"Impact of oil price volatility on the Balance of Payment of oil-based economies"

A dissertation report submitted in partial fulfilment of requirements for

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Declaration

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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Mentor certificate

This is to certify that the dissertation report entitled **"Impact of oil price volatility on the balance of payment of oil-based economies"**, submitted by **Nishant Nair** to **UPES** for partial fulfilment of requirements for **Masters of Business Administration (Energy Trading)** is a bonafide record of the dissertation work carried out by him under my supervision and guidance. The content of the report, in full or parts have not been submitted to any other Institute or University for the award of any other degree or diploma.

(Dr. Hiranmoy Roy) Date:

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Abstract

There are several countries which are dependent on crude oil exports as their major source of income. This report investigates the impact of crude oil price volatility on the balance of payment of ten different countries taking the data from 2005 to 2015. The countries are selected based on their 2012 (pre-oil price crash) oil income shares in GDP. The correlation and causality between crude oil prices (independent variable) and balance of payment (dependent variable) is analysed for the ten countries.

The regression results indicate that the crude oil price and balance of payment of all countries except Libya are correlated and the degree of correlation is found to be high for most countries. But, the Granger causality test reveals cause-effect relationship between the two variables only for Angola, Venezuela and Chad.

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List of Variables

Dependent variable(s):

BoP – balance of payments

Independent variable(s):

GDP – gross domestic product

BoT – balance of trade

COP – crude oil price

IR - interest rate

InR - inflation rate

Introduction

The global oil and gas industry is divided into three distinct segments, the upstream segment i.e. Exploration & Production, the midstream i.e. Refining and the downstream sector, also known as Petroleum Retail & Marketing. Each of these segments is a vast industry in itself, boasting of investments and revenues greater than even some mid-sized countries or economies. The refined crude oil or natural gas products serve as the backbone of several other industries. Petroleum products are used as fuel in transportation, for power generation, as feedstock in other industries and for several other purposes. According to IEA, crude oil and natural gas combined form 49 percent of the primary energy mix.

Unfortunately, the fossil resources are not evenly distributed on the earth, which gives some countries the advantage in securing resources, while others are dependent on imports from excess producers. Oil trade therefore forms an integral part of these countries' economy and any volatility in the prices of these commodities may have significant impact on the economic functioning.

Oil Shocks

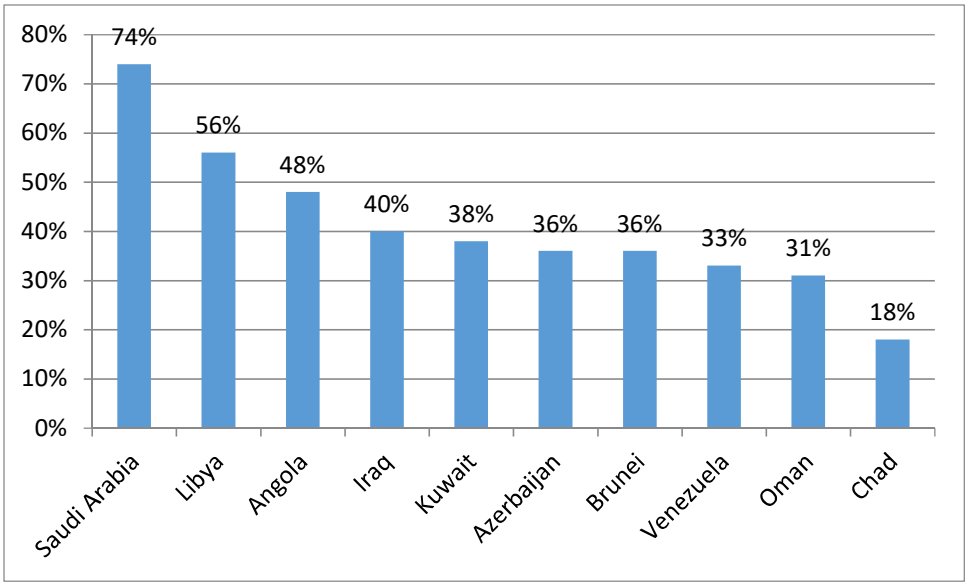
An oil shock can be defined as the significant and unpredictable change in the prices of crude oil either extremely low or high. Although oil shocks were not common before the 1970s, but since then they have been occurring in cycles due to the global nature of oil and gas industry, rapid technological advancements and changes in the geopolitical environment.

There have been several oil shocks since 1970s with the latest ones occurring in the years 2008 and then in 2014. Oil shocks may have significant impact on the global economic functioning, with results including reduced trade and slowdown in growth rate.

The oil and gas prices have seen many ups and downs since the late twentieth century and thus this industry is considered to be extremely volatile. Although falling crude prices will be beneficial for countries that are net importers, it could also mean huge losses of revenue for net exporting countries. This is a grave situation for many countries which are heavily dependent on oil-revenue for generating their income. These countries may end up with negative balance during periods of extremely low oil prices or oil-shocks. The following figure shows the list of countries with some of the highest shares of GDP earned through

export of crude oil. The shares of the countries have been taken for their 2012 value, so that the countries could with biggest shares before the crude oil price fall could be identified.

Figure 1.1: Countries with high shares of oil income in GDP (2012)



The analysis of data in this research is done for these ten countries, which have some of the highest shares of GDP earned through oil exports.

Balance of Payments

The Balance of (international) Payments (BoP) or is the sum of all payments into and out of a country. The BoP includes Balance of Trade, which includes imports and exports, and Balance of Finances, which includes cash flows like loans, gifts, income from services.

The balance of payments is calculated by the following rules:

Current account:

- Product/ services exports – credited (+)
- Product imports/ services – debited (-)
- Income from foreign investments – credited (+)
- Current transfers – credited/ debited (+/-)

Capital/ financial account:

- Investments (FIIs/ FDIs) – credited/ debited (+/-)
- International capital transfers – credited/ debited (+/-)

Net errors and omissions

Official reserves account:

- Domestic investments – credited (+)

Others:

- Gross Domestic Product
- Exchange rate
- Interest rate
- Inflation rate

Literature Review

(Hassan & Abdullah, 2015) study the relation between the oil sales (export) revenue and the GDP of Sudan, exclusively the GDP of services sector. It is found that both the variables, revenue (independent) and services GDP (dependent variable) have a positive correlation.

This study uses the regression method to establish the relation between the variables. The Ordinary Least Square (OLS) method is applied to calculate the value of coefficients. The regression equation is given as follows:

$$GDP = a + b(\text{oil revenue}) + u$$

$$GDP = 4334930 + 0.00024*(\text{oil revenue})$$

The research further utilises Breusch-Godfrey Test and Pagan-Godfrey Heteriskedasticity Test for validating the model.

(Faisal, Tursoy, & Resaloglu, 2016) in their paper analyze the cause-effect relation between energy consumption and GDP, and electricity consumption and GDP in Russia from years 1990 to 2010. It utilises the Toda-Yamamoto method for testing the causality between the variables. This method is a modification of the Wald Test.

It is found that there is a bi-directional causality between electricity consumption and GDP, and the relationship is positive. Whereas, no relationship could be established between energy consumption and the GDP growth in Russia for the given period.

(Sadr, Gudarzi Farahani, & Sharifi, 2012) attempt to understand the cause-effect relationship between energy consumption and economic growth for member countries of Organisation of Petroleum Exporting Countries (OPEC) in the short and long runs.

In this the Granger method is applied to find the causality, Augmented Dicky-Fuller test and Phillips-Perron test were used for co-integration relationship. The causality is tested using t-test and Wald's F-test.

The results of this research show that in the short-run, causality runs from economic growth to energy consumption for 5 countries (Iran, Iraq, Qatar, UAE and Saudi Arabia), whereas for the rest of the countries the reverse is true. In the long-run, no causality was found between the variables for any of the countries.

