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Oil prices and Economic Growth: Cases of Canada and USA

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ABSTRACT

The effects of oil prices on economies has been subjected to a lot of scrutiny since the 1960's. This study conducts an analysis of the impact of oil price shocks on two oil exporting nations, Canada and USA. The transmission mechanisms of oil price changes to any economy vary from the supply effect to the demand effect. High crude oil prices impact the Canadian economy and USA through a variety of channels, in both positive and negative ways. Ceteris paribus more revenue is made when oil prices increase. In this study, I run an ordinary least square estimation with time series data from 1960-2017. The analysis showed a 0.20% increase economic growth in Canada and a 0.18% increase in USA when there is percentage increase in oil prices. Thus, there is a positive relationship between oil prices and economic growth.

Keywords: Oil Prices, Economic growth, Canada, Gross Domestic Product (GDP), USA

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LIST OF ABBREVIATIONS

USA = United States of America

GDP = Gross Domestic Product

CPI = Consumer Price Index

VAR = Vector autoregression

OLS = Ordinary Least of Squares

GARCH = Generalized autoregressive conditional heteroscedasticity

OECD = Organisation for Economic Cooperation and Development

1. Introduction

Oil prices has always been an indicator for economic growth and stability in modern times. The prevailing views among economists is that there is a strong relationship between the growth rate and changes in oil prices (Akpan, 2009). The purpose of this paper is to examine the effect of oil prices on Gross Domestic Product (GDP) on developed countries most especially Canada and United States of America (USA). Does the oil industry contribute significantly to Gross Domestic Product (GDP)? How does inflation caused by oil prices affect general consumption? What is the overall impact of oil prices on household, businesses and investors? How does oil price affect some macroeconomic variables like inflation, unemployment, foreign exchange just to mention a few and its policy implications? What reactions does the government take in reaction to oil price changes and the corresponding effects?

There is a majority of empirical work that addresses whether or not a long-term relationship exists between oil prices and GDP. However, it is well known that asymmetries exist in the links between the two variables (Lardic and Mignon 2008). Oil prices can have positive or negative impact on GDP growth depending on whether the country is an oil importing country or an oil exporting country. Oil price shocks have negative impacts on GDP of oil importing countries like Germany. Literature from econometric studies like Darby (1982) seems to have evidence for this plausible result. Research with structural models also concludes that oil importing countries are negatively hit by rising oil prices. The International Energy Agency (2004) found out in simulations with its World Energy Model that in all OECD countries a rise of the oil price will reduce GDP and raise inflation. In addition, higher oil prices for oil importing countries leads to higher cost of production. Since oil is directly to production process, it can have significant effect on employment

and output. In some cases, this affects consumer prices and importantly reduces general welfare of individuals.

Further studies by Olomola (2006) and Akpan (2009) indicated that for oil-exporting countries like USA, Saudi Arabia Nigeria and Canada, price surge directly increases income because of higher export earnings and rising oil prices promote economic growth. Ceteris paribus, when there is an increase in oil prices, there is a corresponding transfer of income from importing to exporting countries through a shift in terms of trade. Another advantage for oil exporting countries is that, oil price increases leads to higher supply. The country improves technology to find new means of enhancing supply which is generally good. With regards to developing and developed countries, appreciation of domestic currency positively relates with economic growth in a developed country. On the other hand, increased oil prices decrease demand and worsen the balance of current accounts in oil producing countries. This situation generally causes depreciation of the domestic currency, which relates positively with growth in developing countries in general. Nonetheless, these changes correlate negatively with growth in developed countries. Studies has indicated that appreciation in exchange rates makes the import prices cheaper hence economic growth. More specifically, economic activity responds asymmetrically to oil price shocks. Indeed, rising oil prices appear to retard aggregate economic activity by more than falling oil prices stimulate it. There is the need to distinguish positive and negative increments of time series allowing breaking down a series into its initial value and its negative and positive cumulative sums. Asymmetric co-integration comes from the analysis of multivariate combinations arising from this decomposition (Iwayemi and Fowowe 2010). On the demand side, higher oil prices increase the general level of prices of goods and services that are either complements or related to oil. Thus, with the increase in prices of goods and services comes with a reduction in real income hence affecting household

general consumption. Demand consequently falls. Regarding supply, soaring oil price results in a decrease in demand for inputs for production leading to decline of output. When oil prices spike, one can expect gasoline prices to spike as well and that affects the costs faced by the vast majority of households and businesses. Oil price increases will increase inflation and reduce economic growth. About a macroeconomic variable like inflation, oil prices directly affect the prices of goods made with petroleum products. Oil prices would indirectly affect costs such as transportation, manufacturing, and heating. The increase in these costs can in turn affect the prices of a variety of goods and services, as producers may pass production costs on to consumers and possibly creates unemployment because of high cost of production.

The focus of this research would pertain to oil exporting countries specifically Canada and USA. These counties are in North America and are neighbours that produce large quantities of oil. Both countries are developed and the interest to find the relationship of its oil and GDP growth as my past research conducted focused on a developing country (Nigeria) that exports oil as well. There are a lot of similarities between these two countries. However, differences between Canada and USA would be size of the GDP, land mass and population.

