chapter 3 and 4.

## 2.6 Chapter Layout

In the nutshell, this chapter of the previous researches has shown different standpoints to explain the relationship between the inflation and the variables which are oil price, money growth, output growth, financial development, trade openness and renewable source. To study the relationship between exogenous variables and endogenous variables, hypotheses has been formed. Besides, the theory frameworks help to give details of how the independent variables effect on inflation. Moreover, the expanded variables which is corruption perception index that in the previous journal have not examine the impact on inflation. Moreover, we can examine the relationship between the renewable sources substitute for the oil price and inflation. We can identify whether level of development can be one of the factors. According to the literature review in this chapter, we decide to use panel data to run our test. In chapter 3, we will discuss the methodology and methods that estimate the relationship between the independent variables and dependent variable.

# CHAPTER 3: METHODOLOGY

## 3.0 Introduction

In this chapter, the research is carried out in terms of explanation of theoretical model, methodologies and sources of data. The data are obtained from year 1986 to 2014 in annually basis. This study mainly investigates on the key determinants of the impact of changes in oil price towards the inflation. It also includes hypothesis development and conclusion of this chapter.

## 3.1 Theoretical Model

Quantity theory of money states that the more money people have, the more they will spend. However, if people suddenly have more money to spend which means that the prices of goods and services will increase as the value of the money depreciates. This theory is supported by using Fisher Equation. The equation is expressed as below:

$$MV = PY \quad (1)$$

Where M denotes money supply; V denotes velocity of money; P denotes price level; Y denotes volume of the transactions.

In this Fisher equation, both side expressed a same result in a different means. If any of the variables change, the others have to change to achieve the same result. To examine more behind the inflation, rewrite the equation as below:

$$P = \frac{MV}{Y} \quad (2)$$

Model (2) shows that if there is a change in price, three possible causes may have which are changes in M, V, or Y.

Taking the equation in logarithm and expressed in the form of basic model, is:

$$\Delta logP = \Delta logM + \Delta logV - \Delta logY \quad (3)$$

Where Δ denotes the changes in the variables; log denotes the logarithm transformation of the variables.

Due to more money chasing for the limited goods and there is one of the global variables involve in the global economic activity which is crude oil. Crude oil is limited goods that only exist in some of the countries like US, Saudi Arabia, Malaysia and so on. Crude oil also is one of the key driven of the economic. This is because most of the sector need oil especially transportation sector. In a long term, price increase will cause the inflation happened simultaneously.

## 3.2 Empirical Model

In order to examine the impact of oil price on inflation, the relationship between the variables can be expressed as the following function:

$$inf = f(MG, LP, M2GDP, MARCAP, TO, OP) \quad (4)$$

Where inf denotes inflation; MG is the broad money growth; M2GDP denotes M2 over GDP, proxy of financial development; MARCAP denotes market capitalization over GDP, also proxy of financial development; TO denotes trade openness; OP denotes oil price.

### 3.2.1 Baseline Model

The long run relationship between inflation and its variables can be expressed as:

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(OP)_{it} + \varepsilon_{it} \quad (5)$$

Where $\Delta$ denotes the changes in the variables; ln denotes the natural logarithm transformation of the variables.

Model (5) as a basic model to test with the panel data models to determine which it is more suitable in this research.

The expected relationship between inflation and its variables are:

**Oil price influenced the inflation**

This study expects that increase in oil price will reduce the inflation.

$H_1$: Oil price has negative relationship with inflation. ($\beta_6 < 0$)

**Money supply influenced the inflation**

This study expects that while money supply increase will cause the inflation increase.

$H_2$: Money supply has positive relationship with inflation. ($\beta_1 > 0$)

**Output growth influenced the inflation**

This study expects that increase in the output growth will reduce the inflation.

$H_3$: Output growth has a negative significant relationship with inflation. ($\beta_2 < 0$)

**Financial development influenced the inflation**

This study expects that increase in the financial development will reduce the inflation.

$H_4$: Financial development has negative relationship with inflation.

($\beta_3 < 0, \beta_4 < 0$)

**Trade openness influenced the inflation**

This study expects that increase in the trade openness will reduce inflation.

$H_5$: Trade openness has negative relationship with inflation. ($\beta_5 < 0$)

### 3.2.2 Proxy for Oil Prices

Since there are two crude oil prices benchmarks had been chosen, so it is a must to find out which one is more suitable to use in the following test. The model can be shown as below:

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(WTI)_{it} + \varepsilon_{it} \quad (6)$$

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(BRENT)_{it} + \varepsilon_{it} \quad (7)$$

Where WTI denotes West Texas Intermediate spot price; BRENT denotes Brent spot price.

A comparison of oil price between model (6) and model (7) will be found out to determine which spot price continues to be used in the following test.

### 3.2.3 Investigating the Role of Corruption and Renewable Sources

To test what is the impact on inflation if the controlled variables, corruption and renewable sources added into model (5) individually.

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(OP)_{it} + \beta_7 \ln(CP)_{it} + \varepsilon_{it} \quad (8)$$

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(OP)_{it} + \beta_7 RS_{it} + \varepsilon_{it} \quad (9)$$

Where CP denotes corruption perception index; RS denotes renewable sources.

The expected relationships are:

**Corruption influenced the inflation**

This study expects that corruption will bring negative impact to inflation.

$H_6$: Corruption has a negative relationship with inflation. (Model 8 - $\beta_7 < 0$)

**Renewable source influenced the inflation**

This study expects that increase in the renewable source will reduce the inflation.

$H_7$: Renewable source has a negative relationship with inflation. (Model 9 - $\beta_7 < 0$)

To test what is the effect on inflation if the alternative energy variable, renewable sources and the institutional variable, corruption added into the basic model (model 5) simultaneously. The model can be shown as:

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(OP)_{it} + \beta_7 \ln(CP)_{it} + \beta_8 RS_{it} + \varepsilon_{it} \quad (10)$$

### 3.2.4 Investigating the Interaction between Oil Prices, Corruption, and Renewable Sources

To test the interaction between oil price and corruption on inflation, the model can be shown as follow:

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(OP)_{it} + \beta_7 \ln(CP)_{it} + \beta_8 [\ln(OP) \times \ln(CP)]_{it} + \varepsilon_{it} \quad (11)$$

By holding other variables constant, whenever there is a change of oil price, the impacts of inflation is no longer $\beta_6$ but also include $\beta_8 \times \ln CP$:

$$\frac{\text{d inf}}{\text{d ln(OP)}} = \beta_6 + \beta_8 \ln CP \quad (12)$$

To test the interaction between oil price and renewable sources on inflation, the model can be shown as follow:

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(OP)_{it} + \beta_7 RS_{it} + \beta_8 [\ln(OP) \times RS]_{it} + \varepsilon_{it} \quad (13)$$

By holding other variables constant, whenever there is a change of oil price, the impacts of inflation is no longer β6, but also include $\beta_8 \times$ RS .

$$\frac{\text{d inf}}{\text{d ln(OP)}} = \beta_6 + \beta_8 RS \quad (14)$$

### 3.2.5 Investigating the Effects of Developed and Developing Countries

To determine what is the effects of oil price and inflation if the level of development is different. Thus, level of development acts as a dummy variable and adds into model as below:

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(OP)_{it} + \beta_7 \ln(CP)_{it} + \beta_8 [\ln(OP) \times \ln(CP)]_{it} + \beta_9 [\ln(OP) \times \ln(CP)] D_{it} + \varepsilon_{it} \quad (15)$$

$$inf_{it} = \beta_{0it} + \beta_1 MG_{it} + \beta_2 \Delta \ln(LP)_{it} + \beta_3 M2GDP_{it} + \beta_4 MARCAP_{it} + \beta_5 TO_{it} + \beta_6 \ln(OP)_{it} + \beta_7 RS_{it} + \beta_8 [\ln(OP) \times RS]_{it} + \beta_9 [\ln(OP) \times RS] D_{it} + \varepsilon_{it} \quad (16)$$

Where D = 1 for develop country, 0 otherwise.

In model (15), if D = 1:

$$\frac{\mathrm{d\,inf}}{\mathrm{d\,ln(OP)}} = \beta_8 \ln(CP) + \beta_9 \ln(CP) = (\beta_8 + \beta_9) \ln(CP) \quad (17)$$

By holding other variables constant, whenever there is a change of oil price, the impacts of inflation is $\beta_8 \ln(CP)$but also include one more $\beta_9 \ln(CP)$if that is a develop country.

In model (16), if D = 1:

$$\frac{\mathrm{d\,inf}}{\mathrm{d\,ln(OP)}} = \beta_8 \mathrm{RS} + \beta_9 \mathrm{RS} = (\beta_8 + \beta_9) \mathrm{RS} \quad (18)$$

By holding other variables constant, whenever there is a change of oil price, the impacts of inflation is $\beta_8$RS but also include one more $\beta_9$RS if that is a develop country.

## 3.3 Panel Data Models

Panel data used in this research as it take cross sectional heterogeneity explicitly into account. Hence, three popular panel data models had been selected as estimators in dealing with the individual effects, cross sectional or time effects that may or may not be observed during the whole time period (Hauser, 2018).

### 3.3.1 Pooled Ordinary Least Square Model

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it} \quad (19)$$

Pooled Ordinary Least Square Model (POLS) is the most basic type model, but it includes the combination of cross sectional data and also time series data. This means that the data would have space and time dimension.