(Ramalhete Moreira, 2014)analyze the relationship between commodity price volatility and several macroeconomic variables in Brazil. These variables include the basic interest rate, exchange rate, commodities price index. The analysis is done for both long term and short term during the period of 2005 to 2013.

Several tests and methods have been used to obtain the results: Augmented Dickey-Fuller test, Vector Autoregressive model, Granger-causality test, Autoregressive Moving Average and Generalized Autoregressive Heteroscedastic model, and Cointegration Vector Error Correction.

The test results show that as there is increase in volatility of prices of commodities, the GDP tends to be lower in Brazil.

(Yee Ee, 2016) in his study three Sub-Saharan countries are selected as the basis for testing the hypothesis of export-led growth. This empirical study examines the data from 1985 to 2014 to validate this theory.

The methodology followed is panel unit root test, then panel co-integration test. The Fully Modified OLS and Dynamic OLS estimators are used in the regression.

The results indicate that exports have a positive and statistically significant relation with the economic growth in developing countries. Furthermore, for the stable growth in GDP there must be diversification of exports.

(Gokmenoglu, Azin, & Taspinar, 2015) study the relationship between Industrial Production, GDP and oil price, with respect to Turkey, intheir paper. The analysis takes into the period from 1961 to 2012.

For the unit-root test, the Philips-Perron approach was applied. Then to establish the long run relation, Johansen co-integration method was utilised. Lastly, Granger test is done to discover the direction of relations.

The results of the tests describe that there is a long-run relation between the different variables and that oil prices directly affect the industrial production level in Turkey.

(Mastrangelo, 2007)analyzes the natural gas price volatility in the U.S. Henry Hub arket from 1994 to 2006. To assess the price risk it becomes important to study the price

volatility. Natural gas prices are dependent on several variables, including supply & demand, prevalent weather conditions and delivery constraints.

This paper takes into account the price volatility on the basis of annual, monthly and weekly prices. The volatility for a time period is calculated as the standard deviation of the logarithmic price changes during that period. The variables for regression taken in this analysis include natural gas storage levels, seasons, prices and heating degree days.

The methods used in this analysis include the Augmented Dicky-Fuller test, first-order auto-regressive error correction model, Wilcoxon rank-sum and median two-sample test.

The paper concludes that there is no long-term relation between the different variables, but in short-term, during the cold months there is high price volatility due to demand peaks. The volatility is found to be higher in areas where there are higher transportation constraints.

Literature Gap

After reviewing several research papers and reports, we have come to know that there exists a relationship between the economic growth of an oil-based economy and the oil revenues. But almost no research has been done on the relation between oil price volatility and Balance of Payments (BoP) for countries with the highest oil GDPs. Most of the research has been conducted taking GDP as the dependent variable, but none have done this study in relation to Balance of Payments. Also, no research could be comparing the effect of oil price volatility for different countries.

This research intends to bridge this gap and present how these economies are affected when there are changes in oil prices. In this report, we have conducted research to establish the relation between six different independent variables and the dependent variable, balance of payments.

Research Objectives

- To study the relation between Balance of Payment and the different economic variables over the time period of 2005 and 2015.
- To study the impact of oil price volatility on different oil importing countries.
- To study why some countries perform better than others during low oil price scenario.

Research Methodology

Research Type

The research being carried out is exploratory and explanatory (or quantitative and qualitative) nature trying to describe the effect of oil price fluctuations on the balance of payment of countries which are heavily dependent on oil revenues.

The relation between the variables will be described by method of regression and causality testing. The description of data will be explained through qualitative analysis.

Data Collection

Data for this research has been collected through secondary sources, including World Bank, International Monetary Fund and government organisations of several countries. The data has been collected for nine different variables for selected countries for the past 10 years. The variables under consideration include balance of payment, GDP, balance of trade ,crude oil production volume, crude oil exports volume, exchange rate, interest rate, inflation rate and income from crude oil export.

Research Design

A bi-variate and multi-variate regression model for oil-based economies based on the historical data is developed using the simple linear regression method as follows:

$$Y = \alpha + \beta X + .. + \gamma Z + \varepsilon \qquad \text{eqn. (1)}$$

Where, Y represents the dependant variable, X..Z are the independent variables, $\alpha$is the line intercept, $\beta$and $\gamma$are the coefficient to the respective variables.

Since the research is primarily conducted to find the relation between oil price and balance of payments, the bi-variate regression is specified as:

$$Balance\ of\ Payment = \alpha + \beta * crude\ oil\ price + \varepsilon \qquad \text{eqn. (2)}$$

Here, the balance of payments is a dependent variable, whose value is effectively depends on the crude oil prices. The coefficient of oil price indicates the percentage change in BoP caused due to unit change in crude oil price. The intercept value indicates the value of BoP which is independent of oil price, whereas εgives the change in BoP not explained by the given regression equation.

The secondary equation, which is a multi-variate equation, was formed after analysis of all the variables under consideration. The variables taken into account for forming the multi-variate regression are BoP, GDP and oil price. The variables not taken into consideration are crude oil production, oil exports and oil income as they are already accounted for under the GDP and balance of trade. The exchange rate is not considered the oil exports are done to different countries with different currencies and exchange rates, which could not be established for all oil transactions. The value of interest rate was also not considered as there is no short-term variation in the interest rates of many countries. Other variables were eliminated while running regression with several combination of variables. The final equation thus formed is given as:

$$Balance\ of\ payments = \alpha + \beta * GDP + \gamma * oil\ price + \varepsilon$$

eqn. (3)

Here, α is the intercept, β is the coefficient of GDP, γ is the coefficient of crude oil price (COP), and ε is the unexplained residual value.

The test for causality was done using Granger causality test method. Although correlation cannot be definitely established using econometric methods, Granger causality test is used to find the causal relationship between two variables by testing for similar patterns in empirical data. The test for causality is done between BoP and crude oil price with the same regression as eqn. (1). The test allows us to establish whether there is a cause-effect relation between the two variables in one or both directions.

Data Analysis

The simple linear regression method (SLRM) has first been applied to each country, taking eq. (2) model in order to find the linear relation between BoP and crude oil price. Following which, regression was applied to eq. (3) model to find the multi-variate relation between GDP, crude oil price and BoP. Finally, the Granger causality test has been used to check if there exists a cause-effect relation between crude price and BoP.

Assumptions:

For the regression equations:

Null hypothesis, H_0: Balance of payments and crude oil prices of a country are not related.

Alternate hypothesis, H_1: Balance of payments and crude oil prices of the given country are related.

For the Granger test equation:

Null hypothesis, H0: The change in BoP level is not caused by the change in crude oil prices.

Second Null hypothesis, H0': The change in crude oil prices is not caused by the change in BoP.

Alternate hypothesis, H1: The change in BoP level is caused by the change in crude oil prices.

Second Alternate hypothesis, H1': The change in crude oil price is caused by the change in BoP.

The test for Granger causality has been conducted taking 95% significance level and number of lags has been taken as 2.

Kuwait

Kuwait derives about 38 percent of its GDP from crude oil exports. Kuwait is also a major exporter of refined petroleum products, which account for about 20 percent of its GDP.

To find the relation between volatility of COP and its BoP, we conduct two regressions tests and a causality test. The first regression equation was calculated as:

$$BoP = -43.36 + 1.048 * COP + 9.53$$

Since the p-value of the statistic is less than 5 percent, we can conclude that BoP and COP are correlated. Any unit change in price of crude oil ($ per barrel) will lead to 1.048 ($ billion) change in Kuwait's BoP.

Table 5.1: Bi-variate regression results for Kuwait

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-43.36375376	0.01832862	R Square	0.807772718
Crude Oil Price (US$/bbl)	1.047954188	0.000168769	Adjusted R Square	0.786414131

The R-squared statistic which indicates how well the regression equation can predict the actual data level shows that for bi-variate equation, there is an 80 percentgoodness of fit.