Data in this paper are obtained from World Bank, Statistics Canada, Census Bureau, and Data USA among other relevant sources. The data will be from 1960-2017. This will aid to answer the research questions and highlight variables necessary to prove my conclusion. Therefore, this study will make use of a simple Ordinary Least Squares (OLS) estimation regression and Vector autoregression (VAR) model to analyze the impact of oil price shocks on macroeconomic variables. The VAR provides a framework for assessing the effects of a particular variable on other variables and because all variables are considered as endogenous variables, the structural relationships are free of a priori restrictions. Given that, the response to oil prices can be

asymmetric, I study the OLS and the VAR system for this research. In addition, I will do the Granger-causality test on the macroeconomic variables and determine its significance. The Granger-causality test would conclude that there is an interaction between oil price and economic growth. The production function will be $Y= A(K^{\alpha}L^{1-\alpha})^{\beta}(Land)^{1-\beta}$ where Y represents output, A represents Research and Development, K and L representing investments and labor force respectively. Land represents the natural resource (oil) in both countries. Nevertheless, GDP per capita with population will be computed in order to measure the actual impact on individuals of the countries in regard.

The main findings may be summarised as follows: First, it is hypothesised that declining oil price has a negative and significant impact on economic growth in the both Canada and the USA. When allowing for slope heterogeneity, oil price changes is found to have a negative impact on the real GDP growth of all countries. I find a positive relationship between oil prices and economic growth where a one percent increase in oil price will lead to a 0.20% and 0.18% in GDP for Canada and USA respectively however depending the macroeconomic variable, there can be an adverse significant relationship.

This paper is organized as follows: Section 2 reviews related literature and information that already exists between Canada, United States of America, other developed countries as well as developing countries about their economic growth and oil prices. The section also discusses the effects of increasing oil prices on production, inflation and other significant macroeconomic variables like unemployment and investment. Section 3 introduces a growth model with natural resource and hypothesis. Section 4 describes the data. Section 5 outlines the estimates and empirical analysis of our research. The final section encompasses the outcomes and offer some conclusions and suggestions for future work.

2. Literature Review

Given the importance of oil in the global economy, the impact of oil price changes on economic activity has received significant attention in the literature. The interest can be justified – not only is oil the most traded commodity in the world, it is still the world's largest energy source, providing 33 percent of global primary energy consumption. Its dominance in the transport sector, where it represents 94 percent of energy used, further underlines its importance (Eyden et al., 2019). The relationship between oil price and economic growth has received a plethora of theoretical and empirical research over the past decades. The impact of oil price fluctuations is different for oil-importing and oil-exporting countries. In general, oil price increases are good news for oil-exporting countries and bad news for importing countries. Oil price changes creates uncertainty on aggregate economic activity. This leads to postponement of investment, which in turn, leads to temporary declines in aggregate output level. For example, a firm engaged in energy exploration may postpone investment if it cannot distinguish whether an increase in energy prices is permanent or transitory. Similarly, an automobile manufacturer may defer committing new resources to the production of either hybrids or S.U.V.s if it cannot discern whether a decrease in energy prices is lasting or temporary.

Theoretically, the same holds true for consumers, who also postpone expenditures in the wake of increased oil market volatility. Thus, volatility in the oil price creates uncertainty about its future path, resulting in consumers and firms postponing expenditure and investment, and potentially requiring costly reallocation of resources. This channel through which energy prices may affect aggregate economic activity is fascinating because it represents one possible explanation for the apparent skewness in the effect of energy prices on output growth — that is, the apparent failure of falling energy prices to stimulate output growth equal to the decline in output growth correlated

with increasing energy prices. Elder and Serletis (2009) find evidence in support of this mechanism, showing that oil prices changes has the tendency to depress U.S. output, investment and consumption, in data samples post-1980 and in samples post-1987. In particular, a rise in the oil price may have an adverse effect on economic activity, but an oil price decline may not necessarily lead to increased output levels. Bashar et al (2013), in support of this argument, find that shocks to oil price level do not affect the aggregate level of output of the Canadian economy; on the other hand, oil price changes make a major contribution to overall variation in output level. They report a significant decline in both output and prices following increased oil price precariousness, resembling an adverse demand shock. Studies show that increases in oil prices impair macroeconomic activity in both oil-importing and oil-exporting countries through supply-side as well as demand-side channels involving trade, unemployment, investment, interest rates and inflation.