### 3.3.2 Fixed Effects Model

$$Y_{it} = \beta_{0_i} + \beta_1 X_{it} + \varepsilon_{it} \quad (20)$$

The Fixed Effect Model (FEM) can be known as Common Effect Model. The model is basically shown it only use one effect in the model. The analysis of this model will take all variable data and come out with one average result from data given. It will ignore the difference between data and the result, or it could be the singular effect since there is only one average result.

### 3.3.3 Random Effects Model

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \omega_{it} \quad (21)$$

Where $\omega_{it} = \mu_i + \alpha_t + \varepsilon_{it}$

Random Effects Model (REM) also known as Error Component Model. It different from Fixed Effects Model, because the REM can have different from time to time depend on the data use. For example, the REM will also have a mean value from the data given but it will have an adjusted value from every data to make sure that there will not be any linkage left over or error for the final result. The results may be biased as the omitted variables are being ignored (Williams, 2018).

### 3.3.4 Model Comparison

Three model comparison tests will be done in order to decide which panel data model is more suitable. There are Likelihood Ratio test, Breusch and Pagan Lagrange Multiplier test, and Hausman test. The Likelihood Ratio test is tested on the POLS and FEM. If the null hypothesis is rejected, FEM is better than POLS. The Breusch and Pagan Lagrange Multiplier test is used on the POLS and FEM. If the null hypothesis is rejected, FEM is better than POLS. To decide whether FEM or REM is better, Hausman test is tested. If the null hypothesis is rejected, FEM is preferred.

## 3.4 Data

Fifty countries had been selected if the data of the country was sufficient and adequate. Besides, all of the data that used in this research are obtained from online sources (See Table 3.1).

### 3.4.1 Sources of Data

If the data or the information is already analysed or collected by other researchers or anybody else for some purpose, the data or the information could be known as secondary data (Sloboda, 2016). The purpose of using secondary data is that it is more effective. It acts as a reference for future researchers to obtain and understand clearly from our research.

A lot of information is taken from online such as journals, articles and data. Most of the journal articles are sourced from Google Scholar and ScienceDirect while most of the data are obtained from World Bank, Penn World Table and DataHub.

In this research, panel data is used for analyze the results. Since there have fifty countries included, so the annual data collected is from 1981 to 2014. Besides, oil price such as WTI spot price and Brent spot price are also included in this research. The WTI spot price is obtained from the year 1986 to 2014. Moreover, Brent spot price is collected from 1987 to 2014.

Table 3.1: Sources of Data

| Variables | Proxy | Year | Sources |
|---|---|---|---|
| **Inflation** | Consumer Prices (Annual %) | 1960-2014 | World Bank |
| **Broad Money Growth** | M1 Growth Rate (%) | 1960-2014 | World Bank |
| **Output Growth** | Labour Productivity Growth | 1981-2014 | Penn World Table |
| **Financial Development** | M2/GDP | 1960-2014 | World Bank |
| | Market Capitalization/GDP | 1975-2014 | World Bank |
| **Trade Openness** | - | 1960-2014 | World Bank |
| **Oil Price** | WTI Spot Price | 1986-2014 | Fred Economic Data |
| | Brent Spot Price | 1987-2014 | Fred Economic Data |
| **Corruption Perception Index** | - | 1998-2014 | Datahub |
| **Renewable Sources** | Total final energy consumption (%) | 1990-2014 | World Bank |

### 3.4.2 Countries

The fifty countries comprises from six continents which are North America, South America, Oceania, Europe, Africa, and Asia. In North America, it included Dominican Republic, United States, Panama, Jamaica, Canada and Mexico. In South America, there are four countries included which are Peru, Chile, Paraguay, Uruguay, Brazil, Argentina and Colombia. There are only two countries in Oceania which are Australia and New Zealand. In Europe, nine countries are included in this research such as Switzerland, Sweden, Turkey, Poland, Iceland, United Kingdom,

Denmark, Norway and Russian Federation. There are countries in Africa which are Central Africa Republic, Morocco, Mauritius, South Africa, Egypt, Equatorial Guinea and Nigeria. In this six continents, Asia is occupies most of the countries in this research. There are nineteen countries included in Asia such as Maldives, Myanmar, Philippines, Israel, India, Pakistan, Japan, Korea, Sri Lanka, Thailand, Singapore, China, Hong Kong, Indonesia, Malaysia, Qatar, Iran, Vietnam and Saudi Arabia. These fifty countries were divided into developed and developing countries based on the latest year, GDP per capita from World Bank. The countries that exceed USD 12,000 will list as developed countries while the countries that below USD 12,000 will list as developing countries (Table 3.2).

Table 3.2: Developed and Developing Countries

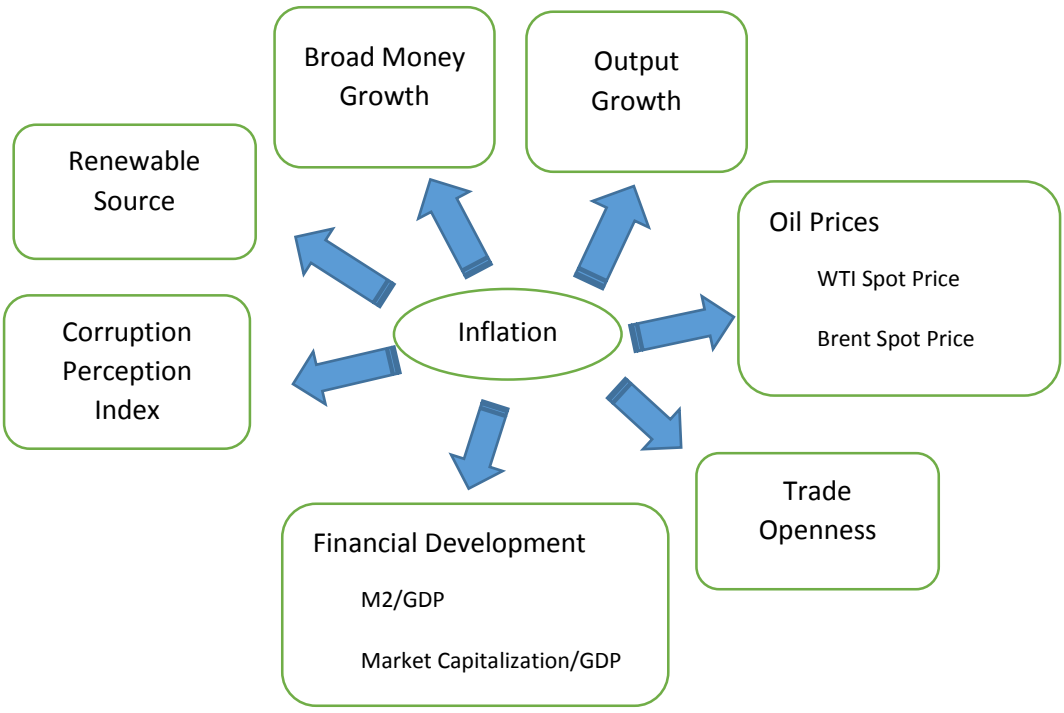
| Continents | Developed Countries | Developing Countries |
|---|---|---|
| **Africa** | • Equatorial Guinea | • Central African Republic<br>• Egypt<br>• Morocco<br>• Nigeria<br>• Mauritius<br>• South Africa |
| **Asia** | • Qatar<br>• Israel<br>• Japan<br>• Korea<br>• Singapore<br>• Hong Kong<br>• Saudi Arabia | • Maldives<br>• Myanmar<br>• Malaysia<br>• Philippines<br>• India<br>• Pakistan<br>• Sri Lanka<br>• Iran<br>• Vietnam<br>• Thailand<br>• China<br>• Indonesia |
| **Europe** | • Switzerland<br>• Norway<br>• Denmark<br>• Russian Federation<br>• Sweden<br>• Turkey<br>• Poland<br>• Iceland<br>• United Kingdom | |

| | | |
|---|---|---|
| **North America** | • Canada<br>• United States<br>• Panama | • Dominican Republic<br>• Mexico<br>• Jamaica |
| **Oceania** | • Australia<br>• New Zealand | - |
| **South America** | • Brazil<br>• Argentina<br>• Chile<br>• Uruguay | • Peru<br>• Colombia<br>• Paraguay |

## 3.5 Model Discussion

These are the variables that included in order studying out the impact of inflation (See Figure 3.1).

Figure 3.1: Variables



### 3.5.1 Inflation

Inflation means there is an increase of the price of goods and services. A high inflation may increase the cost of living and reduce the purchasing power. In this research, Consumer Price Index (CPI) is used as a proxy of inflation. CPI is defines as the cost for the consumer of acquiring a basket of goods and services at a certain period, for example annually (BusinessDictionary, n.d.). Annual percentage changes of CPI had been collected to indicate the inflation rate. According to Lioudis (2018), inflation has the same movement with oil price in the economy. A cause and effect relationship will be reviewed in this research.

### 3.5.2 Oil Price

In this research, two crude oil prices benchmark, West Texas Intermediate and Brent had been chosen to determine the relationship with inflation. West Texas Intermediate (WTI) crude oil is produced in North America. According to U.S. Energy Information Administration (EIA), WTI spot price is important as it acts as a benchmark price for buyers and sellers of other crude streams. A crude stream produced in Texas and Southern Oklahoma. The major trading centre of WTI is at Cushing, Oklahoma. WTI spot price is used to study with inflation whether there will be a cause and effect relationship. Besides, Brent crude oil is produced in the North Sea. Brent spot price becomes one of the most popular reference prices of crude oil. Although Brent spot price and WTI spot price are the most popular reference price in pricing crude streams, but their prices are often been compared as both of them only different in a few dollars. Brent spot price is used to study with inflation whether there is a cause and effect relationship.