Similarly, the multi-variate regression is:

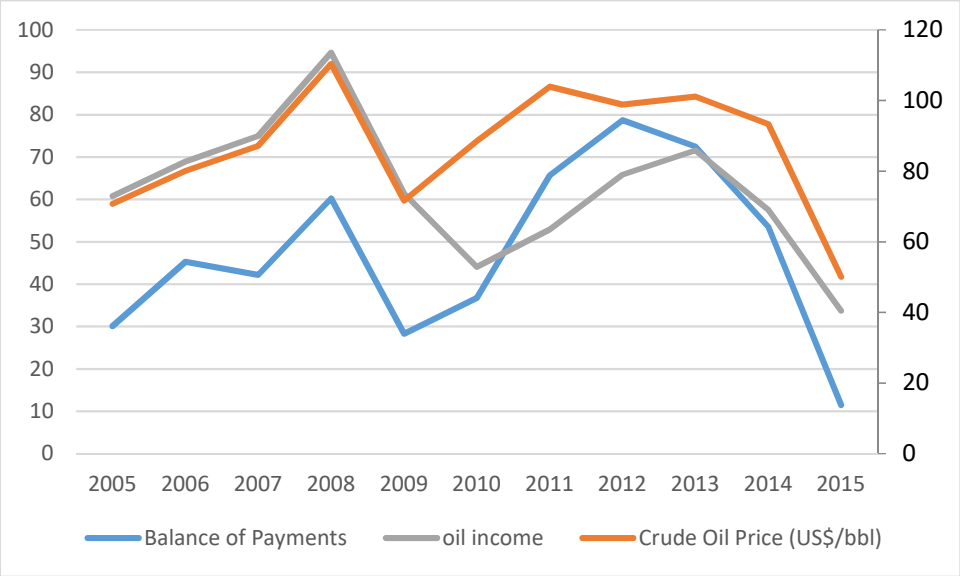
$$BoP = -47.3279 + 0.249 * GDP + 0.717 * COP + 8$$

This indicates that a unit change in GDP ($ billion) and COP will have 0.966 $ billion change in BoP. Here, the R-squared statistic indicates an 87 percent goodness of fit.

Table 5.2: Multi-variate regression results for Kuwait

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-47.3279	0.006023	Multiple R	0.937941
GDP	0.249265	0.06012	R Square	0.879734
Crude Oil Price (US$/bbl)	0.716903	0.008774	Adjusted R Square	0.849667

Figure 5.1: BoP, crude price and oil income of Kuwait (2005-2015)



To check for causality between the COP and BoP, we run a Granger causality test using eq. (2) as described earlier.

Table 5.3: Granger causality test output for Kuwait

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	0.41892	0.6836
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		0.43997	0.6719

The results from the causality test give probability of 0.6, which is greater than 0.05, for causality in both directions. This indicates that causality does not exist between COP and BoP in the case of Kuwait.

Libya

Libya's share of oil income in the GDP was 56 percent, the second highest among all the countries taken into consideration in this research. Libya also has refined petroleum and natural gas exports, which form 7 percent of its GDP.

The regression equation thus obtained is:

$$BoP = -24.75 + 0.4328 * COP + 16.35$$

Table 5.4: Bi-variate regression output for Libya

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-24.7517	0.363895079	R Square	0.195782
Crude Oil Price (US$/bbl)	0.432824	0.172952075	Adjusted R Square	0.106425

Both the p-value and the R-squared statistic indicate that there is no correlation between the BoP and COP in case of Libya. Here, p-value is 0.17 > 0.05 and R-square only shows 19 percent goodness of fit.

The multi-variate regression equation is:

$$BoP = -31.14 + 0.683 * GDP + 0.043 * COP + 12.12$$

The p-value is observed to be greater than 0.05 and the R-square value indicates that only 50 percent of the regression is explained by the variables. Therefore, we can conclude that the BoP and other independent variables are not correlated.

Table 5.5: Multi-variate regression results for Libya

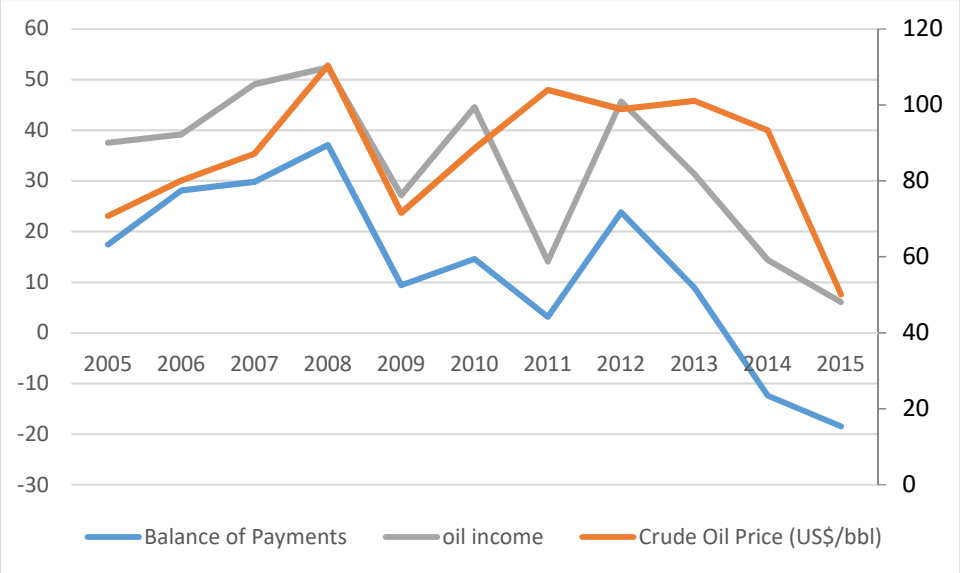
	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-31.1377	0.145538	Multiple R	0.779254
GDP	0.683565	0.020046	R Square	0.607237
Crude Oil Price (US$/bbl)	0.043503	0.086881	Adjusted R Square	0.509046

Since there is no correlation, it can also be interpreted that there will not be any causation between the variables under consideration. This is also proven by the causality test results, where the probability of non-causation is obtained as 56 and 75 percent.

Table 5.6: Granger causality test output for Libya

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	0.65051	0.5694
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		0.29958	0.7564

Figure 5.2: BoP, crude price and oil income of Libya (2005-2015)



Saudi Arabia

Saudi Arabia is the world's largest oil-based economy, generating over 74 percent of its GDP through oil income from exports. Saudi Arabia also had exports of refined petroleum products in its portfolio, but these formed a very small percentage before the 2014 price crash.

The regression results for Saudi are as follows:

$$BoP = -149 + 2.78 * COP + 29.86$$

The value of p is less than the significance level, from which we can determine that the two variables are correlated, and the R-square value indicates that there is 75 percent goodness of fit between the regression and the given data.

Table 5.7: Bi-variate regression output for Saudi Arabia

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-149.696	0.011429	R Square	0.751414
Crude Oil Price (US$/bbl)	2.785666	0.000552	Adjusted R Square	0.723793

The multi-variate regression formed for Saudi Arabia is:

$$BoP = -141 - 0.03235 * GDP + 2.89 * COP + 31.23$$

For this regression, the p-value for COP coefficient is below 0.05, whereas the value for GDP coefficient is slightly above at 0.06, which is still within acceptable limits. The R-square value indicates 75 percent goodness of fit. Therefore, the variables are correlated.

