International Journal of Economic Research

ISSN : 0972-9380

available at http: www.serialsjournals.com

Volume 14 • Number 14 • 2017

Impact of Lower Oil Prices on Some Selected Oil Exporting Countries: A Panel Causality Analysis

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ABSTRACT

This paper is aimed at assessing the impact of oil prices on the GDP growth rate of a sample of four major net oil exporting OPEC countries (Russia, Saudi Arabia, Venezuela and Nigeria) during the period 2006-2016.The study uses the Pesaran (2007) and Levin, Lin and Chu (2002) unit root tests, FGLS estimators and Granger Causality Test to examine the direction of causality. The empirical results found that the relative economic importance of crude oil price fluctuations hasa positive relationship and a highly significant effect on the rate of economic growth in these countries and that the impact was less till 2009.The Causality results also prove a unidirectional causality between oil prices and GDP growth in oil exporting countries.

JEL Classification Codes: C33, C52, E30, P28.

Keywords: OPEC, Granger Causality, Panel Unit Root, FGLS estimator.

1. INTRODUCTION

The price of oil is of crucial importance to today's world economy; given that oil is the major globally traded goods, both in volume and value terms, generating a hydrocarbon economy. Further the costs of energy-intensive goods and services are interrelated to energy rates, of which oil makes up a distinct share. In addition, the price of oil is related to the price of other fuels. Hence, an unexpected change in the price of oil has wide-ranging implications for both oil-producing and oil-consuming countries. The long run decline in world oil prices since 2014 certainly needs to be examined with respect to its effect on major oil exporting countries. The world history has witnessed how the oil price shock in the global market has created inconvenience for all the countries more than once since the emergence of OPEC (Oil and Petroleum Exporting Countries) Union. Oil represents one of the most important macroeconomic factors in the world economy and the crude oil market is the largest commodity market in the world. What makes

oil price changes even more interesting is not only their direct impact on economic activity, but also the changes in oil prices might reflect or even forecast changes in the intercontinental stability. As a difference from other commodities, oil is probably one of the few or the only production input that can affect both positively and negatively economic growth, to an extent that it might even lead to a recession. Oil price volatility dampens growth through different channels, from an increase in production cost to inflation expectations. According to the Energy Information Administration (EIA)[1], global economic performance remains highly correlated with oil prices. Overall, an oil-price increase leads to a transfer of wealth from importing to exporting countries through a shift in the terms of trade. The magnitude of the direct effect of a given price increase depends on the share of the cost of oil in national income, the degree of dependence on imported oil and the ability of end-user to reduce their consumption and switch away from oil (IEA, 2006). The oil-economic growth relationship became a popular research topic in 1980s. Hamilton, J.D (1982)[2] found a negative correlation between oil prices and GDP growth, which proved that recessions in the U.S.A economy and the oil shock during the sample period. The empirical evidence from a growing body of academic literature and reports from government institutions clearly suggests that oil price increases dull macroeconomic growth by increasing inflation and unemployment and depressing the value of financial and other assets, at least in oil importing nations (Awerbuch, 2003). For most developing countries oil accounts for a large proportion of gross domestic product expenditures in energy production. According to the IEA, oil accounted for 40% of the global energy needed in 2000. Significant increases in energy prices will lead to a considerable rise in production and transportation cost for many industries and this in turn drives wages and inflation upwards, while also dampening economic growth (O'Neill, Penm & Terrell,2008). According to Hamilton & Herrera (2003)[3] inexpensive oil is crucial for the world's demand for energy but its availability is scarce, therefore volatility in supply will have substantial economic impact.

From the peak in June 2014 to the trough in January 2016, crude oil prices dropped by USD 82 per barrel (70%). While record of the oil price decline in 2014 could be explicated by the major increase in the supply of oil, the lower price has replicated weaker global demand. On the supply side, significant technological revolutions (shale oil extraction) caused oil production to heave in energy-intensive oil exporting countries, pushing oil prices downward. The OPEC's pronouncement in November 2014 to keep production measures unaffected caused the downward spiral of oil prices with rising stock of oil.