### 3.5.3 Broad Money Growth

Broad money is the total of money outside banks. It includes notes and coins, savings accounts, demand deposits and traveller's checks. It also includes illiquid

forms of money like treasury bills and bank deposits; and other securities such as commercial paper and certificates of deposit. "Increasing the money supply faster than the growth in real output will cause inflation," (Pettinger, 2015). Broad money growth is used to predict the outlook of inflation.

### 3.5.4 Output Growth

An output of a country's economy is mostly shown on the labour productivity. According to OECD, "Labour productivity is defined as output per unit of labour input." In this research, real GDP acts as the measurement of the total output in the economy. There are many factors in affecting the labour productivity growth such as rules and regulation, skills and qualifications of workers, technological, and so on. Labour productivity growth is one of the factors in determining the inflation. Some of the researcher suggested that countries with high labour productivity growth may have a low inflation and remain low costs.

### 3.5.5 Financial Development

Two proxies of financial development had included in this research. First financial development's proxy is M2 over GDP. Broad money, M2 includes everything in M1 plus savings accounts and other short term time deposits, foreign currency deposits, bank and traveller's checks and other deposits in money market accounts. These M2 are less liquid than M1. Besides, gross domestic product (GDP) plays an important role on a country's economic performance. GDP is the final value of all the finished goods and services produced by the country. This proxy has been chosen as it is one of the popular proxies that used by many researchers in financial development. Second proxy is market capitalization over GDP. Market capitalization, is also known as market cap, where the total market value of a company is based on its outstanding shares and share prices. The formula for market capitalization is:

$$Market\ Capitalization = Share\ Price \times Number of\ Shares\ Outstanding \quad (22)$$

The result of market capitalization over GDP is to evaluate whether the overall market is overvalued or undervalued. These two proxies have been chosen as both of them are popular proxies that used by past researchers in financial development.

### 3.5.6 Trade Openness

Trade openness refers to the total trade over GDP of a given country's economy. Total trade can be measured by the sum of exports and imports of goods and services. Trade openness has a lot of benefits. For example, increased labour productivity will enhance the economic growth. Trade openness acts as a proxy for financial development in this research.

### 3.5.7 Corruption Perception Index

Corruption Perception Index (CP) is created by Transparency International in 1995. According to Transparency International, CP is used to measure a country's level of corruption towards the public sectors are believed to be. It defines on a scale from 0 to 10 as 0 means highly corrupted and 10 means not corrupted. CP that delivered by Transparency International is a trustworthy and reliable message and cannot be ignored by the government. CP acts as an institutional variable and converts into percentage to have a consistent result. CP is to determine whether CP will affect inflation in this research.

### 3.5.8 Renewable Sources

Renewable energy sources refer to the resources that can be replaced by the nature. For example, solar energy is generated from sun and wind energy is generated from wind. Renewable energy consumption is the total final energy consumption of the usage of renewable energy. In this research, renewable source acts as a controlled variable which determines whether renewable energy source can be substitute for the crude oil in the future.

## 3.6 Chapter Layout

In conclusion, these models are mainly to examine the research questions in Chapter 1. It briefly study out the theoretical model, empirical model, sources of data, and also discuss about the variables on inflation. With the data and information obtained, the actual result and the interpretation will be carried out in the following chapter.

# CHAPTER 4: DATA ANALYSIS

## 4.0 Introduction

Interpreting and analysing on the empirical result will be the main focus in this whole chapter, apart from that, the methods that will be used in this chapter which had stated in the previous chapter. To explain the relationship between the inflation rate with two global variables which are West Texas Intermediate and Brent crude oil price, renewable source consumption served as alternative energy variable as well as the government corruption index as the institution variable. We are using panel data which comprises 50 countries with net oil importing and net oil exporting where we combined the time series data and pooled data of fifty countries data from year 1981 to year 2014 in annual basis. In order to have more accurate result, Eview 10 will be the software we carried out for this research. The model such as Pooled Ordinary Least Square model, Fixed Effect Model, Random Effect Model have been inserted into the result. Meanwhile, diagnostic checking test such as Likelihood Ratio Test, Lagrange Multiple Test and Hausman Test had been conducted throughout the research.

## 4.1 Descriptive Analysis

Table 4.1 shows the descriptive analysis statistical result for fifty country with thirty-four years annual data from year 1981 to year 2014 by using Eview 10 software and has been simplified into a summary table which shown as below. The interpretation of statistical result will be written in the following parts.

Table 4.1 Descriptive Analysis from Year 1981 to Year 2014

| | Mean | Median | Max | Min | Std. Dev | Jarque-Bera |
|---|---|---|---|---|---|---|
| INF (%) | 31.3584 | 5.4465 | 7481.6640 | -23.8221 | 253.0741 | 17663216*** |
| MG (%) | 34.2577 | 16.5030 | 6384.9160 | -51.9853 | 186.7610 | 50279660*** |
| LLP (Index) | 0.2367 | 0.0248 | 6.6748 | -1.1689 | 1.0562 | 40062.69*** |
| M2GDP (%) | 62.1686 | 51.7800 | 361.3410 | -0.4308 | 46.7681 | 4115.50*** |
| MARCAP (%) | 74.4064 | 46.9755 | 1254.4650 | 0.4039 | 112.7092 | 130368.4*** |
| TO (%) | 78.9451 | 59.2348 | 531.7374 | 0.1674 | 71.8047 | 7924.51*** |
| LOP (WTI) | 3.5194 | 3.2573 | 4.6019 | 2.6686 | 0.6715 | 170.4756*** |

**Notes:** ***, **, * referring to the rejection of null hypothesis at significance level 1%, 5% and 10% respectively. INF denotes Inflation, MG denotes money growth, LLP denotes log labour productivity, M2GDP denotes M2 over gross domestic product, MARCAP denotes market capital, TO denotes trade openness, LOP (WTI) denotes log oil price West Texas Intermediate Spot Price.

The form that shown in the Table 4.1 above, indicates the average value for the data set; median is the middle value from the data set; maximum will be the highest value in the data set; minimum reveals the lowest value from the data set; standard deviation represents the average differences between mean and single observation; while lastly the Jarque-Bera examines whether the variables are in normal distribution, otherwise, not.

Inflation has a mean value of 31.358 percent, median is 5.4465 percent. The standard deviation for this variable is 253.0741 percent. It has maximum value of 7481.664 percent and minimum value of -23.8221 percent. Since this result is mixing with countries from different stages of the countries: the third world, developing countries and the modern countries, therefore, it is difficult to determine

which the real effects are during the financial crisis and economy boom. Each of the country will have different influences that will differ the result.

For labour productivity variable, it has 0.2367 for its mean index, 0.024831 for its median index, 1.0562 is the standard deviation index, 6.6748 for its maximum index and -1.1689 for its minimum index. The level of labour productivity is reducing which that means it is weaker. We believe that it might due to the third world countries that do not have advance technology and well-trained courses provided to their labour.

Besides, money growth has 34.2577 percent for its mean, 16.503 percent for median, 186.761 percent is the standard deviation value. The maximum value is 6384.916 percent and minimum value is -51.9853 percent which shows a huge gap between them, this might cause by the economy in those emerging countries that has better cash flow and attract more foreign investors to enhance their financial market. Compared to that, the economy in modern countries is just constant and having a stable growth.

According to market capitalization variable, its mean value is 74.4064 USD, median is 46.9755 USD, and standard deviation is 112.7092 USD. The maximum value is 1254.465 USD and 0.4039 USD for its minimum value. The modern countries acts as a role to assist other countries by raising the data set result since they have larger amount of capital flow cycle in their financial market as well as the financial market in their country is more mature and educated.

For M2 GDP, it has 62.1686 percent for its mean, 51.78 percent for its median, 46.7681 percent for its standard deviation value and 361.341 percent for its maximum value and -0.4308 percent for its minimum value. The modern country will raise up the result as the country will have more trade in the business and the sector that is covered will be wider included its capital market and money market compare to those developing country and third world country will more depend on it country natural resource or agriculture sector that have lesser effect on adding it country M2 GDP.

For trade openness part, it has 78.9451 USD for its mean, 59.2348 USD for its median, 71.8047 USD as standard deviation value and 531.7374 USD for its maximum value and 0.1674 USD for its minimum value. The result shown might be due to every country is standing at different position. It should take into consideration by the policies implemented in each countries, its diplomatic abilities and country leader negotiation abilities therefore resulting different result for the value of trade openness. For example, after China government has decided to reform their policies, they attract foreign investors and reward their citizens, consequently it has threaten the place of United State to obtain the only number one economy in the world.

In addition, WTI crude oil has been log so it mean value of 3.5194, median value of 3.2573, and standard deviation of 0.6715. Its maximum value is 4.6019 and minimum value is 2.6686. The result is unexpected as we have logged the data set which mean the result is not as efficient.

Lastly, the Jarque-Bera is used for the normality test of variables and will be the main and most concern in the research. Fortunately, all variables included independent variables and dependent variable obtain a perfect significant which is 1% of level significant as the probabilities are lower to 0.01.