Table 5.8: Multi-variate regression results for Saudi Arabia

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-141.159	0.027699	Multiple R	0.870814
GDP	-0.03235	0.064544	R Square	0.758316
Crude Oil Price (US$/bbl)	2.895393	0.001365	Adjusted R Square	0.697896

Figure 5.3: BoP, crude price and oil income of Saudi Arabia (2005-2015)

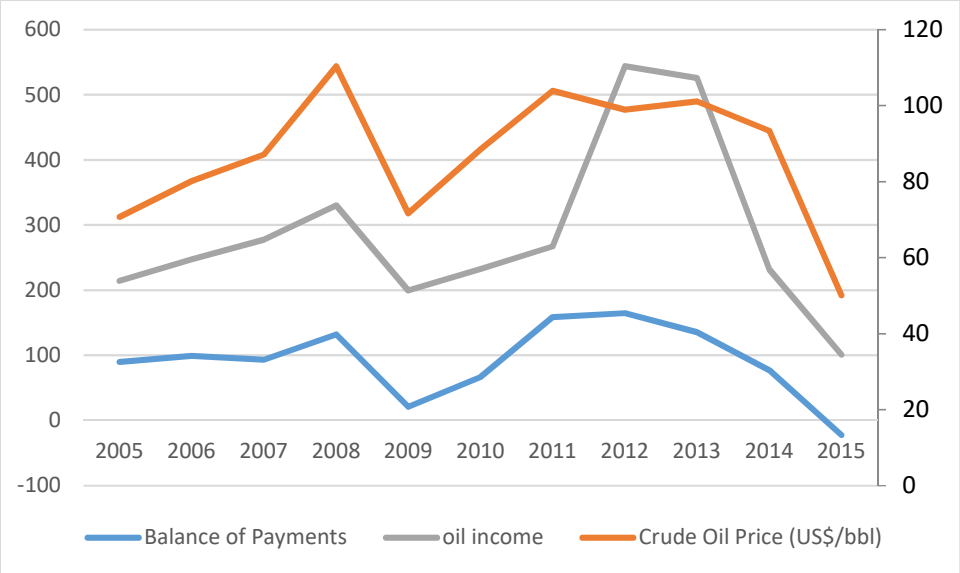


Table 5.9: Granger causality test output for Saudi Arabia

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	2.78286	0.1749
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		1.17734	0.3962

The probability of non-causality is much higher than the level of significance. The Granger test results indicate no causality in either direction between COP and BoP.

Iraq

Iraq derives about 40 percent of its annual GDP from oil export revenue. Iraq's exports almost completely consist of crude oil (about 99 percent).

The regression for relation between its COP and BoP is given as:

$$BoP = -46.69 + 0.58 * COP + 7.85$$

This indicates that for every unit change in COP, Iraq's BoP value changes by $0.58 billion.

Table 5.10: Bi-variate regression output for Iraq

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-46.6913	0.004495	R Square	0.654974
Crude Oil Price (US$/bbl)	0.580115	0.002547	Adjusted R Square	0.616638

Although p-value of the bi-variate regression is much less than the level of significance, i.e. $0.004 << 0.05$, which shows that the two variables are correlated, the R-square value is 0.65, indicating that only 65 percent of the variability in the data is explained by the regression.

The multi-variate regression equation obtained is:

$$BoP = -45.49 – 0.074 * GDP + 0.69 * COP + 6.77$$

Table 5.11: Multi-variate regression results for Iraq

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-45.4926	0.002834	Multiple R	0.878638
GDP	-0.07418	0.077283	R Square	0.772005
Crude Oil Price (US$/bbl)	0.691579	0.00082	Adjusted R Square	0.715007

The p-value for GDP and COP coefficients in the multi-variate regression are 0.077 and 0.0008, which are within acceptable limits of the significance level, so we can conclude that there exists correlation between the three variables. There is also 77 percent goodness of fit between the given data and the regression thus obtained.

Figure 5.3: BoP, crude price and oil income of Iraq (2005-2015)

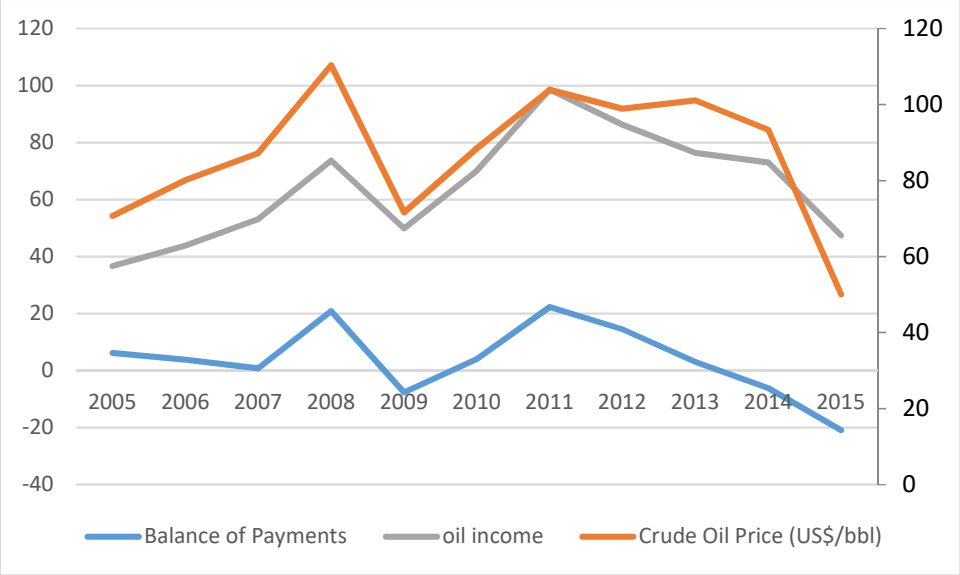


Table 5.12: Granger causality test output for Iraq

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	1.40355	0.3453
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		1.03045	0.4356

The Granger causality test shows that there is no causal relationship between COP and BoP, since the probability of non-causality is very large.

Angola

Angola has the third largest share of GDP from its crude oil exports.The country only exports crude petroleum and no other petrochemical products.

The regression between its BoP level and COP is obtained as:

$$BoP = -20.32 + 0.296 * COP + 6$$

From the p-value ($0.02 < 0.05$), we can determine that the two variables are correlated, but the regression only explains 39 percent (R-square is 0.39) of the variability in the data.

Table 5.13: Bi-variate regression output for Angola

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-20.3196	0.06099	R Square	0.457724
Crude Oil Price (US$/bbl)	0.295621	0.022249	Adjusted R Square	0.397471

The multi-variate regression is:

$$BoP = -17.89 – 0.0976 * GDP + 0.364 * COP + 5.43$$

The p-values for GDP and COP indicate that the variables are significant and are correlated to the BoP of Angola. Although the goodness of fit is only 60 percent. From this we can infer that for unit change in annual GDP and COP, the BoP will change by $0.4616 billion.

Table 5.14: Multi-variate regression results for Angola

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-17.899	0.074185	Multiple R	0.77718
GDP	-0.09762	0.023915	R Square	0.604008
Crude Oil Price (US$/bbl)	0.364428	0.008488	Adjusted R Square	0.505011

The probability value for null hypothesis, H0 for Granger causality test is obtained as 0.0726, which is close to the test significance level. Therefore, we reject the null hypothesis and accept the alternate hypothesis, H1.