In numerous net oil-exporting countries, the oil price drop coupled with other geo political factors have led to a significant macroeconomic adjustment. Major net oil exporters have managed to mitigate, to a certain degree, the early adverse effect on their output by running extensive and intensifying fiscal deficits. Nevertheless, GDP growth in these countries has still dropped in comparison to the rest of the world and the fiscal state has become progressively more trying in some major oil producers (like Saudi Arabia, Nigeria and the UAE) predominantly those with currency pegs to the US dollar. Monetary policy has also been inhibited in a few exporting countries with more elastic exchange rates (Canada and Russia). As the currencies of these oil exporting countries have (sharply) denigrated, inflationary pressures have mounted, thus restraining the zone for easing of monetary policy as a solution for slowing growth. Though the share

1 Energy Information Administration (EIA). 2014c. Monthly Energy Review (February). Washington, DC: US Energy Information Administration.

2 Hamilton, J. D. 1983. Oil and the Macro economy since World War II. *Journal of Political Economy* 91(2): 228–248.

3 Hamilton, J. D., and A. M. Herrera. 2004. Oil Shocks and Aggregate Macroeconomic Behavior: The Role of Monetary Policy. *Journal of Money, Credit and Banking* 36: 265–286.

of major oil-exporting countries in the global economy is approximately 15% of global Gross Domestic Product (GDP) based on purchasing power parity, which is rather very minor adverse spill overs to nations with greater trade with these countries, have weighed on global economic activity.

This paper presents an assessment of magnitude, drivers and implications of recent oil price drops on the economic growth of four major oil exporting countries viz. Saudi Arabia, Russia, Nigeria and Venezuela. The data used in the study is annual and spans 2006 to 2015. The macroeconomic variables considered are: The Gross Domestic Product (GDP) which captures the real output growth in the economy. Oil price volatility (OL) is used to capture exogenous factors that can affect output growth, Inflation rate (INFL) to measure macroeconomic steadiness and DEBT to check the effect of borrowings on the real growth.

This study investigates:

1. If the reduction in crude oil prices have had an impact on the economic growth of major oil exporting countries?
2. If the reduction in oil prices coupled with rate of inflation and debt level in currency have influenced the GDP growth in these major oil exporting countries?
3. Is there causality between the crude oil prices and the rate of economic growth in major oil exporting countries?

This paper is organized in sections viz. section 2 deals with a review of related literature on the subject matter; section 3 presents the data, sample period, econometric modeling and the discussion of the obtained empirical results; finally, section 4 presents the conclusion and concedes the limitations of this research.

2. REVIEW OF RELATED LITERATURE

Globally there is yet to be an accord on how the performance of the world oil market may be studied or demonstrated. The first theory considers crude oil as an asset whose price is determined by fluctuations in demand thus leading to a situation where proxies respond by taking long or short oil positions. It follows that the spot and forward price of crude oil, as well as the stock maintained by various agencies instantaneously counter to those signals. Another theory considers that the price of crude oil is decided by shocks taking place due to supply and demand for crude oil and not the stock available.

The empirical literature focused to validate the impact of oil price fluctuations evolved after the first oil price shock by Darby (1982) and Hamilton (1983). The latter found significant relationship oil price changes and real GNP growth in USA before and after the shock. The existing literature generally focuses on Economic properties of the Industry, its effect globally in a collective manner and on diverse economies. There are studies on specific macro variables as well with a few estimating the variables using econometric techniques (other than Panel data) to report for significant relationship among variables using SVAR, FEVD tests etc. Finally, there are papers which examine the asymmetrical relationship between oil price level changes and economic growth

Literature on Oil Shocks on Diverse Economies: To begin with, Barsky & Kilian (2004)[4]proposed operational classification of 03 types of shocksthat affect supply and demand of oil:

[4] Barsky, B. and L. Kilian, 2004. Economic growth: Determinants, issues and lessons. Bangladesh: Chukizak printings.

(a) Those related to the current physical availability of crude oil (supply-side shocks).

(b) Shocks on the current demand for crude oil, resulting from fluctuations of the overall economy (aggregate demand shocks).

(c) Shocks produced by fluctuations in precautionary oil demand.

Reviewing role of oil price in macroeconomic dynamics originated since 1970s, though it became a focal point of research after Hamilton (1983)[5] proved that seven out of eight economic recessions in the US after WWII were preceded by very high oil price. Centering on USA, the studies argued that oil shocks lead to higher inflation and lesser production. Gisser & Goodwin (1985)[6] claimed that the role of oil price in cyclical movements of economy is even more important than fiscal and monetary policy. As per Dotsey & Reid, 1992 & Bernanke et. al, (2002)[7] historical coincidence of oil shocks and economic recessions is not adequate to argue that there is a causal relationship between them. They proposed monetary policy as the source. The impact of asymmetric effects of oil price shocks on economy was examined by Tatom, 1988, Mork, 1989; Mork et. al., 1994 and Mory, 1993. In next few years the scope of research expanded to other countries, albeit oil importers in most cases, which proved that oil price hikes result in economic recession.