## 4.2 Basic Model Analysis

This part will further describe and interpret the basic models: Pooled Ordinary Least Square model (POLS), Fixed Effect Model (FEM), and Random Effect Model (REM) which consist of money growth, labor productivity, M2 GDP, market capital, trade openness, and WTI crude oil. Different type of model results will be carried out and shown. The best model will be chosen to conduct further research in this chapter.

Firstly, money growth has shown the perfect significant which 1% of level significant in all three basic models. It is the only variable that meets all the

significant level in three models, the statistic of all three models are quite similar where they have positive sign and the statistic range is between 1.4392 and 1.4739, which means that by holding other variables constant then the money growth remain the significance level by 1% and inflation rate will increase from 1.4392% to 1.4739%. Ojede (2015) and Jiang, Chang, and Li (2015) stated that money growth is one of the variables that will increase inflation rate in the country.

Table 4.2 Basic Model Table

| Variable | POLS | FEM | REM |
|---|---|---|---|
| C | -14.6507* | -13.2170 | -22.6583** |
| | (-8.29) | (-10.72) | (-8.902) |
| MG | 1.4392*** | 1.4739*** | 1.4663*** |
| | (-0.0157) | (-0.0145) | (-0.0144) |
| LP | 2.1014** | -15.7260 | 1.9837 |
| | (-1.017) | (-13.75) | (-2.643) |
| M2GDP | -0.0093 | -0.3559*** | -0.1459** |
| | (-0.038) | (-0.108) | (-0.0685) |
| MARCAP | -0.0098 | 0.0159 | -0.0020 |
| | (-0.0175) | (-0.0262) | (-0.0219) |
| TO | 0.0529** | 0.1179 | 0.1034** |
| | (-0.0235) | (-0.0975) | (-0.0499) |
| OP (WTI) | -2.3316 | 4.438* | 0.8726 |
| | (-2.174) | (-2.539) | (-2.169) |
| Adjusted $R^2$ | 0.918 | 0.9374 | 0.9308 |
| Likelihood Ratio Test | - | 247.51*** | - |
| Langrage Multiplier Test | 200.2*** | - | - |
| Hausman Test | - | - | 21.51*** |

**Notes:** ***, **, * referring to the rejection of null hypothesis at significance level 1%, 5% and 10% respectively. INF denotes Inflation, MG denotes money growth, LLP denotes labour productivity, M2GDP denotes M2 over gross domestic product, MARCAP denotes market capital, TO denotes trade openness, LOP (WTI) denotes log oil price West Texas Intermediate Spot Price.

Besides, we found that market capitalization the only variable that didn't meet any significant variable in all three models. Despite increase the level of significant to 10% still it is not significant. The POLS and REM both have a negative sign while FEM has positive sign which indicates that it has wide range of

the gap between 0.01589 to -0.009816. We could strongly believe that MARCAP is not the factor to affect the movement of inflation rate, as the previous research Coşkun, Seven, Ertuğrul, and Ulussever, (2017) matched with this expectation.

Apart from that, M2 GDP has negative signs on the three models, but it is significant to both models FEM and REM. FEM has 1 % of level significant while REM has 5% level of significant. This variable can be proven by holding other variables constant, M2 GDP increase by 1%, the inflation rate will decrease in the range of 0.1459 to 0.3559. Therefore, when a country is facing situation with high inflation, they have to increase their M2 GDP in order to lower down the high inflation rate.

Labour productivity variable shows that only POLS model is significant among the three models. As the level of significant expands to 10 %, the labour productivity will have a positive sign of 2.1014 which means that when labour productivity is higher, more quantity of products will be produced which lower the manufacturing cost, although inflation strikes up, the company will not affected but increase the revenue. However, there is only one model which supported this statement, therefore it has no direct relationship between the inflation rate and labour productivity. Indeed, this can be corresponded with the researcher Ojede (2015) which stated that labour productivity will not bring much effect towards inflation rate.

Furthermore, trade openness is significant to both POLS and REM model at 5% significant level, but respond to FEM model, it is not significant even the level is adjusted to 10%. Notwithstanding the above, we believe that it is worth to further discuss in this chapter as it meets all positive signs on three models indicating that country with strong trade openness level will provide positive impacts on the inflation rate.

WTI crude oil as the core variable only meets FEM model at 10% significant level. This can be concluded that whenever crude oil price increases, positive impacts will affect the inflation rate no matter it is importing or exporting countries.

Choi et al. (2018) and Zhao et al. (2016) both imposed the same results of increase in crude oil price by 10%, the average global inflation will increase by 0.4 %.

Lastly, the best model will be chosen out from the three models by using likelihood ratio test. We prefer FEM model as the test statistic result has a value of 0.000 which we have to reject POLS model. Besides, the langrage multiple test indicates that REM model is more desirable as compared to POLS model. By using Hausman test, a result of 0.0015 from FEM model which REM model is rejected. Since FEM model is the only model that is significant to WTI crude oil which serves as the core variable. Therefore, FEM model is chosen as the best model to further carry out our research.

## 4.3 The Best Crude Oil Variable

The Table 4.3 below shows the result of both crude oil variables which are WTI and Brent, other variables will be included to test for the best crude oil variable. FEM model is chosen to run the test as it is the best model in the previous section.

The model of WTI and Brent Crude Oil shows a very similar result which can strongly prove that both variables share and affected by the global crude oil inventory. Both of them carries the similar characteristics and roles in the financial market including the spot market and future market where basically a place for buyers and sellers hedge in the future market and spot market. The presence of speculators in the future market is to increase the liquidity as they speculate for the future market trade for the profits. Supply and demand of the global crude oil and rig count for the transactions will increase the production of crude oil.

According to the table, WTI has same level of significant with Brent but when observe on the statistic result, WTI has a greater fluctuation to inflation rate compared to Brent. This is shown when WTI increased by 1%, the inflation rate will increased by 4.4379%, while Brent will only bring 4.1457% of effect to inflation rate by holding other variables constant.

Furthermore, WTI has a larger market share compared to Brent. Most of the countries would rather use WTI crude oil futures for exchanging their stock to the buyer and trade for profits. For example, the country that imports crude oil from United State and OPEC countries which have a position in crude oil market.

Table 4.3 Comparison between WTI and Brent

| Variable | WTI | Brent |
|---|---|---|
| C | -13.2170<br>(-10.72) | -12.8612<br>(-10.78) |
| MG | 1.4739***<br>(-0.0145) | 1.4736***<br>(-0.0146) |
| LP | -15.7260<br>(-13.75) | -13.8506<br>(-14.18) |
| M2GDP | -0.3559***<br>(-0.108) | -0.3645***<br>(-0.1113) |
| MARCAP | 0.0159<br>(-0.0262) | 0.0178<br>(-0.0265) |
| TO | 0.1179<br>(-0.0975) | 0.1211<br>(-0.1001) |
| OP (WTI) | 4.438*<br>(-2.539) | - |
| OP (Brent) | - | 4.146*<br>(-2.359) |
| F-Test statistic | 249.3903 | 246.8650 |
| Adjusted $R^2$ | 0.9374 | 0.9378 |

**Notes:** ***, **, * referring to the rejection of null hypothesis at significance level 1%, 5% and 10% respectively. INF denotes Inflation, MG denotes money growth, LLP denotes labour productivity, M2GDP denotes M2 over gross domestic product, MARCAP denotes market capital, TO denotes trade openness, LOP (WTI) denotes log oil price West Texas Intermediate Spot Price, LOP (Brent) log oil price Brent spot price.

## 4.4 Role of Corruption and Renewable Source Variable

In this section Table 4.4, it is shown that the role of corruption perception index and renewable source consumption respond to the inflation in the basic model. Also, to determine the relationship between corruption and renewable source consumption with crude oil and how does it relate to the inflation rate. The following part will further interprets and explains on the result that we carried out.

Table 4.4 Corruption and Renewable Source Included to Basic Model

| Variable | Model 3 | Model 4 | Model 5 |
|---|---|---|---|
| C | 11.1*** | 8.94 | 5.768 |
| | (-2.684) | (-11.97) | (-4.068) |
| MG | 0.2052*** | 1.928*** | 0.1994*** |
| | (-0.0211) | (-0.0218) | (-0.0213) |
| LLP | -9.236*** | -24.22** | -8.989** |
| | (-3.483) | (-10.99) | (-3.499) |
| M2GDP | -0.0614** | 0.4254*** | -0.0537** |
| | (-0.0251) | (-0.082) | (-0.0254) |
| MARCAP | 0.0034 | 0.0173 | 0.0036 |
| | (-0.0051) | (-0.0189) | (-0.00511) |
| TO | 0.0577*** | 0.1876** | 0.0507*** |
| | (-0.0189) | (-0.0735) | (-0.0194) |
| LOP (WTI) | -1.396** | 3.771** | -1.284** |
| | (-0.5422) | (-1.872) | (-0.5484) |
| LCP | -0.1593 | - | -0.0933 |
| | (-0.3135) | | (-0.3153) |
| RS | - | -1.011*** | 0.1894* |
| | | (-0.3045) | (-0.1078) |
| F-Statistic | 12.57 | 180.83 | 12.62 |
| Adjusted $R^2$ | 0.5225 | 0.9215 | 0.526 |

**Notes:** ***, **, * referring to the rejection of null hypothesis at significance level 1%, 5% and 10% respectively. INF denotes Inflation, MG denotes money growth, LLP denotes labour productivity, M2GDP denotes M2 over gross domestic product, MARCAP denotes market capital, TO denotes trade openness, LOP (WTI) denotes log oil price West Texas Intermediate Spot Price, LCP denotes log corruption index, RS denotes renewable source.