Figure 5.5: BoP, crude price and oil income of Angola (2005-2015)

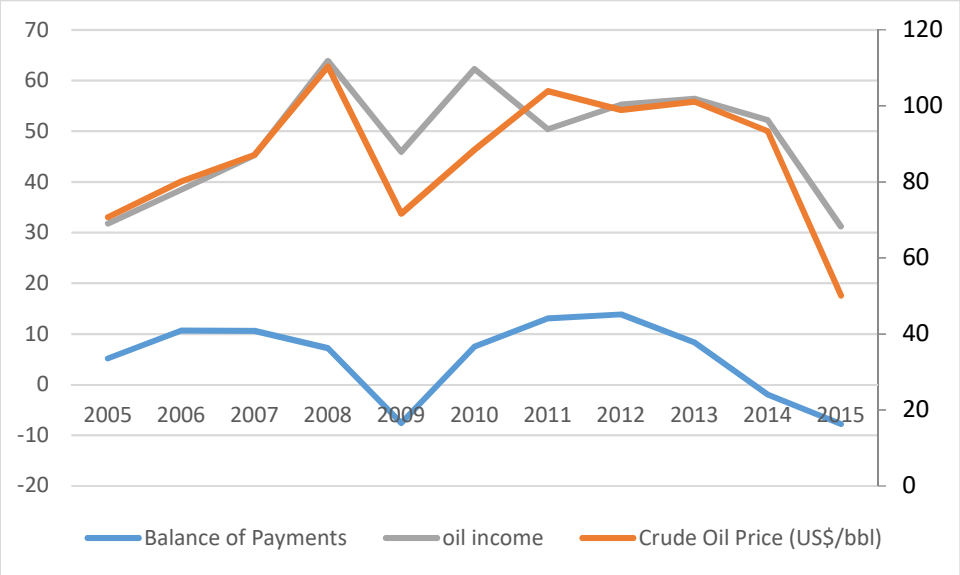


Table 5.15: Granger causality test output for Angola

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	5.42084	0.0726
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		2.79818	0.1737

From the above causality test results, we can assume that there exists a causal relation between COP and BoP for Angola. But the reverse causality does not hold true, i.e. BoP level does not affect the COP.

Oman

Oman's oil exports account for about 31 percent of its overall revenue share. About 14 percent of its GDP is also generated through the export of refined petroleum and natural gas products. The country also exports several other products that use oil and gas feedstocks, such as fertilizers.

The bi-variate regression between BoP and COP for Oman is formulated as:

$$BoP = -16.58 + 0.228 * COP + 3.44$$

Table 5.16: Bi-variate regression output for Oman

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-16.5767	0.013978	R Square	0.604908
Crude Oil Price (US$/bbl)	0.228548	0.004829	Adjusted R Square	0.561009

The p-values for the regressor indicates that it is significant and therefore the two variables are correlated. From the R-square value it is found that the goodness of fit is 60 percent. So, the change in COP by one unit will result in $0.228 billion change in BoP.

The regression between BoP, GDP and COP is:

$$BoP = -13.06 – 0.13 * GDP + 0.277 * COP + 2.78$$

The independent variables are found to be significant from their p-value and the R-square value indicates that the regression equation is able to explain 77 percent of the variability in the data.

Table 5.17: Multi-variate regression results for Oman

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-13.0607	0.022839	Multiple R	0.877508
GDP	-0.13057	0.043409	R Square	0.77002
Crude Oil Price (US$/bbl)	0.277261	0.000872	Adjusted R Square	0.712525

Figure 5.6: BoP, crude price and oil income of Oman (2005-2015)

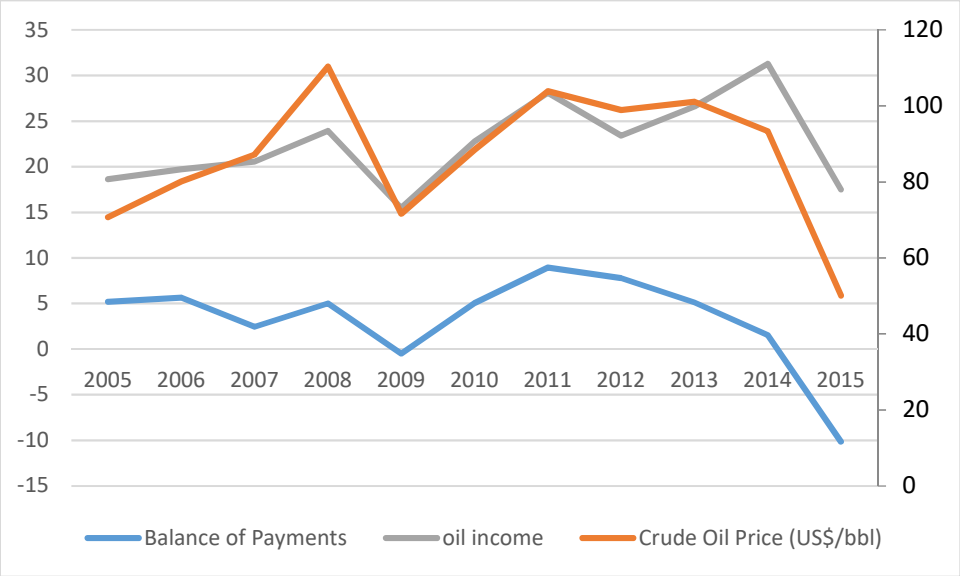


Table 5.18: Granger causality test output for Oman

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	1.13496	0.4070
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		0.77391	0.5198

The p-value from causality test is 0.407 >> 0.05. From the Granger test results, we can conclude that no causality exists between COP and BoP for Oman.

Azerbaijan

The share of oil export revenue in Azerbaijan's GDP is nearly 36 percent. The only major export from Azerbaijan is crude oil, which accounts for about 90 percent of its exports.

The regression equation for the relation between its BoP and COP is:

$$BoP = -14.04 + 0.278 * COP + 3.44$$

The p-values from the test indicate that the independent variables are significant and the R-squared value shows that there is 69 percent goodness of fit between the regression and data.

Table 5.19: Bi-variate regression output for Azerbaijan

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-14.0388	0.029765	R Square	0.69357
Crude Oil Price (US$/bbl)	0.277607	0.001461	Adjusted R Square	0.659522

Unit change in annual average COP will lead to $0.278 billion change in the BoP for Azerbaijan in the same direction as the COP movement.

The multi-variate regression for Azerbaijan is formulated as:

$$BoP = -14.22 + 0.097 * GDP + 0.224 * COP + 3.05$$

The p-value shows that the regressors are significant. The R-square value is 0.785, which reflects that 78 percent of the variability in data can be explained by the regression equation.

Table 5.20: Multi-variate regression results for Azerbaijan

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-14.2157	0.018752	Multiple R	0.886014
GDP	0.097144	0.022962	R Square	0.78502
Crude Oil Price (US$/bbl)	0.223764	0.006862	Adjusted R Square	0.731275

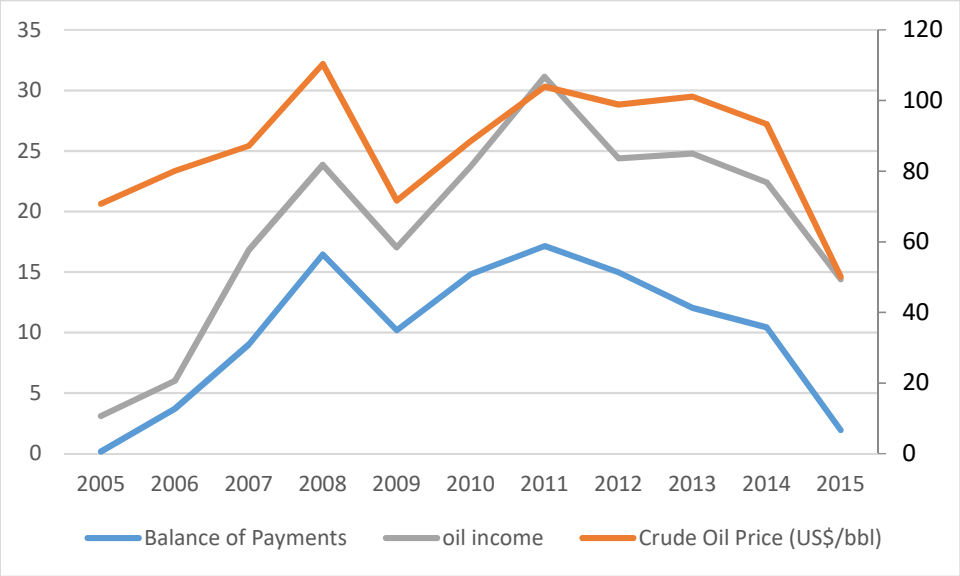
Change in one unit of GDP and COP will change BoP by $0.321 billion in case of Azerbaijan.