While many empirical studies have concentrated on the correlation between oil price level changes or shocks and economic activity, the literature that investigates the linkage between oil price volatility (often associated with the standard deviation in a given period) and macroeconomic performance is also quite voluminous. Numerous researchers report empirical facts that increased oil price uncertainty is associated with fragile macroeconomic activity. Early studies by Ferderer (1996) and Sadorsky (1999) found that oil price changes has a negative and significant effect on growth in gross domestic product. Investigation conducted on the impact of oil price uncertainty on investment in the USA using a multivariate GARCH in-mean VAR model and conclude that fluctuations in the oil price tend to depress certain components of aggregate investment in developing countries. In addition, Yoon and Ratti (2011) show that increased energy price uncertainty has an adverse effect on the economy through the demand channel, as suggested by

the theory of irreversible investment. The authors argue that cautious behaviour on the side of US manufacturing firms due to oil price uncertainty reduces the responsiveness of investment spending to sales growth. Elder and Serletis (2009), Rahman and Serletis (2012) and Bashar et al. (2013) also draws similar conclusions for other G7 countries. Ali Ahmed et al (2012) study the impact of oil price uncertainty on US industrial production by decomposing oil price volatility into permanent and transitory components. Their decompositions provide important evidence on sources an asymmetric effects of oil price volatility. Their results suggest that shocks to the transitory component induce increased volatility in the general price level and non-fuel commodity prices in the US. Ji and Fan (2012) further reports price and volatility spillovers from the crude oil market to non-energy commodity markets which demonstrates its core position among commodity markets. Persistently, high crude oil prices impact the Canadian economy through a variety of channels, in both positive and negative ways. As the world's sixth largest producer of crude oil and a net exporter of the commodity, higher crude oil prices are a boom for Canada's resource-rich provinces (notably Alberta, Saskatchewan, and Newfoundland & Labrador) they stimulate production, investment, consumer spending, employment and wages. Kremmidas (2015) noted that Canada's oil-intensive sectors—including manufacturing and transportation—face an increase in production costs, potentially slowing economic activity. Also, higher oil prices would be expected to lead initially to a reduction in the earnings of businesses producing energy-intensive output and in their market valuations. Conversely, she indicated, it would boost profits at many energy companies. This is beecause the Toronto Stock Exchange is heavily weighted towards energy stocks, many Canadian shareholders including pensioners who own equity through Registered pension plans, Registered retirement savings and mutual funds tend to benefit from a rise in oil prices.

Elder and Serletis (2009) found evidence that oil prices tends to reduce output in the United States. Their paper finds a similar effect on Canadian output — increase in changes about oil prices has tended to decrease Canadian industrial production, output in goods producing industries and mining and oil and gas extraction. The results provided additional evidence of an asymmetry in the response of output to oil shocks. A negative oil shock (lower prices), if accompanied by an increase in uncertainty about future oil prices, will not stimulate output as much as an positive oil shock (higher prices) tends to decrease output. They also show that output in Canada declined in the mid-1980s as oil prices collapsed and uncertainty about oil prices soared — a pattern similar to that for the United States. Impulse-response analysis indicates that accounting for the effects of oil price uncertainty tends to reinforce the negative response of output to a positive oil shock. In addition, the research also provide evidence that the theory of investment under uncertainty with real options may explain some features of aggregate output. As indicated earlier, the impact of oil price rises on net exporting oil economy is positive. This direct impact can be referred to as the revenue effect (Rafiq et al., 2016). The revenue effect is likely to improve terms of trade for oil exporters resulting in increases in revenue, terms of trade and increases in both consumption and investment.

Olomola (2006) and Akpan (2009) indicated that for net-oil exporting countries, a price surge in oil prices directly increases income because of higher export earnings and rising oil prices promote economic growth. This is evident since oil revenue gained from the exports increases GDP. All things being equal, oil prices and appreciation of domestic currency relate positively with economic growth. Darby (1982) showed that oil price surges result from increases in demand rather than from supply sides effects. These articles have demonstrated empirically that surges in oil prices cause economic growth.

Furthermore, other studies showed that oil price volatility and resulting shocks leads to negative economic growth. Gounder and Bartleet (2007) noted that demand-side shocks of energy crisis could result in high inflation and high unemployment rates. Bernanke (1983) demonstrated in a partial equilibrium model that oil price shocks would tend to reduce value added, because firms will defer irreversible investment decisions as they endeavour to find out whether the increase in oil price is temporary or lasting. Thus, producers will find it more and more desirable to postpone permanent investment decisions when they are uncertain about future crude oil price changes. Such decisions are also likely to negatively affect the growth of output of an economy. Kremmidas (2015), conversely deduced that continuous high prices would further slow down the U.S. economy reflecting the country's dependence on oil imports, and drive up the Canadian dollar creating headwinds for Canadian exporters. Hence the relationship between oil prices and economic growth can be negative because increased oil prices decrease demand and worsen the balance of current accounts in oil-producing countries like Canada and United States of America. Mork (1989) indicated that increases and decreases in oil prices as a separate variable allowed for an asymmetric response of the U.S economy activity. He revealed that the effects of oil price increases are different from those of decreases and that oil price decreases are not statistically significant in the US. This suggested a movement from the linear specifications in which oil price increases and decreases have symmetrically equal impacts on real economic activity.

The studies mentioned above leave no clear solution whether oil price affects economic growth, vice versa or whether there is an unknown variable guiding them in certain directions. A possible reason why there are so many different conclusions regarding the subject is the usage of various different models. By using one model a certain solution is found, while another one might find the opposite results.