Based on the model 3, it is shown that the effects of corruption perception index responded to the inflation rate. The previous researcher Blackburn, K., & Powell, J. (2011) stated that corruption will cause a country inflation higher no matter in the long term or short term. The only way to reduce the effects is to increase government officer integrity, awareness and acknowledge on the negative impact that will come along with corruption. From the table, we found that corruption had gradually turned the WTI variable into negative thus indirectly affect the inflation while corruption itself also brings negative impact to inflation rate. Therefore, we estimated that the greater the corruption activity carried on, the lower the inflation rate. However, the result proved that corruption variable is not significant, so the statement above is not valid as well as it matched the outcome of Blackburn, K., & Powell, J. (2011) which it provide evidence that quantity of money theory is taken into account rather than the corruption perception index.

Moreover, corruption has 1% of level of negative significant on the renewable source consumption variable, 5% of positive significant on the WTI variable. Therefore, this situation can be well-explain that the renewable source is a substitute or an alternative to the oil price as it can lower rate of the inflation since we believe that it can reduce the cost of production. However, in the research of Afonso, T. L., Marques, A. C., & Fuinhas, J. A. (2017), the renewable source will bring negative impact to the economic growth. It can lower down the inflation rate but also cause constant growth in economy. It has dual-effect to the economic growth and inflation, therefore the policy marker should balance it to prevent hyperinflation and deflation happen.

Based on the model 5, WTI and renewable source consumption variable will still remain significant but relationship between inflation rates has been changed. The expected sign for renewable source is negatively affects the inflation rate while WTI is positively affects the inflation rate. Yet, the result showed that renewable source has a positive impact meanwhile WTI has a negative impact to the inflation. Hence, we can realize that corruption perception index model is not suitable to carry out the test. To conclude this section, we can serve renewable source consumption variable (model 5) as the control variable that provide logical result and proceed to carry out further discussion.

## 4.5 Interactive of Corruption and Renewable Source Variable

Since the previous section concluded that corruption perception index does not largely affected inflation rate while renewable source consumption is a perfect alternative to substitute the crude oil variable. Thus, in this section, we will interpret on the interaction between crude oil prices and both variables of corruption and renewable source consumption.

Model 6 shows the interaction between WTI crude oil with corruption perception index. Based on the result above, the core variable in the model are not significant even though the level of significant is increase to 10%. Although the previous researcher Blackburn, K., & Powell, J. (2011) has verified that corruption perception index will have direct relationship with inflation rate, yet it is rejected in our research. This is due to the test is proven that the crude oil will not have any interactive and significant relationship with corruption index. It shows that it is indirectly influence the inflation rate with a stronger force.

Model 7 detects that there is an interaction between the WTI and renewable source consumption at 5% significant level. It is shown that it has negative significant relationship with WTI as it can be a prefect substitute for crude oil. When crude oil price increases by 1%, the inflation rate will increase by 7.8413% by holding other variables constant. While when the renewable source consumption increases by 1%, the inflation rate will decrease by 33.5272%. It will not only reduce the effect by the increasing crude oil price but also will weaken the effect of other variables. Since then, we can estimate that if renewable source is widely consume in a country, it will affect the inflation rate in the country constantly.

Table 4.5 Interaction between Oil Price with Corruption Perception Index and Renewable Sources

| Variable | Model 6 | Model 7 |
|---|---|---|
| C | 11.72*** | 34.44** |
| | (-2.718) | (-17.27) |
| MG | 0.2038*** | 1.929*** |
| | (-0.0211) | (-0.0218) |
| LLP | -10.02*** | -24.16** |
| | (-3.525) | (-10.96) |
| M2GDP | -0.0657*** | -0.4196*** |
| | (-0.0253) | (-0.0819) |
| MARCAP | 0.0038 | 0.0188 |
| | (-0.0051) | (-0.0189) |
| TO | 0.0549*** | 0.193*** |
| | (-0.019) | (-0.0733) |
| LOP (WTI) | -0.2641 | 7.841*** |
| | (-0.9848) | (-2.73) |
| LCP | 1.476 | - |
| | (-1.225) | |
| LOP_LCP | -8.911 | - |
| | (-6.456) | |
| RS | - | -0.4516 |
| | | (-0.4088) |
| LOP_RS | - | -33.53** |
| | | (-16.4) |
| F-Statistic | 12.37 | 177.9 |
| Adjusted $R^2$ | 0.5234 | 0.9218 |

**Notes:** ***, **, * referring to the rejection of null hypothesis at significance level 1%, 5% and 10% respectively. The result is using overall data without using dummy variable to separate it into develop country and others. INF denotes Inflation, MG denotes money growth, LLP denotes labour productivity, M2GDP denotes M2 over gross domestic product, MARCAP denotes market capital, TO denotes trade openness, LOP (WTI) denotes log oil price West Texas Intermediate Spot Price, LCP denotes log corruption index, RS denotes renewable source. LOP_LCP denotes log oil price multiple log corruption index, LOP_RS denotes log oil price multiple renewable source.

## 4.6 Role of Level of Development

Indeed, in the next section, we will separate the countries into developing, developed and developing countries turned into developed. This is to determine whether the corruption and renewable source will bring the effects on inflation rate in each of the country. The procedure is carried out by using the GDP per capita, the national GDP per capital as an estimator. If level of the GDP per capita is above USD 12,000, it will consider as developed country, otherwise not.

The model is shown the effects of corruption perception index and renewable source on the inflation rate which level of development is taken into consideration. On the other hand, we determine whether the corruption and renewable source are able to affect the position of crude oil.

The previous result showed the corruption variable is not significant when interact with crude oil. But after we further classify our data set into level of development, corruption finally obtains significant at the level of 10% significant level while WTI crude oil does not significant. Therefore, if the level of development for the country is taken into account, corruption perception index will weaken the role of crude oil on the inflation. This scenario is shown when the corruption rises for 1%, inflation rate will strike up by 2.1197%. Thus, this is supported by Blackburn, K., & Powell, J. (2011) which the corruption may lead to a higher inflation rate of the country.

Lastly, renewable source is proven to weaken the position of WTI crude oil on the inflation. It brings negative effect toward the inflation rate. WTI crude oil and developed countries with renewable sources will obtain a 1% of significant level which means that renewable source can replace oil in the future. A 1% appreciation in renewable source consumption in the developed countries will induce 9.2459% of inflation rate by holding other variables constant. We can conclude that our estimated result is equal to the final result.

Table 4.6 Role of Level of Development

| Variable | Model 8 | Model 9 |
|---|---|---|
| C | 11.19***<br>(-2.735) | 23.95<br>(-17.54) |
| MG | 0.2099***<br>(-0.0214) | 1.93***<br>(-0.0217) |
| LLP | -9.851***<br>(-3.521) | -24.1**<br>(-10.9) |
| M2GDP | -0.0665***<br>(-0.0252) | -0.393***<br>(-0.0819) |
| MARCAP | 0.0032<br>(-0.0051) | 0.0141<br>(-0.0188) |
| TO | 0.0586***<br>(-0.019) | 0.193***<br>(-0.0729) |
| LOP (WTI) | 0.1047<br>(-1.012) | 8.357***<br>(-2.72) |
| LCP | 2.12*<br>(-1.293) | - |
| LOP_LCP | -11.01<br>(-6.589) | - |
| α_LOP_LCP | -2.184<br>(-1.423) | - |
| RS | - | -0.483<br>(-0.4066) |
| LOP_RS | - | -25.9<br>(-16.52) |
| α_LOP_RS | - | -9.25***<br>(-3.17) |
| F-Statistic | 12.2 | 176.39 |
| Adjusted $R^2$ | 0.5248 | 0.9227 |

**Notes:** ***, **, * referring to the rejection of null hypothesis at significance level 1%, 5% and 10% respectively. The result using dummy variable to separate it into develop country and others type of country. INF denotes Inflation, MG denotes money growth, LLP denotes labor productivity, M2GDP denotes M2 over gross domestic product, MARCAP denotes market capital, TO denotes trade openness, LOP (WTI) denotes log oil price West Texas Intermediate Spot Price, LCP denotes log corruption index, RS denotes renewable source. LOP_LCP denotes log oil price multiple log corruption index, LOP_RS denotes log oil price multiple renewable source. $\alpha$_LOP_LCP denotes dummy variable for log oil price multiple log corruption index if developed country equal one, otherwise zero, $\alpha$_LOP_RS dummy variable for log oil price multiple renewable source if developed country equal one, otherwise, zero.

## 4.7 Chapter Layout

In conclusion, this chapter is to test the data set and find out the relationship between inflation rate and the variables (oil price, money growth, output growth, financial development, trade openness and renewable source) that will affect the country variables. After a series of test examined, we concluded that Fixed Effect Model is the best model to fit in into in this research. Besides, WTI crude oil is more suitable to fit into this research model as it has a better statistical result and larger market share compared to Brent. Renewable sources is the best variable that able to weaken down the impact of crude oil on the inflation rate. Meanwhile, after the countries is separated into different level of development, corruption only shows the significant relationship to weaken oil price on the inflation.