On testing for causality, the Granger test results show that the null hypothesis stands true and there is no causal relation between COP and BoP. The p-values for regression in both direction is >> 0.05.

Table 5.21: Granger causality test output for Azerbaijan

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	2.21861	0.2248
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		0.60625	0.5889

Figure 5.7: BoP, crude price and oil income of Azerbaijan (2005-2015)



Venezuela

About one-third of Venezuela's GDP is derived from crude oil exports. Venezuela also exports refined petroleum, which derives about 6 percent of its GDP share.

The regression equation obtained from the bi-variate output is:

$$BoP = -13 + 0.315 * COP + 10.52$$

The p-value from the regression indicates that there exists a correlation between the COP and the BoP of Venezuela, and the R-square value also shows that the regression is able to explain the large variability in data.

Table 5.22: Bi-variate regression output for Venezuela

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-12.9957	0.455068	R Square	0.704654
Crude Oil Price (US$/bbl)	0.315664	0.00638	Adjusted R Square	0.604654

Running the multi-variate regression, we get the following equation:

$$BoP = -7.16 - 0.085 * GDP + 0.553 * COP + 6.92$$

The p-value for both regressors, GDP and COP is << 0.05, which proves the correlation between the three variables. The R-squared value is 0.706, which indicates a high level of goodness of fit between the regression equation and the data.

Thus, we can say that unit change in both the independent variables will lead to $0.468 billion change in the BoP.

Table 5.23: Multi-variate regression results for Venezuela

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-7.16188	0.536265	Multiple R	0.840499
GDP	-0.08502	0.007278	R Square	0.706438
Crude Oil Price			Adjusted R	
(US$/bbl)	0.553509	0.004319	Square	0.633048

Figure 5.8: BoP, crude price and oil income of Venezuela (2005-2015)

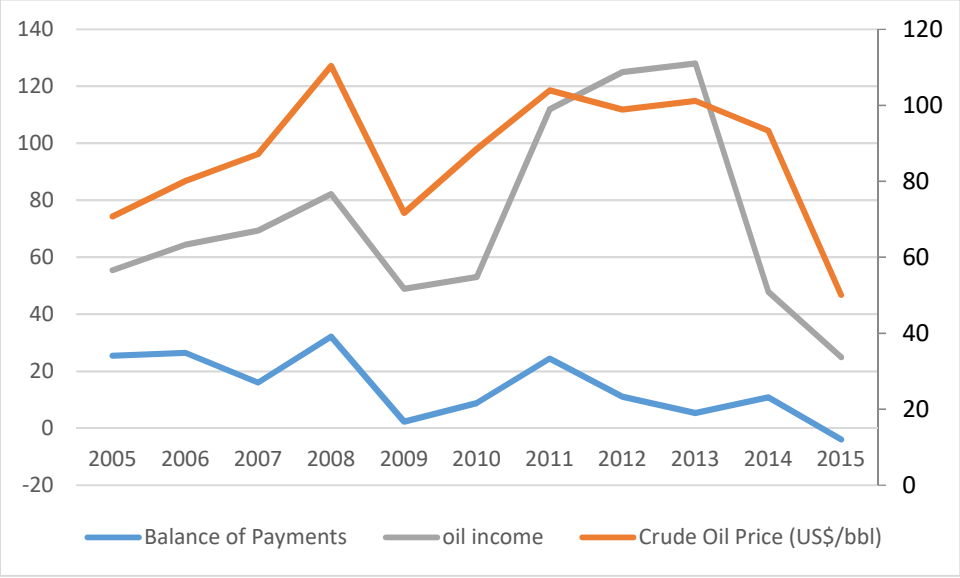


Table 5.24: Granger causality test output for Venezuela

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	9.67131	0.0294
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		3.05072	0.1568

The Granger causality test for Venezuela yields a p-value of 0.029, for uni-directional causality from COP to BoP. This indicates that a change in COP does cause the change in BoP, in the case of Venezuela.

Chad

Around 18 percent of Chad's GDP is generated from oil revenues. Chad's major export is crude oil only, with very limited amount of refined petroleum exports.

It is the country with the lowest share of oil income in GDP that has been considered in this research.

The regression is obtained as:

$$BoP = -0.87 + 0.004 * COP + 0.78$$

From the p-value and R-square value we can determine that COP and BoP of Chad are not completely correlated, but the p-value is within acceptable range.

Table 5.25: Bi-variate regression output for Chad

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-0.87158	0.049827	R Square	0.659254
Crude Oil Price (US$/bbl)	0.404657	0.077842	Adjusted R Square	0.601725

The multi-variate regression, however, shows that:

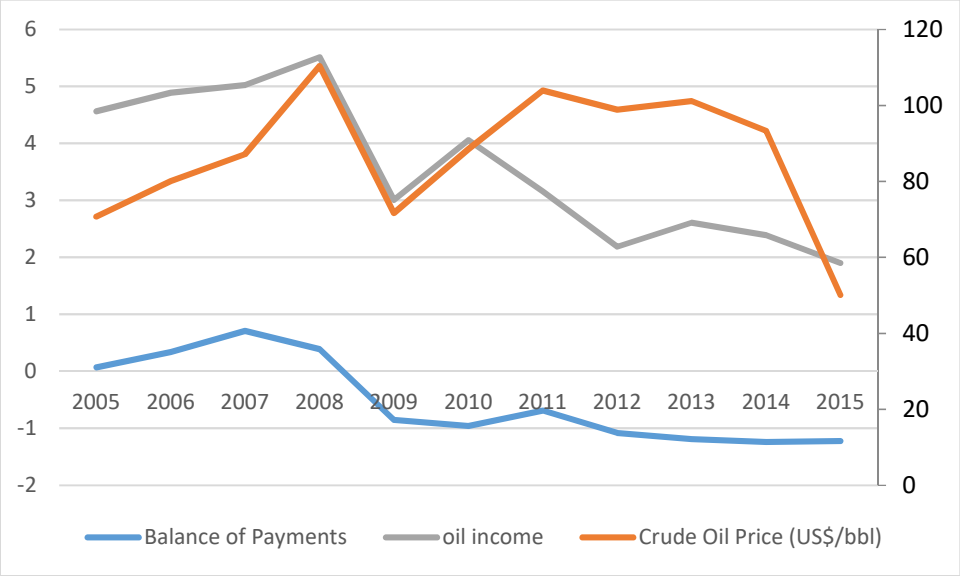
$$BoP = 0.7928 – 0.323 * GDP + 0.0238 * COP + 0.374$$

The R-square value is 0.79, which shows that 79 percent of the variation in data is explained by the regression equation.

Table 5.26: Multi-variate regression results for Chad

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	0.792876	0.266719	Multiple R	0.892721
GDP	-0.32313	0.000528	R Square	0.796951
Crude Oil Price (US$/bbl)	0.023855	0.013707	Adjusted R Square	0.746189

Figure 5.9: BoP, crude price and oil income of Chad (2005-2015)



The causality test gives a p-value of 0.012 for the null hypothesis, therefore the null hypothesis is rejected, which means for Chad, the COP has a cause-effect relation with BoP.

Table 5.27: Granger causality test output for Chad

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	16.2253	0.0120
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		0.00114	0.9989

Brunei

In the case of Brunei, nearly one-third of the GDP is generated through oil-revenues from the export of crude oil. The country exports an almost equal value of natural gas, whose share has increased after the oil price crash.