3. Economic Model

Since the objective of the study is to examine the relationship between economic growth and oil price, the study adopts a widely used general production function. I consider a growth model that includes natural resource:

$$Y= A(K^{\alpha}L^{1-\alpha})^{\beta}(Land)^{1-\beta}$$

Where Y is the flow of output and A represents Research and Development, which is the technology employed by capital and labour force in the extraction of the oil. K and L representing investments and labor force respectively in both countries. This encompasses the machinery that manpower uses. Furthermore, this aids in identifying how skilled and efficient capital and labor in the countries in regard, extract oil. High skilled labor and capital is characterised by high productivity. Land represents the natural resource (oil) in both countries. I expect all three factors will affect the flow of output positively. Specifically, I assume:

$$\frac{\partial Y}{\partial K} > 0, \qquad \frac{\partial Y}{\partial A} > 0, \qquad \frac{\partial Y}{\partial L} > 0 \quad \frac{\partial Y}{\partial Land} > 0$$

In other words, Y(t) is an increasing function of K(t), A(t), L(t) and Land.

Apart from the traditional input of production, the model also assumes other conventional inputs. Literature on economic growth indicates that, there are multitudes of potential variables that can affect the production function. However, owing to the data available, the study examined the following variables of interest resulting in:

$$lnGDPCapita = \beta_1 + \beta_2 lnoilprice + \beta_3 Xi + \varepsilon i$$

where *lnGDPCapita* is the natural logarithm for Gross Domestic Product per capita in both

countries, β_1 is the constant term which has no economic meaning, β_2 is the coefficient of our main exogenous variable, oil prices, β_3 is the coefficient of other explanatory variables and εi is the error term.

There is a link between the production function mentioned above and the regression equation. Considering the production function, GDP represents the output as a result of production. The gross capital formation represents capital and the research. Unemployment rates reiterates the labor force that was used in the production process and the land represents the natural resource of oil.

4. Data

The paper uses annual data from 1960 to 2017 for Canada and USA. The motivation behind selecting this period is to capture all the effects of oil price distortions that were experienced by the world, as a result of the recession in 2008. Clearly, the larger the number of observations the more valid the result. Statistics Canada was the main source of data for our variables for Canada. The World Bank was also a major source of data for both Canada and most especially the United States. The World Bank was again the source for oil prices used. The crude oil prices is usually quoted in US dollars and thus for the purpose of this study, the US dollar price of crude oil will be maintained for both countries All units of data would be in US dollars for a better analysis.

Detailed information is shown in Table 4.1

Table 4.1: Explanation of the variables

Variable	Variable name on StataMP	Measurement in raw data	Source
Gross Domestic Product per Capita - USA	*GDPCapita*	Annual gross domestic product per capita	World Bank
Gross Domestic Product - Canada	*GDPCapita*	Annual gross domestic product	World Bank
Oil prices - USA	*oilprice*	Annual average prices in US dollars	WDI
Oil prices - Canada	*oilprice*	Annual average prices in US dollars	WDI
Government Consumption Expenditure - USA	*Govtconsump*	Annual government expenditure	WDI
Government Consumption Expenditure - Canada	*Govtconsump*	Annual government expenditure	WDI
Inflation - USA	*inflation*	Annual inflation rates	World Bank
Inflation - Canada	*inflation*	Annual inflation rates	Statistics Canada
Unemployment Rate - USA	*unemployment*	Annual unemployment rate	World Bank
Unemployment Rate - Canada	*unemployment*	Annual unemployment rate	World Bank
Research and development- USA	*rnd*	Annual values of gross capital formation	World Bank
Research and development - Canada	*rnd*	Annual values of gross capital formation	World Bank
Net Exports - USA	*netexports*	Annual net exports	World Bank
Net Exports - Canada	*netexports*	Annual net exports	World Bank

Source: Authors' compilation

For the purpose this empirical analysis, I decided to detrend all our variables on time. This is to eliminate any form of distortion from our results. Also, I transformed the two main variables to include logarithms in order to measure the percentage change. These variables are the Gross Domestic Product per capita and oil prices. The descriptions of the variables in the model are as follows:

1. Gross domestic product per capita (*GDPCapita*)

GDP is one of the primary indicators used to gauge the health of a country's economy. However, GDPCapita measures the country's output that accounts for its number of people. In other words, it measures the standard of living. I generated "*lnGDPCapita"* as the logarithm of gross domestic product per capita to measure the percentage effect. It is also the endogenous variable for the regression model. I expect a positive relationship between oil revenue and oil prices hence rise in GDP ceteris paribus.

2. Oil Prices. (*oilprice)*

Oil prices is the main exogenous variable as it is the main variable under focus. It is basically the prices of crude oil from 1960-2017. Logarithm of oil prices was generated in order to measure the percentage effect.

3. Inflation (*inflation*)

It is a direct measure of general prices of goods and services. This variable is used in order to observe how prices of goods and services are affected by changes in oil prices. This generally affects individuals spending as well as businesses. An increase in inflation imply rise in price level which will lead to a reduction in consumption and consequently a reduction in GDP. It is thus

significant to include inflation in the model. A negative relationship is therefore expected for inflation.