# CHAPTER 5: DISCUSSION, CONCLUSION AND IMPLICATIONS

## 5.0 Introduction

This chapter consists of discussion and major findings from chapter 4 by comparing the literature review and test findings. Additionally, this chapter also discuss about the implication, limitation and recommendations to increase the value of the information to the reader.

## 5.1 Major findings

Based on the model 5 that tested in chapter 4, the result shown is negative significant relationship between renewable source and inflation at 1% significant level. This indicates that the relationship is getting weaker which the inflation increases, the renewable source will decrease. In the contrast of the previous journal Samawi, Mdanat and Arabiyat (2017) that has the same result as the renewable source has negative effect of energy on inflation. Increase in the renewable source will lead to decrease in the inflation rate. Renewable sources (interactive role) reduces impacts of oil price on inflation, but by itself shows negative insignificant relationship.

Since we find limited research papers that carried out the variable of corruption perception index to support our findings, therefore it serves as new variable to be investigated in our research. Corruption acts as the interactive role that does not change the relationship of oil price and inflation although by itself it is positive significant after level of development is taken into account.

Besides, we testify that money growth has positive significant relationship effect on the inflation rate. However, it is vary with the study of Sabade (2014)

where there is no evidence to prove that money growth will cause inflation to slow down. It pointed out that money growth and inflation rate has indirect relationship between each other. Since then, most journals share the same result which highlights that both money growth and inflation rate have a positive significant relationship. The study proved that the impact of money growth on inflation is positively correlated in the long run (Ofori et at., 2014). Obi and Uzodigwe (2015) found that money growth has a significant relationship on inflation rate. Increase in the money growth will lead to increase in inflation rate.

Besides, the result shows that labour productivity has negative significant effect on inflation rate. It has the same outcome with the past researches. Based on the journal by Ericsson, Irons & Tryon (2001), it illustrated that inflation and output growth are in negative relationship. Mallik and Chowdhury (2011) provided an evidence showing that inflation has negative significant effects on labour productivity. However, Mallik and Bhar (2010) concluded that relationship between labour productivity and inflation is positive and significant.

On the other hand, we revealed that trade openness has positive significant relationship effect on the inflation rate yet it is not concise with the journal that showing different result between trade openness and inflation rate. From the he study of Bowdler and malik (2017), it is found that there is a negative impact of openness effect on inflation. Besides, trade openness will lead to a negative impacts towards the inflation. For example, 1 percentage point increase in trade over gross domestic product (GDP) will decrease 0.8 percentage point in inflation (Lin et al., 2017). Romer (1993) also found that there is a strong negative relationship between trade openness and inflation.

## 5.2 Implications of the Study

This research contributes to the future researches and policymakers in several aspects. First of all, it establishes an overall discussion on the awareness of renewable sources might replace the oil productions in the future. It provides a consistent evidence related to the impact of oil price towards inflation, that is, does the oil price really matters? Hence, is there any other factors that affect the inflation?

The model framework draws attention to the significance of integrating economic theories with expanded variables to investigate oil doesn't fully control inflation. Besides, this research offers a new inspired where renewable sources could be a promising avenue to break the dependent of inflation on oil price.

Given the fact that having an alternative energy source could reduce impacts of oil price on inflation, policymakers could pay greater attention to develop new source for the benefits of the citizens. Besides, Corruption Perception, though may not as statistically significant as we expect, still plays a role in inflation dynamics. In particular, reducing corruption is still an effort not to be missed.

## 5.3 Limitations of the Study

Based on the research, there are a few limitations that we found out throughout the research. First of all the control variable (Renewable source and Corruption perception index) which is to control the result of basic model are the alternative energy and institutional variable. We did not consider a wide-range of omitted variable such as exchange rate. We also did not consider policy variables such as fiscal and monetary instruments.

Furthermore, we do not take into account for interest rate as the variable in this research where the policy is implemented by the federal bank of the country therefore it might influence the inflation rate (Anari, A., & Kolari, J. 2016). From the previous researchers, interest rate will directly affect the supply and demand of

money in the financial market and indirectly affect the inflation rate. Theoretically, we found that the higher the interest rate, the higher the inflation rate.

## 5.4 Recommendations

From the limitations above, there are some recommendations we would like to suggest for the future researchers to carry out further discussions and analyses. There are few substitutes for the oil such as solar power investment, nuclear power consumption and wind power investment can be taken into account as the alternative energy variable rather than only renewable source consumption in our research. While the institution variable such as country debts and government reputation index can be the factors that influence inflation rate.

We believe that interest rate might be the main factor that affect the inflation rate which we do not carry out in our research. Therefore, increase or decrease in interest rate can be one of the tools that control the inflation rate depends on the country financial market conditions. This is because it is proven that a little change of federal bank interest rate (0.25%) will cause a huge effect in money multiple effect and the bank multiple effect will then change the commercial bank rate and the financial market condition (Koepke, 2018).

## 5.5 Conclusion

In a nutshell, the main objective is to examine the impact of the key determinants that we deem to be fundamental drivers of inflation (oil price, financial development, money growth, output growth, trade openness, level of development, corruption perception index and renewable source) on the inflation for fifty countries throughout the period from 1981 to 2014 in annual basis.

The hypotheses testing results the relationship between the selected independent variables and inflation. The result shows that the oil price (WTI and Brent) is significant related to the inflation. Therefore, financial development is significant and negative relationship with inflation. In addition, the relationship between trade openness and inflation is positive and significant.

This particular chapter summarized the major finding of researches and also the implication or significance of studies for certain parties. Besides, the limitations of studies in this research paper and some critical recommendations against these problems and future studies are being discussed.

Lastly, this research analysis can contribute to any parties by clarifying the relationship between inflation rate and renewable source that we took into consideration. This can definitely assist them in making decisions to identify which factors stands more important role in determining the inflation rate.

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## Appendix A: Basic Model

Result of Pooled Ordinary Least Square Model

Dependent Variable: INF
Method: Panel Least Squares
Date: 06/21/18 Time: 23:23
Sample (adjusted): 1986 2014
Periods included: 29
Cross-sections included: 41
Total panel (unbalanced) observations: 764

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.439203 | 0.015678 | 91.79557 | 0.0000 |
| LABPRO | 2.101447 | 1.016670 | 2.066990 | 0.0391 |
| M2GDP | -0.009293 | 0.037941 | -0.244933 | 0.8066 |
| MARCAP | -0.009816 | 0.017522 | -0.560235 | 0.5755 |
| TRADEOPENESS | 0.052919 | 0.023467 | 2.255043 | 0.0244 |
| WTI | -2.331585 | 2.174327 | -1.072325 | 0.2839 |
| C | -14.65067 | 8.289659 | -1.767343 | 0.0776 |

| | | | |
|---|---|---|---|
| R-squared | 0.918670 | Mean dependent var | 15.45530 |
| Adjusted R-squared | 0.918026 | S.D. dependent var | 140.1930 |
| S.E. of regression | 40.13888 | Akaike info criterion | 10.23169 |
| Sum squared resid | 1219625. | Schwarz criterion | 10.27419 |
| Log likelihood | -3901.505 | Hannan-Quinn criter. | 10.24805 |
| F-statistic | 1425.132 | Durbin-Watson stat | 1.498074 |
| Prob(F-statistic) | 0.000000 | | |

Result of Fixed Effect Model

Dependent Variable: INF
Method: Panel Least Squares
Date: 06/21/18 Time: 23:23
Sample (adjusted): 1986 2014
Periods included: 29
Cross-sections included: 41
Total panel (unbalanced) observations: 764

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.473907 | 0.014492 | 101.7024 | 0.0000 |
| LABPRO | -15.72595 | 13.74767 | -1.143899 | 0.2530 |
| M2GDP | -0.355858 | 0.107964 | -3.296083 | 0.0010 |
| MARCAP | 0.015893 | 0.026200 | 0.606628 | 0.5443 |
| TRADEOPENESS | 0.117903 | 0.097483 | 1.209481 | 0.2269 |
| WTI | 4.437886 | 2.539107 | 1.747814 | 0.0809 |
| C | -13.21701 | 10.72229 | -1.232666 | 0.2181 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.941176 | Mean dependent var | 15.45530 |
| Adjusted R-squared | 0.937402 | S.D. dependent var | 140.1930 |
| S.E. of regression | 35.07562 | Akaike info criterion | 10.01243 |
| Sum squared resid | 882124.7 | Schwarz criterion | 10.29779 |
| Log likelihood | -3777.750 | Hannan-Quinn criter. | 10.12229 |
| F-statistic | 249.3903 | Durbin-Watson stat | 2.065265 |
| Prob(F-statistic) | 0.000000 | | |

Result of Random Effect Model

Dependent Variable: INF
Method: Panel EGLS (Cross-section random effects)
Date: 06/21/18 Time: 23:24
Sample (adjusted): 1986 2014
Periods included: 29
Cross-sections included: 41
Total panel (unbalanced) observations: 764
Swamy and Arora estimator of component variances

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.466303 | 0.014377 | 101.9928 | 0.0000 |
| LABPRO | 1.983649 | 2.643245 | 0.750460 | 0.4532 |
| M2GDP | -0.145925 | 0.068477 | -2.131023 | 0.0334 |
| MARCAP | -0.002010 | 0.021874 | -0.091876 | 0.9268 |
| TRADEOPENESS | 0.103392 | 0.049877 | 2.072923 | 0.0385 |
| WTI | 0.872598 | 2.169441 | 0.402223 | 0.6876 |
| C | -22.65830 | 8.901741 | -2.545379 | 0.0111 |

| Effects Specification | S.D. | Rho |
|---|---|---|
| Cross-section random | 18.94949 | 0.2259 |
| Idiosyncratic random | 35.07562 | 0.7741 |