The regression between COP and BoP indicates that they are correlated and from the R-square value, it is found that there is 70 percent goodness of fit between the regression and data.

$$BoP = -3.12 + 0.095 * COP + 0.62$$

Table 5.28: Bi-variate regression output for Brunei

	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-3.11698	0.12193	R Square	0.703034
Crude Oil Price (US$/bbl)	0.095201	0.001262	Adjusted R Square	0.670037

The multi-variate regression also shows that the variables are correlated and that 92 percent of the variability in data is explained by the regression.

Table 5.29: Multi-variate regression results for Brunei

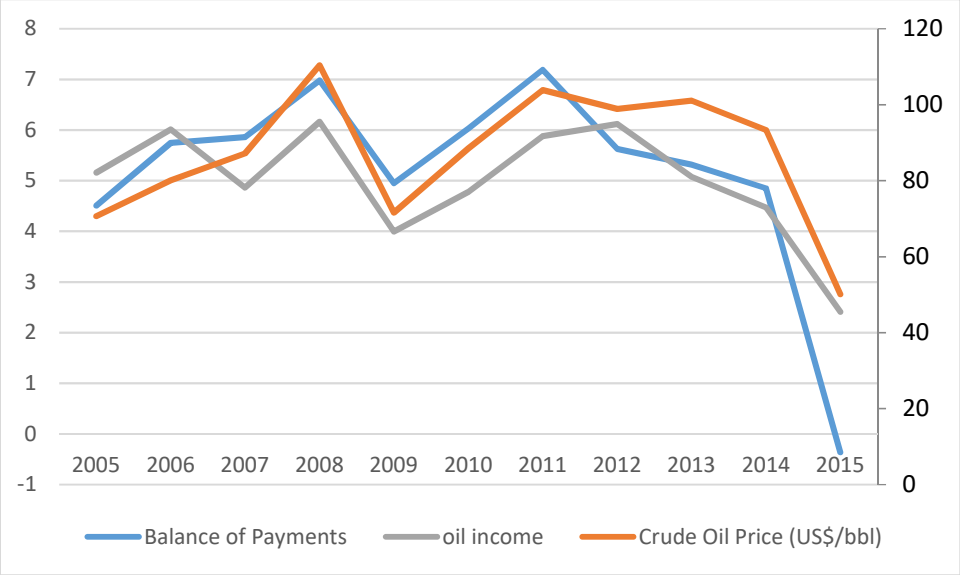
	Coefficients	*P-value*	*Regression Statistics*	
Intercept	-0.12059	0.920228	Multiple R	0.960827
GDP	-0.38649	0.001376	R Square	0.923189
Crude Oil Price (US$/bbl)	0.122623	9.87E-06	Adjusted R Square	0.903986

Table 5.30: Granger causality test output for Libya

Null Hypothesis:	Obs	F-Statistic	Prob.
CRUDE_OIL_PRICE__US$_BBL does not Granger Cause BALANCE_OF_PAYMENTS	9	4.37495	0.0984
BALANCE_OF_PAYMENTS does not Granger Cause CRUDE_OIL_PRICE__US$_BBL		2.72266	0.1793

The causality test shows that the p-value is close to the significance level, but does not clearly indicate causal relation between COP and BoP.

Figure 5.10: BoP, crude price and oil income of Brunei (2005-2015)



Qualitative analysis

Kuwait

Kuwait is a middle-east country with the highest share of oil-based GDP. Oil exports account for more than 90 percent of the overall revenue from exports.The government has tried to bring in more private sector investments in order to diversify its economy, the business environment and laws in Kuwait do not allow private sector to grow. The country has been able to reduce the effect of oil price crash due to its strategic Future Generations Fund (FGF), which was implemented in 1976. The FGF initiative mandates a minimum 10 percent of annual government income to be transferred to the FGF. The FGF manages these deposits and invests them in various long-term assets.

Libya

Libya has been embroiled in civil unrest for a long time. The country faces widespread corruption in the government. It had been under military dictatorship from 1969 to 2015.

Libya has been unable to cope up with the oil price crash as it almost completely depends on oil revenues for running the economy. The country lacks critical infrastructure due to misappropriation of oil revenues. Libyan oil production has also declined due to internal conflict and attacks by ISIS.

Saudi Arabia

The country is the largest exporter of crude oil in the world. Due to its significant oil reserves, Saudi Arabia has been able to develop some parts of its economy. The country is classified as partly-developed as its cities are comparable to developed economies in infrastructure and services, but most parts of the country are still backward. Although the country currently has a negative BoP, it is able to support its economy by using its huge foreign asset portfolio.

Angola

Angola generates about 48 percent of its GDP from oil exports. Oil revenues account for more than 90 percent of the total exports revenue. Angola had faced several years of civil war which had left its infrastructure in poor situation. The government took up infrastructure building activities in 2002, but faced by the 2008 crude price crash the Angolan economy fell again. Angola has been able to tackle its falling surplus reserves by reducing the domestic subsidies given out by the government and introducing import quotas, which limit the quantity of goods that can be imported into the country.

Azerbaijan

Azerbaijan derives about 36 percent of its GDP share from oil export revenues. Although the country is highly dependent on oil for its sustenance, the country has been the front-runner in the countries currently under consideration for investments to expand and diversify its economy into non-energy sectors. Azerbaijan government had introduced a State Oil Fund in 1999, which collects the excess oil and gas profits and invests them in assets to mitigate economic risks and invest in non-oil sectors. Azerbaijan introduced economic reforms in 2008, which make it easier to business in the country. This has led to increased investments

in the country. Azerbaijan also is starting to invest in natural gas fields to widen its energy portfolio.

(CIA, n.d.)

The review of exports from the ten countries shows that the following countries also export refined petroleum and natural gas products in addition to crude petroleum:

Kuwait – 20% of GDP (refined petroleum products and natural gas)

Libya – 6%of GDP

Oman – 14%of GDP

Venezuela – 6%of GDP

Chad – 18%of GDP

This may indicate that the causal relation between COP and BoP cannot be perfectly established in case of these countries. Since decline in crude oil prices will also subsequently affect the refined petroleum and natural gas prices.

(Snudden, 2016)in his research paper has explained that most of the countries dependent on oil exports do not have an associated fiscal policy to properly manage the volatility in oil prices. Only a limited number of countries, most of which are developed, are noted to have proper policy in place to accommodate the cyclic nature of crude prices or to deal with oil shocks.

Most of the countries under consideration in the current research are associated with the Organisation of Petroleum Exporting Countries (OPEC), which may have had significant impact on the revenues generated by export of crude oil from these countries. The OPEC has historically maintained high output volume to counter the decline in its share of market. This has led to fall of crude oil prices to below the break-even levels.

(Irina Ahmed, 2017) have explained that the OPEC countries are overly dependent on oil exports, with several countries having oil as the only export commodity. Most of the countries have failed to diversify their economy even over several decades of oil exports and increasing revenue.

Although some countries, such as Saudi Arabia and Kuwait have been able to expand their domestic infrastructure by using the oil revenues, these infrastructures have not been able to generate sizeable revenues.

Conclusions

- This report examines the impact of crude oil prices on the balance of payment for ten countries with high shares of GDP generated through income from crude oil exports.

From the analysis of the data for the ten countries, we can summarise the relation between crude oil price and balance of payment as following:

	Country	**Correlation**	**R-square value (bi-variate)**	**Causal relation (b/w COP &BoP)**
1.	Kuwait	Correlated	0.80	Non-causal
2.	Libya	Un-correlated	0.19	Non-causal
3.	Saudi Arabia	Correlated	0.75	Non-causal
4.	Iraq	Correlated	0.65	Non-causal
5.	Angola	Correlated	0.45	Causal
6.	Oman	Correlated	0.60	Non-causal
7.	Azerbaijan	Correlated	0.78	Non-causal
8.	Venezuela	Correlated	0.70	Causal
9.	Chad	Correlated	0.66	Causal
10.	Brunei	Correlated	0.70	Non-causal

- Most countries exhibit non-causal relation even though the movement of crude oil prices and balance of payment is observed to be positively correlated. This result may be attributed to the limitations of the causality testing methods which rely on historical values.