4. Net Exports (*netexports*)

Net exports refers to the difference between a country's exports and its imports. Since no country is an island USA and Canada have trades with other countries. It is a measure used to aggregate a country's expenditures or gross domestic product in an open economy. I generated the logarithm of the net exports to measure the percentage effects on GDP

5. Unemployment (*unemployment*)

Unemployment rates is simply defined as the annual average percentage of people willing to work in the labor force but do not have jobs. The unemployment rate provides insights into the economy's spare capacity and unused resources. Here I would like to examine the relationship unemployment rates affects production.

6. Gross Capital Formation. (Grosscapitalformation)

This variable is used to represent investment in technology to enhance production of oil. According to the Solow Growth model, investment is considered a significant factor of output hence a positive sign is expected.

7. Government Consumption Expenditure. (*Govtconsumptionexpenditure*)

This variable is used to represent the government aggregate transaction amount of a country's GDP spent on goods and services that are used for the direct satisfaction of individual needs. Here the oil prices thus have a direct effect of government spending. I expect a negative relationship between government consumption expenditure and GDP since high crude oil prices will lead to higher prices hence government reducing its expenditure on general goods and services.

I used the following multivariate regression model to capture the significance of oil prices on GDP.

$lnGDPCapita = \beta_1 + \beta_2 lnoilprice + \beta_3 inflation + \beta_4 lnnetexports + \beta_5 unemployment + \beta_6 grosscapitalformation + \beta_7 Govtconsumptionexpenditure$

Table 4.2: Summary of Data- Canada

Variable	Observations	Mean	Std Deviation	Min	Max
lnGDPCapita	58	10.43	0.30	9.77	10.84
lnoilprice	58	3.74	0.52	2.91	4.74
Government Consumption Expenditure	58	2.92	2.77	-1.90	13.10
Inflation	57	3.98%	3.29%	-2.29%	15.19%
Net Exports	58	3.90	2.02	-3.94	4.57
Unemployment	58	7.95%	1.74%	4.70%	12.01%
Gross Capital Formation	58	22.60	2.12	18.43	26.38

Source: Authors' compilation

Table 4.3: Summary of Data- United States America

Variable	Observations	Mean	Std Deviation	Min	Max
lnGDPCapita	58	10.42	0.33	9.77	10.88
lnoilprice	58	3.74	0.52	2.92	4.74
Government Consumption Expenditure	58	1.41	1.61	-3.01	4.92
Inflation	58	3.78%	2.80%	0.75%	9.33%
Net Exports	48	-3.13	3.07	-8.37	8.91
Unemployment	58	6.03%	1.55%	3.5%	9.7%

Gross Capital Formation	58	22.19	1.58	17.51	25.07

Source: Authors' compilation

Table 4.2 and 4.3 reports descriptive statistics the full sample of USA and Canada.

5. Empirical analysis

5.1 OLS Results

The objective is to investigate if there is any direct influence of the explanatory variable, which is the oil price on economic growth. Following other studies like Iwayemi et al. (2011), six macroeconomic variables are used, and these are GDP per capita, inflation, net exports, unemployment and gross capital formation. For all regression, the dependent variable is economic growth measured in terms of GDP per capita. Data chosen are annually for both Canada and United States of America. The time series is from 1960 -2017. To examine the relationship between economic growth and oil prices, I examine the following general econometric model using the time series data.

Based on the economic model introduced above, I consider stock of gross capital formation, inflation and unemployment rates as other explanatory variables that may potentially affect the endogenous variable. To further estimate the econometric model, considering the availability of data, I used the natural logarithm of GDP per capita, β is the vector coefficient of each variable with indicating the constant term. *Oil price* is the main explanatory variable for this study. All things being equal, an increase in oil prices is considered positive in oil exporting countries. It is important to note that market interactions determine oil prices for both USA and Canada. The first of the other explanatory variables is gross domestic capital formation. This variable fills in for

capital input in the production process for Canada and USA. Generally, the higher the capital formation of an economy, the faster an economy can grow its aggregate income. Hence, my expectation follows this analogy. The variable inflation is crucial to measure the significance of other prices of goods and services on the respective GDP's of US and Canada. The final explanatory variable is unemployment rates. Unemployment rate is defined as the percentage of unemployed workers in the total labor force. It is widely recognized as a key indicator of labor market performance. Unemployment is important because it serves primarily as a measurement of economic health. Having defined our explanatory variables, the main specification of interest is as follows:

$lnGDPCapita = \beta_1 + \beta_2 lnoilprice + \beta_3 inflation + \beta_4 lnnetexports + \beta_5 unemployment + \beta_6 grosscapitalformation + \beta_7 Govtconsumptionexpenditure$ where

lnGDPCapita is natural logarithm of GDP per Capita,

lnoilprice is natural logarithm prices of oil in US dollars,

netexports is the difference between a country's exports and its imports.

inflation is annual average inflation rates measured in percentages

unemployment is annual unemployment rates measured in percentages

grosscapitalformation is used to represent investment in capital to enhance production of oil

Govtconsumptionexpenditure is used to represent the government aggregate transaction amount of a country's GDP spent on goods and services that are used for the direct satisfaction of individual needs.