Weighted Statistics

| | | | |
|---|---|---|---|
| R-squared | 0.931303 | Mean dependent var | 5.468076 |
| Adjusted R-squared | 0.930759 | S.D. dependent var | 134.5794 |
| S.E. of regression | 35.41632 | Sum squared resid | 949517.0 |
| F-statistic | 1710.402 | Durbin-Watson stat | 1.927743 |
| Prob(F-statistic) | 0.000000 | | |

Unweighted Statistics

| | | | |
|---|---|---|---|
| R-squared | 0.916310 | Mean dependent var | 15.45530 |
| Sum squared resid | 1255022. | Durbin-Watson stat | 1.458480 |

## Appendix B: Model Comparison

Result of Likelihood Test

(Comparison Between POLS and FEM)

Redundant Fixed Effects Tests
Equation: BASIC_WTI_FEM
Test cross-section fixed effects

| Effects Test | Statistic | d.f. | Prob. |
|---|---|---|---|
| Cross-section F | 6.858092 | (40,717) | 0.0000 |
| Cross-section Chi-square | 247.509470 | 40 | 0.0000 |

Cross-section fixed effects test equation:
Dependent Variable: INF
Method: Panel Least Squares
Date: 07/15/18 Time: 18:04
Sample (adjusted): 1986 2014
Periods included: 29
Cross-sections included: 41
Total panel (unbalanced) observations: 764

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.439203 | 0.015678 | 91.79557 | 0.0000 |
| LABPRO | 2.101447 | 1.016670 | 2.066990 | 0.0391 |
| M2GDP | -0.009293 | 0.037941 | -0.244933 | 0.8066 |
| MARCAP | -0.009816 | 0.017522 | -0.560235 | 0.5755 |
| TRADEOPENESS | 0.052919 | 0.023467 | 2.255043 | 0.0244 |
| WTI | -2.331585 | 2.174327 | -1.072325 | 0.2839 |
| C | -14.65067 | 8.289659 | -1.767343 | 0.0776 |

| | | | |
|---|---|---|---|
| R-squared | 0.918670 | Mean dependent var | 15.45530 |
| Adjusted R-squared | 0.918026 | S.D. dependent var | 140.1930 |
| S.E. of regression | 40.13888 | Akaike info criterion | 10.23169 |
| Sum squared resid | 1219625. | Schwarz criterion | 10.27419 |
| Log likelihood | -3901.505 | Hannan-Quinn criter. | 10.24805 |
| F-statistic | 1425.132 | Durbin-Watson stat | 1.498074 |
| Prob(F-statistic) | 0.000000 | | |

Result of Hausman Test

(Comparison Between FEM and REM)

Correlated Random Effects - Hausman Test
Equation: BASIC_WTI_REM
Test cross-section random effects

| Test Summary | Chi-Sq. Statistic | Chi-Sq. d.f. | Prob. |
|---|---|---|---|
| Cross-section random | 21.507914 | 6 | 0.0015 |

Cross-section random effects test comparisons:

| Variable | Fixed | Random | Var(Diff.) | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.473907 | 1.466303 | 0.000003 | 0.0000 |
| LABPRO | -15.725951 | 1.983649 | 182.011788 | 0.1893 |
| M2GDP | -0.355858 | -0.145925 | 0.006967 | 0.0119 |
| MARCAP | 0.015893 | -0.002010 | 0.000208 | 0.2144 |
| TRADEOPENESS | 0.117903 | 0.103392 | 0.007015 | 0.8624 |
| WTI | 4.437886 | 0.872598 | 1.740589 | 0.0069 |

Cross-section random effects test equation:
Dependent Variable: INF
Method: Panel Least Squares
Date: 07/15/18 Time: 18:05
Sample (adjusted): 1986 2014
Periods included: 29
Cross-sections included: 41
Total panel (unbalanced) observations: 764

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -13.21701 | 10.72229 | -1.232666 | 0.2181 |
| MONGROWTH | 1.473907 | 0.014492 | 101.7024 | 0.0000 |
| LABPRO | -15.72595 | 13.74767 | -1.143899 | 0.2530 |
| M2GDP | -0.355858 | 0.107964 | -3.296083 | 0.0010 |
| MARCAP | 0.015893 | 0.026200 | 0.606628 | 0.5443 |
| TRADEOPENESS | 0.117903 | 0.097483 | 1.209481 | 0.2269 |

## Appendix C: Comparison between WTI and BRENT

Result of WTI Crude Oil

Dependent Variable: INF
Method: Panel Least Squares
Date: 06/21/18 Time: 23:23
Sample (adjusted): 1986 2014
Periods included: 29
Cross-sections included: 41
Total panel (unbalanced) observations: 764

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.473907 | 0.014492 | 101.7024 | 0.0000 |
| LABPRO | -15.72595 | 13.74767 | -1.143899 | 0.2530 |
| M2GDP | -0.355858 | 0.107964 | -3.296083 | 0.0010 |
| MARCAP | 0.015893 | 0.026200 | 0.606628 | 0.5443 |
| TRADEOPENESS | 0.117903 | 0.097483 | 1.209481 | 0.2269 |
| WTI | 4.437886 | 2.539107 | 1.747814 | 0.0809 |
| C | -13.21701 | 10.72229 | -1.232666 | 0.2181 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.941176 | Mean dependent var | 15.45530 |
| Adjusted R-squared | 0.937402 | S.D. dependent var | 140.1930 |
| S.E. of regression | 35.07562 | Akaike info criterion | 10.01243 |
| Sum squared resid | 882124.7 | Schwarz criterion | 10.29779 |
| Log likelihood | -3777.750 | Hannan-Quinn criter. | 10.12229 |
| F-statistic | 249.3903 | Durbin-Watson stat | 2.065265 |
| Prob(F-statistic) | 0.000000 | | |

Result of Brent Crude Oil

Dependent Variable: INF
Method: Panel Least Squares
Date: 06/21/18 Time: 23:25
Sample (adjusted): 1987 2014
Periods included: 28
Cross-sections included: 41
Total panel (unbalanced) observations: 751

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.473635 | 0.014571 | 101.1373 | 0.0000 |
| LABPRO | -13.85061 | 14.17494 | -0.977120 | 0.3288 |
| M2GDP | -0.364476 | 0.111326 | -3.273940 | 0.0011 |
| MARCAP | 0.017805 | 0.026503 | 0.671807 | 0.5019 |
| TRADEOPENESS | 0.121105 | 0.100132 | 1.209459 | 0.2269 |
| BRENT | 4.145677 | 2.359251 | 1.757201 | 0.0793 |
| C | -12.86120 | 10.78210 | -1.192829 | 0.2333 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.941624 | Mean dependent var | 15.29486 |
| Adjusted R-squared | 0.937810 | S.D. dependent var | 141.3368 |
| S.E. of regression | 35.24650 | Akaike info criterion | 10.02315 |
| Sum squared resid | 874590.1 | Schwarz criterion | 10.31237 |
| Log likelihood | -3716.692 | Hannan-Quinn criter. | 10.13459 |
| F-statistic | 246.8650 | Durbin-Watson stat | 2.072624 |
| Prob(F-statistic) | 0.000000 | | |

## Appendix D: Investigate Role of Corruption and Renewable Source

Result of Renewable Source

Dependent Variable: INF
Method: Panel Least Squares
Date: 06/21/18 Time: 23:32
Sample (adjusted): 1990 2014
Periods included: 25
Cross-sections included: 40
Total panel (unbalanced) observations: 706

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.928105 | 0.021824 | 88.34924 | 0.0000 |
| LABPRO | -24.21947 | 10.98753 | -2.204268 | 0.0279 |
| M2GDP | -0.425348 | 0.082010 | -5.186541 | 0.0000 |
| MARCAP | 0.017289 | 0.018888 | 0.915345 | 0.3603 |
| TRADEOPENESS | 0.187615 | 0.073456 | 2.554132 | 0.0109 |
| WTI | 3.771286 | 1.872363 | 2.014185 | 0.0444 |
| RNWSOUR | -1.010705 | 0.304542 | -3.318774 | 0.0010 |
| C | 8.942438 | 11.97313 | 0.746876 | 0.4554 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.926591 | Mean dependent var | 10.43084 |
| Adjusted R-squared | 0.921467 | S.D. dependent var | 87.73024 |
| S.E. of regression | 24.58536 | Akaike info criterion | 9.306432 |
| Sum squared resid | 398326.0 | Schwarz criterion | 9.609976 |
| Log likelihood | -3238.171 | Hannan-Quinn criter. | 9.423724 |
| F-statistic | 180.8276 | Durbin-Watson stat | 1.179309 |
| Prob(F-statistic) | 0.000000 | | |

Result of Corruption Perception Index

Dependent Variable: INF
Method: Panel Least Squares
Date: 06/21/18 Time: 23:29
Sample (adjusted): 1989 2014
Periods included: 18
Cross-sections included: 41
Total panel (unbalanced) observations: 498