- The countries that were able to maintain positive balance of payments, even after the 2014 oil price crash are: Kuwait, Angola and Azerbaijan. Although these countries maintain a positive balance of international payments, it is not an indicator of superior economic performance.

- Most of the countries performing poorly due to oil price volatility have no significant policies to deal with volatility and many of these countries are prone to social unrest and disruptive governments systems. Absence of stable government does not allow long-term planning and policy implementation, which has been the main cause of economic disruption in most countries.

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Appendix

Exhibit 1: Economic data for Kuwait (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	30.07	80.798	70.71	29.07	60.8
2006	45.31	101.55	80.118	38.77	68.9
2007	42.19	114.64	87.17	41.33	75.0
2008	60.25	147.4	110.38	62.62	94.6
2009	28.29	105.9	71.623	34.12	61.4
2010	36.71	115.42	88.503	47.3	44.1
2011	65.72	154.03	103.9	77.01	52.9
2012	78.71	174.07	98.898	91.65	65.8
2013	72.46	174.16	101.11	85.81	71.6
2014	53.53	163.61	93.338	72.83	57.5
2015	11.43	112.81	50.09	23.55	33.7

Exhibit 2: Economic data for Libya (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	17.43	47.334	70.71	25.28	37.6
2006	28.09	54.962	80.1175	34.22	39.2
2007	29.83	67.516	87.17	40.24	49.1
2008	37.08	87.14	110.3775	52.95	52.4
2009	9.38	63.028	71.6225	24.09	27.2
2010	14.58	74.773	88.5025	31	44.5
2011	3.17	34.699	103.9	11	14.1
2012	23.84	81.905	98.8975	38.95	45.7
2013	8.9	65.504	101.11	16.5	31.3
2014	-12.39	41.143	93.3375	2	14.4
2015	-18.47	29.153	50.09	-2.8	6.1

Exhibit 3: Economic data for Saudi Arabia (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	90.09	328.46	70.71	121.25	214.2
2006	99.13	376.9	80.1175	141.51	247.1
2007	93.41	415.965	87.17	143.11	277.7
2008	132.32	519.797	110.3775	198.33	330.4
2009	20.96	429.098	71.6225	96.76	199.6
2010	66.75	526.811	88.5025	144.28	232.6
2011	158.58	669.507	103.9	233.08	267.4
2012	164.76	733.956	98.8975	232.81	544.0
2013	135.44	744.336	101.11	207.72	526.0
2014	76.92	753.831	93.3375	168.47	232.0
2015	-22.38	646.002	50.09	29.49	101.0

Exhibit 4: Economic data for Iraq (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	6.18	49.955	70.71	0.17	36.6
2006	3.86	65.14	80.1175	8.47	43.9
2007	0.74	88.84	87.17	19.75	53.1
2008	20.89	131.614	110.3775	28.27	73.7
2009	-7.6	111.661	71.6225	3.49	49.9
2010	4.1	138.517	88.5025	8.57	70.1
2011	22.31	185.75	103.9	35.42	98.6
2012	14.52	218.001	98.8975	38.16	86.3
2013	3.02	232.497	101.11	28.74	76.4
2014	-6.21	223.508	93.3375	25.63	73.0
2015	-20.92	168.607	50.09	-2.68	47.4

Exhibit 5: Economic data for Angola (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	5.14	28.234	70.71	10.28	0.0
2006	10.69	41.789	80.1175	15.4	0.0
2007	10.58	60.449	87.17	22.6	0.0
2008	7.19	84.178	110.3775	38.9	0.0
2009	-7.57	75.492	71.6225	17	0.0
2010	7.51	82.471	88.5025	29.1	0.0
2011	13.04	104.116	103.9	35.6	50.4
2012	13.85	115.398	98.8975	38.7	55.3
2013	8.35	124.912	101.11	37.9	56.4
2014	-1.95	126.775	93.3375		52.2
2015	-7.78	102.643	50.09		31.2

Exhibit 6: Economic data for Oman (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	5.18	31.082	70.71	8.26	18.6
2006	5.66	37.216	80.1175	10	19.7
2007	2.46	42.085	87.17	6.9	20.6
2008	5.02	60.905	110.3775	11.2	23.9
2009	-0.5	48.388	71.6225	6.6	15.5
2010	5.04	58.641	88.5025	11.4	22.8
2011	8.95	67.938	103.9	19.8	28.1
2012	7.8	76.341	98.8975	16.6	23.4
2013	5.12	78.183	101.11	13.3	26.6
2014	1.54	81.797	93.3375	18.8	31.3
2015	-10.16	70.255	50.09		17.5

Exhibit 7: Economic data for Azerbaijan (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	0.17	13.245	70.71	-0.38	3.1
2006	3.71	20.983	80.1175	1.3	6.0
2007	9.02	33.05	87.17	6.05	16.8
2008	16.45	48.852	110.3775	24.9	23.9
2009	10.18	44.291	71.6225	9.27	17.0
2010	14.83	52.903	88.5025	15.2	23.7
2011	17.15	65.952	103.9	17	31.1
2012	14.99	68.731	98.8975	14.2	24.4
2013	12.05	73.56	101.11	13.4	24.8
2014	10.43	75.198	93.3375	11.8	22.4
2015	1.94	53.047	50.09		14.4

Exhibit 8: Economic data for Venezuela (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	25.45	145.513	70.71	31.69	55.5
2006	26.46	183.478	80.1175	31.96	64.4
2007	15.98	230.364	87.17	23.88	69.4
2008	32.15	315.6	110.3775	44.57	82.2
2009	2.26	329.419	71.6225	16.06	48.9
2010	8.81	393.801	88.5025	26.75	53.1
2011	24.39	316.482	103.9	44.81	112.0
2012	11.02	381.286	98.8975	46.01	125.0
2013	5.33	371.337	101.11	39.98	128.0
2014	10.89	509.968	93.3375	31.54	47.8
2015	-3.97	251.495	50.09	3.7	24.9

Exhibit 9: Economic data for Chad (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	0.07	6.647	70.71	1.481	4.6
2006	0.34	7.422	80.1175	1.765	4.9
2007	0.71	8.639	87.17	1.663	5.0
2008	0.39	10.352	110.3775	2.69	5.5
2009	-0.85	9.253	71.6225	1.153	3.0
2010	-0.96	10.658	88.5025	1.45	4.1
2011	-0.69	12.156	103.9	2.619	3.2
2012	-1.08	12.368	98.8975	1.91	2.2
2013	-1.19	12.95	101.11	1.64	2.6
2014	-1.24	13.922	93.3375	1.23	2.4
2015	-1.22	10.889	50.09		1.9

Exhibit 10: Economic data for Brunei (2005-2015)

Year	Balance of Payments	GDP	Crude Oil Price (US$/bbl)	Balance of Trade	oil income
2005	4.51	9.531	70.71	4.16	5.2
2006	5.75	11.471	80.1175	5.6	6.0
2007	5.86	12.248	87.17	5.19	4.9
2008	6.98	14.393	110.3775	8.06	6.2
2009	4.95	10.732	71.6225	4.18	4.0
2010	6.03	12.371	88.5025	5.52	4.8
2011	7.19	16.692	103.9	7.32	5.9
2012	5.63	16.954	98.8975	8.14	6.1
2013	5.32	16.111	101.11	5.68	5.1
2014	4.85	17.105	93.3375	6.63	4.5
2015	-0.36	15.492	50.09		2.4