To see the effect of the exogenous variables on individual lives in both countries, I consider the specification with GDP per capita as the dependent variable. I included the gross capital formation

in order to ascertain the effect capital input changes has on oil prices and GDP. Studies mentioned above leave no clear solution whether oil price affects economic growth positively or negatively however we expect a positive relationship between oil prices, oil revenue and economic growth. This is because, all things being equal, as prices increase, revenue increases and hence a corresponding increase in gross domestic product. I also predict that the gross capital formation and exchange rates have positive effect; and unemployment rate has negative effect on GDP per capita growth rate. To eliminate any linear trend from our time series data to see the actual correlations, I de-trended our data in stata and used the de-trended data in our multivariate regression analysis. Using the OLS estimation technique in stata, I obtained the following estimation results:

Table 5.1 – OLS regression results

Coefficient estimates, Standard Errors and P-Values		
Variables	**Canada**	**USA**
Constants	9.850***	11.271***
Standard Error	(0.675)	(0.278)
P-values	**0.000**	**0.000**
Lnoilprice	0.201***	0.189***
Std Err.	(0.060)	(0.068)
P-values	**0.003**	**0.008**
Inflation	-0.034***	-0.038***
Std Err.	(0.009)	(0.009)

P-values	**0.002**	**0.000**
Lnnetexports	0.033**	0.034**
Std Err.	(0.015)	(0.013)
P-values	**0.042**	**0.017**
Unemployment	-0.037**	-0.070***
Std Err.	(0.019)	(0.018)
P-values	**0.068**	**0.001**
Grosscapitalformation	-0.015	-0.043***
Std Err.	(0.020)	(0.012)
P-values	**0.454**	**0.001**
Govtconsumptionexpenditure	-0.025**	0.007
Std Err.	(0.011)	(0.009)
P-values	**0.030**	**0.419**
R^2	0.74	0.88

Source: Authors' compilation using Stata

******* 1% significant level

****** 5% significiant level

***** 10% significant level

From Table 5.1 are estimates of an OLS regression for two for both countries. The signs of the coefficients are in line with a prior theoretical expectation and mostly appear statistically significant. The regression using *lnpercapita* will be used to show the impact of this economic

growth on the lives of each individual in these economies. Gross capital formation as a variable for capital was statically insignificant for Canada but statistically significant at one percent level. Per estimation of results in Table 5.1, the positive relationship between oil price and per capita GDP is significant at one per cent level. It is no surprise as a percentage increase in oil prices leads to a 0.201% increase in GDP per capita for Canada. In the USA however a percentage increase in oil prices leads to a 0.189% increase in per capita GDP. The difference of about 0.02% might be related to how large the US economy is as compared to Canada's economy. However, the trend of positive relationship between the two North American countries is the same as can be seen in figure 5.1 and 5.2.

Also, there was a negative relationship between gross capital formation and GDP for both countries. Since gross capital formation was an input with regards to investment on capital, it is however not expected to have a negative relationship. Investment represented by gross capital formation exert an affirmative influence on growth. In Canada, a unit increase in *gfc* decreases GDP per capita by 1.5% and 4.3% decrease for the USA. It is very important to mention that the result is largely statistically insignificant for Canada and thus does not reflect the true correlation of investment.

Inflation yields a negative relationship as expected to GDP. General rise in prices of goods and services reduces total consumption and this reduces general output. In Canada a unit increase in inflation will lead to a 3.4% decrease in GDP per capita. For USA, a unit increase in inflation leads to a 3.8% decrease in GDP per capita. Therefore, it is observed how inflation has a significant effect of GDP in USA when general prices increase. It is worth mentioning that the result is statically significant at one per cent level. Net exports have a positive relationship with GDP per capita for both USA and Canada. A percentage increase in net exports leads to 0.033% increase in

GDP per capita. This further explains that more revenue is gained by the increase in oil prices hence ability to produce more and export. The higher the exports yields revenue which intends contributes to GDP. Likewise, the USA, a percentage increase in net exports increase GDP per capita by 0.034%. This result is statistically significant at five percent. A unit increase in annual average unemployment rates leads to a 3.7% decrease in GDP per capita for Canada. This is because of the labor force lost whose contributions would have added up to GDP. This numeric result is statically significant at ten percent. The same directional trend of negative relationship of unemployment applies to the USA as well. A unit increase in unemployment rates in the USA leads to a 7.0% reduction in output per individual. This estimate for the USA is also statistically insignificant.