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 0.205153 | 0.021075 | 9.734650 | 0.0000 |
| LABPRO | -9.236267 | 3.482730 | -2.652019 | 0.0083 |
| M2GDP | -0.061387 | 0.025100 | -2.445698 | 0.0148 |
| MARCAP | 0.003366 | 0.005095 | 0.660717 | 0.5091 |
| TRADEOPENESS | 0.057703 | 0.018879 | 3.056495 | 0.0024 |
| WTI | -1.396400 | 0.542201 | -2.575429 | 0.0103 |
| CORRP | -0.159252 | 0.313456 | -0.508053 | 0.6117 |
| C | 11.10288 | 2.683834 | 4.136947 | 0.0000 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.567611 | Mean dependent var | 5.540984 |
| Adjusted R-squared | 0.522450 | S.D. dependent var | 7.793314 |
| S.E. of regression | 5.385567 | Akaike info criterion | 6.296741 |
| Sum squared resid | 13051.95 | Schwarz criterion | 6.702582 |
| Log likelihood | -1519.888 | Hannan-Quinn criter. | 6.456019 |
| F-statistic | 12.56871 | Durbin-Watson stat | 0.769397 |
| Prob(F-statistic) | 0.000000 | | |

Result of Corruption and Renewable Source

Dependent Variable: INF
Method: Panel Least Squares
Date: 07/17/18 Time: 01:45
Sample (adjusted): 1998 2014
Periods included: 17
Cross-sections included: 40
Total panel (unbalanced) observations: 493

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 0.199357 | 0.021317 | 9.352106 | 0.0000 |
| LABPRO | -8.989333 | 3.498874 | -2.569207 | 0.0105 |
| M2GDP | -0.053709 | 0.025401 | -2.114418 | 0.0350 |
| MARCAP | 0.003591 | 0.005111 | 0.702677 | 0.4826 |
| TRADEOPENESS | 0.050681 | 0.019388 | 2.613978 | 0.0093 |
| WTI | -1.284344 | 0.548353 | -2.342186 | 0.0196 |
| RNWSOUR | 0.189367 | 0.107824 | 1.756249 | 0.0797 |
| CORRP | -0.093276 | 0.315311 | -0.295820 | 0.7675 |
| C | 5.768033 | 4.068273 | 1.417809 | 0.1569 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.571320 | Mean dependent var | 5.516351 |
| Adjusted R-squared | 0.526044 | S.D. dependent var | 7.810648 |
| S.E. of regression | 5.377199 | Akaike info criterion | 6.294503 |
| Sum squared resid | 12866.85 | Schwarz criterion | 6.703478 |
| Log likelihood | -1503.595 | Hannan-Quinn criter. | 6.455081 |
| F-statistic | 12.61853 | Durbin-Watson stat | 0.767248 |
| Prob(F-statistic) | 0.000000 | | |

## Appendix E: Investigate Interaction between Crude Oil with Corruption and Renewable Source

Result of Interaction between Crude Oil and Corruption

Dependent Variable: INF
Method: Panel Least Squares
Date: 06/21/18 Time: 23:39
Sample (adjusted): 1989 2014
Periods included: 18
Cross-sections included: 41
Total panel (unbalanced) observations: 498

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 0.203774 | 0.021077 | 9.668072 | 0.0000 |
| LABPRO | -10.01530 | 3.524707 | -2.841457 | 0.0047 |
| M2GDP | -0.065682 | 0.025267 | -2.599514 | 0.0096 |
| MARCAP | 0.003805 | 0.005100 | 0.746179 | 0.4559 |
| TRADEOPENESS | 0.054861 | 0.018972 | 2.891684 | 0.0040 |
| WTI | -0.261076 | 0.984813 | -0.265102 | 0.7911 |
| CORRP | 1.476008 | 1.225337 | 1.204573 | 0.2290 |
| INTERACTIVE_WTI_CORRUP | -8.911161 | 6.455611 | -1.380375 | 0.1682 |
| C | 11.71449 | 2.717502 | 4.310756 | 0.0000 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.569438 | Mean dependent var | 5.540984 |
| Adjusted R-squared | 0.523409 | S.D. dependent var | 7.793314 |
| S.E. of regression | 5.380157 | Akaike info criterion | 6.296522 |
| Sum squared resid | 12996.80 | Schwarz criterion | 6.710818 |
| Log likelihood | -1518.834 | Hannan-Quinn criter. | 6.459119 |
| F-statistic | 12.37132 | Durbin-Watson stat | 0.775031 |
| Prob(F-statistic) | 0.000000 | | |

Result of Interaction between Crude Oil and Renewable Source

Dependent Variable: INF
Method: Panel Least Squares
Date: 06/21/18 Time: 23:38
Sample (adjusted): 1990 2014
Periods included: 25
Cross-sections included: 40
Total panel (unbalanced) observations: 706

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.928882 | 0.021775 | 88.58428 | 0.0000 |
| LABPRO | -24.16003 | 10.96117 | -2.204148 | 0.0279 |
| M2GDP | -0.419624 | 0.081861 | -5.126076 | 0.0000 |
| MARCAP | 0.018806 | 0.018858 | 0.997244 | 0.3190 |
| TRADEOPENESS | 0.193022 | 0.073327 | 2.632346 | 0.0087 |
| WTI | 7.841329 | 2.729977 | 2.872305 | 0.0042 |
| RNWSOUR | -0.451628 | 0.408771 | -1.104844 | 0.2696 |
| INTERACTIVE_WTI_RNWSOUR | -33.52721 | 16.40053 | -2.044277 | 0.0413 |
| C | 34.44304 | 17.27055 | 1.994322 | 0.0465 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.927054 | Mean dependent var | 10.43084 |
| Adjusted R-squared | 0.921844 | S.D. dependent var | 87.73024 |
| S.E. of regression | 24.52628 | Akaike info criterion | 9.302934 |
| Sum squared resid | 395812.2 | Schwarz criterion | 9.612936 |
| Log likelihood | -3235.936 | Hannan-Quinn criter. | 9.422721 |
| F-statistic | 177.9228 | Durbin-Watson stat | 1.187576 |
| Prob(F-statistic) | 0.000000 | | |

## Appendices F: Investigate the Role of Level of Development

Result of Corruption

Dependent Variable: INF
Method: Panel Least Squares
Date: 07/08/18 Time: 17:45
Sample (adjusted): 1989 2014
Periods included: 18
Cross-sections included: 41
Total panel (unbalanced) observations: 498

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 0.209894 | 0.021420 | 9.799045 | 0.0000 |
| LABPRO | -9.850517 | 3.521040 | -2.797616 | 0.0054 |
| M2GDP | -0.066460 | 0.025234 | -2.633744 | 0.0087 |
| MARCAP | 0.003197 | 0.005107 | 0.626027 | 0.5316 |
| TRADEOPENNESS | 0.058622 | 0.019101 | 3.069013 | 0.0023 |
| WTI | 0.104660 | 1.011804 | 0.103439 | 0.9177 |
| CORRUP | 2.119744 | 1.293416 | 1.638873 | 0.1019 |
| INTERACTIVE_WTI_CORRUP | -11.00954 | 6.589352 | -1.670809 | 0.0955 |
| INTERACTIVE_WTI_CORRUP_DCDUMMY | -2.183750 | 1.423111 | -1.534490 | 0.1256 |
| C | 11.19294 | 2.734616 | 4.093058 | 0.0001 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.571689 | Mean dependent var | 5.540984 |
| Adjusted R-squared | 0.524843 | S.D. dependent var | 7.793314 |
| S.E. of regression | 5.372060 | Akaike info criterion | 6.295296 |
| Sum squared resid | 12928.84 | Schwarz criterion | 6.718047 |
| Log likelihood | -1517.529 | Hannan-Quinn criter. | 6.461211 |
| F-statistic | 12.20347 | Durbin-Watson stat | 0.789369 |
| Prob(F-statistic) | 0.000000 | | |

## Result of Renewable Source

Dependent Variable: INF
Method: Panel Least Squares
Date: 07/08/18 Time: 17:42
Sample (adjusted): 1990 2014
Periods included: 25
Cross-sections included: 40
Total panel (unbalanced) observations: 706

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MONGROWTH | 1.930086 | 0.021655 | 89.12943 | 0.0000 |
| LABPRO | -24.10266 | 10.89897 | -2.211463 | 0.0273 |
| M2GDP | -0.393286 | 0.081894 | -4.802389 | 0.0000 |
| MARCAP | 0.014099 | 0.018820 | 0.749145 | 0.4540 |
| TRADEOPENNESS | 0.193020 | 0.072911 | 2.647349 | 0.0083 |
| WTI | 8.356555 | 2.720206 | 3.072031 | 0.0022 |
| RNWSOUR | -0.482977 | 0.406593 | -1.187864 | 0.2353 |
| INTERACTIVE_WTI_RNWSOUR | -25.90318 | 16.51495 | -1.568468 | 0.1173 |
| INTERACTIVE_WTI_RNWSOUR_DCDUMMY | -9.245861 | 3.165011 | -2.921272 | 0.0036 |
| C | 23.94601 | 17.54444 | 1.364878 | 0.1728 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.927989 | Mean dependent var | 10.43084 |
| Adjusted R-squared | 0.922728 | S.D. dependent var | 87.73024 |
| S.E. of regression | 24.38706 | Akaike info criterion | 9.292862 |
| Sum squared resid | 390736.9 | Schwarz criterion | 9.609322 |
| Log likelihood | -3231.380 | Hannan-Quinn criter. | 9.415144 |
| F-statistic | 176.3886 | Durbin-Watson stat | 1.213137 |
| Prob(F-statistic) | 0.000000 | | |