Figure 5.1- Canada

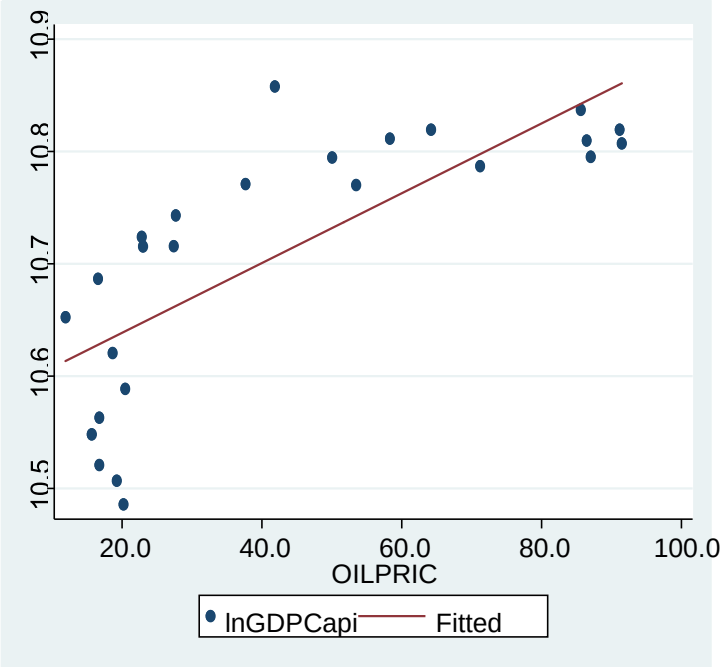
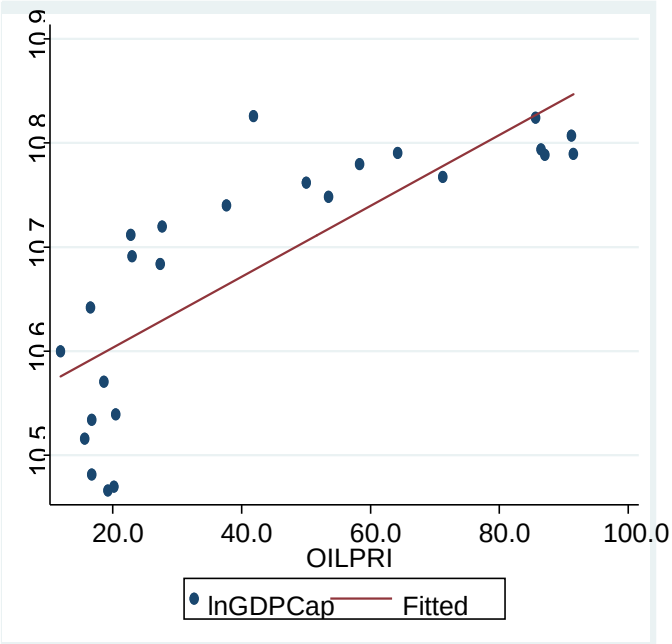


Figure 5.2- USA



Source – Authors compilation

5.2 Vector Autoregression Analysis

In this section, I conducted a VAR to model a general framework in order to describe the dynamic interrelationship between oil price and economic growth. Defining the relationship between oil price shocks and a country's GDP has proved a contentious issue as discussed extensively in the literature review. However, the measure of oil pricing determines the functional form of the relationship and it has been suggested that incorrect analysis of the link has contributed to the unstable empirical relationship observed between oil prices and macroeconomic variables (Hamilton, 2003). Studies have shown that unrestricted VARs perform better in the short run. Therefore, this research adopted the VAR model to analyze the impact of oil prices on macroeconomic variables specifically GDP. The VAR provides a framework for assessing the effects of a variable on other variables, the structural relationships are free of a priori restrictions (Farzanegan and Markwadt, 2009). After estimating the VAR, I would use the Granger-casualty tests to examine if oil price changes have a direct impact on the macroeconomy. The test would indicate whether oil prices is causal to GDP or vice versa. The equations below was used to obtain the results.

$$Y_t = \beta_1 + \beta_2 Y_{t-1} + \beta_3 Xt_{-1} + V^y$$

$$X_t = \beta_{11} + \beta_{21} Y_{t-1} + \beta_{31} Xt_{-1} + V^x$$

Where Y_t represents the GDP per capita for period t

X_t represents the in oil price for period t

β represents the respective coefficients

V represents the error term.

Table 5.2 shows the results of VAR

Table 5.2: Vector autoregression- Canada

Vector autoregression- Canada					
Sample: 1960 - 2017				Number of obs = 58	
Log likelihood = 146.393				Det(Sigma_ml) = 0.0000184	
FPE = 0.0000228				HQIC = -4.930	
Det(Sigma_ml) = 0.0000184				SBIC = -4.80	
Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_lnoilprice	3	0.244	0.014	0.804	0.669
D_lnGDPCapita	3	0 .0191	0.172	11.663	0.002
	Coef.	Std. Err.	z	P>|z	95% Conf.Interval
D_lnoilprice lnoilprice LD	0.056	0.137	0.41	0.682	-0.213 - 0 .325
lnGDPCapita LD.	1.075	1.600	0.67	0.502	-2.061 - 4.212
Cons	-0.010	0.043	-0.23	0.821	-0.096 - 0.076
D_lnGDPCapita lnoilprice |LD.	-0.020	0.010	-1.93	0.053	-0.042 - 0.000
lnGDPCapita LD.	0.402	0.125	3.21	0.001	0.157 - 0.647
Cons	0.011	0.003	3.37	0.001	0.004 - 0.018

Source – Author's compilation

From the Table 5.3, it observed that there is a positive relationship between oil price changes and the macroeconomic variable GDP per capita. Hence as oil prices increases, there is a tendency of individuals per capita increasing by 0.056%. The causal effect where GDP causes a change in oil prices result is -0.02% As a result of that, Canada experiences positive economic growth when oil

price increases and vice versa. The 95% confidence interval is a range of values that you can be 95% certain contains the true mean of the population. Thus, for Canada, we are certain the true mean for *lnoilprice* is contained between the values of -0.213 and 0.325. For *lnGDPCapita*, the true mean is between -0.042 and 0.000.

Table 5.3: Vector autoregression- USA

Vector autoregression- USA					
Sample: 1960 - 2017				Number of obs = 58	
Log likelihood = 145.97				Det(Sigma_ml) = -4.998	
FPE = 0.0000231				HQIC = -4.914	
Det(Sigma_ml) = 0.0000187				SBIC = -4.78	
Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_lnoilprice	3	0.244	0.017	1.016	0.602
D_lnGDPCapita	3	0 .018	0.159	10.610	0.005
	Coef.	Std. Err.	z	P>|z	95%Conf.Interval
D_lnoilprice lnoilpriceLD	0.078	0.133	0.59	0.556	-0.182 - 0 .338
lnGDPCapita LD.	1.293	1.600	0.81	0.416	-1.823 - 4.410
Cons	-0.015	0.044	-0.34	0.733	-0.102 - 0.072
D_lnGDPCapita lnoilprice|LD.	-0.023	0.010	-2.27	0.023	-0.043 - 0.003
lnGDPCapita LD	0.287	0.122	2.35	0.019	0.047 - 0.526

Cons	0.014	0.003	4.19	0.000	0.008 - 0.021

Source – Author's compilation

From the table, there is also a positive relationship between oil price and GDP per capita in the USA as well. It is also observed that most of the results are similar as the reason can be attributed to the fact that these two countries are developed, and the impact of oil price shocks are similar in many ways when their macroeconomic variables are concerned.

5.3 Granger-causality test

Results in Table 5.4 and Table 5.5 show the Granger-causality test. The results indicate that the null hypothesis that DlnGDPCapita will not Granger-cause Dlnoilprice cannot be rejected however the null hypothesis that Dlnoilprice will not Granger-cause DlnGDPCapita has to be rejected. In other words, oil price is a causality factor in GDP per capita. This decision is the same for both Canada and the USA. Thus, the results confirm findings of other studies which found oil price changes did have a significant effect on macroeconomic variables like net exports, inflation and unemployment Hooker (1996) and (Lorde et al. 2009). Oil price shocks do not Granger-cause because net exports as both Canada and USA have a large variety of exports and import transactions. Estimates obtained show that there is a little or no significant effect of negative oil shocks on the macroeconomy of both countries. This can be explained by the fact that both countries have a variety or diversity of sectors that contribute to their GDP.

Table 5.4 – Canada Granger causality Wald tests

Equation	Excluded	Chi2	df	Prob > chi2	Decision
D_lnoilprice	D.lnGDPCapita	0.451	1	0.502	Do not reject
D_lnGDPCapita	D.lnoilprice	3.736	1	0.053	Reject

Source – Author's compilation

Table 5.5 – USA Granger causality Wald tests

Equation	Excluded	Chi2	df	Prob > chi2	Decision
D_lnoilprice	D.lnGDPCapita	0.662	1	0.416	Do not reject
D_lnGDPCapita	D.lnoilprice	5.167	1	0.023	Reject

Source – Author's compilation

6. Conclusion

This research was conducted to identify the relationship between oil prices and economic growth between Canada and USA. There is an abundance of literature on the effects and such studies have largely proposed theoretical relationships. The findings in this paper showed that there is a positive relationship between oil prices and economic growth. Thus, rising oil prices means more oil revenue as both countries benefit from exporting oil. Households spending is thus boosted by this with higher income. If higher oil prices reflect global economic activity that encourages demand for oil, Canada and USA benefits as foreign demand increases. When the increase in prices is caused by higher world demand, the net effect for both countries GDP is positive. It is also observed that both countries have similar results and thus move in the same direction. This matches my expected results as both countries are similar in many ways. The similarity includes both countries being highly developed countries and do not significantly depend on oil. The economies

are diversified. The results of the Granger-causality tests showed that the linear oil price change does cause GDP per capita. The causality tests support the existence of asymmetric of oil price shocks as positive oil price shocks significantly cause output to shift.

For future work, I would add more developed countries to study if the trend for oil exporters is the same as it is the similar for USA and Canada. More so, regional data or provinces can be obtained and analyzed to ascertain the effects on provinces or regions that produce oil as against those that do not within a country. For example, effects of oil price on the province Alberta and the province Ontario. I would also consider using quarterly data for my analysis in order to capture the business cycles between periods. This would include using vector autoregression analysis technique and impulse response functions together with the variance decompositions to show the effects of oil prices on the adjustment path of the variables involved.

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