Literature on Oil Exporting Countries: There is a relationship between Oil Prices and Macro- economic variables. The paramount illustration of the first block of research was carried out by Chen (2009), where the author's main objective is to take a broad view of a series of papers, which focus on the subject of the impact of declining oil price on inflation and other economic variables. The author used statistics from a few industrialized countries and with augmented Phillips curve model and examined that the stability of the forecasted short-run pass-through coefficients via one-time structural break test used by Andrews (1993). However, in case of oil exporting countries research on the role of oil price shocks on macroeconomic fluctuations focused on individual countries. Al-Mutairi (1993)[8] ascertained that dependence of the fiscal policy on oil price had significant impact on production in Kuwait. Eltony (2001)[9] proved the existence of causal relationship from oil revenues towards other macroeconomic variables in Kuwait. Dibooğlu & Aleisa (2004)[10] used structural VAR method and found out the causes of macroeconomic fluctuations and indicated that price level, real exchange rate, and to a minor degree output is susceptible to terms of trade shocks in case of Saudi Arabia. They were driven by output, trade balance, and aggregate demand shocks. The research, which is a fine instance of the second block of papers, is the one performed by Cologni and Manera (2008), where the economic effects of oil price are projected by way of a SVAR for G7 countries. The focus was on monetary variables, interest rate and money aggregate M1 to prove how the latter react

5 Hamilton, J. D. 1983. Oil and the Macro economy since World War II. *Journal of Political Economy* 91(2): 228–248.

6 Gisser and Goodwin P., 1985. Oil price changes and government revenue effect. Bangladesh Journal of Economics, 3(6): 2-4.

7 Barsky, R. B., and L. Kilian. 2002. Do We Really Know that Oil Caused the Great Stagflation? A Monetary Alternative. In *NBER Macroeconomics Annual 2001*, edited by B. S. Bernanke and K. Rogoff. Cambridge, MA: MIT Press. 137–183.

8 Al-Mutairi, N. 1993. Determines the sources of output fluctuations in Kuwait. Finance and Industry, Vol. 11, pp. 20-78.

9 Eltony Nagy M. (2001) "Oil Price fluctuations and their Impact on the Macroeconomic Variables of Kuwait: A Case Study Using VAR Model for Kuwait" No. 6, 14.

10 Dibooglu, Aleisa, (2004), Relationships among US oil prices and oil industry equity indices, International Review of Economics and Finance 13(4),427-453.

to exogenous oil price shocks.Anshasy et. al., (2005)[11] reconnoitered the association between oil prices, government proceeds, government consumption expenditure, GDP and investment by a VAR/VECM model and determined that in Venezuela, fiscal equilibrium in both short and long run affects economic growth. Olomola & Adejumo (2006)[12]observed the impact of oil price shocks on output, inflation, real exchange rate and money supply in Nigeria in a VAR framework and concluded that oil price volatility significantly affect the exchange rate. Mehrara & Oskui (2007)[13] conducted a research to discern the sources of macroeconomic fluctuations in four oil-exporting countries –Indonesia, Iran, Kuwait and Saudi Arabia. While oil price shocks were found to be the main source of production fluctuations in Saudi Arabia and Iran, in Kuwait and Indonesia, output variations were primarily found to be due to combined supply shocks. Lescaroux & Migno(2008)[14]scrutinized the relation between oil prices and GDP, CPI, unemployment rate and bond price in a panel study. Using causality tests, they estimated the cross-correlations between the cyclical components of the series; they found positive causality between oil prices and macroeconomic variables in short and long run. Berument et. al., (2010)[15] examined the impact of oil price shocks on the productivity of certain Middle East and North African (MENA) countries that are either exporters or net importers of oil commodities. The SVAR analysis found oil price shocks had a significant impact on GDP in most of oil exporters, namely Algeria, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Syria and UAE as well as one oil importing country, Tunisia.

Oil Exporting Countries and Impact on Growth Rate:Studies by Martin and Subramanian (2003)[16] and Smith (2004)[17] indicates that the growth rates of rich oil exporting countries are at a lesser pace in comparison to countries which have no such reserves. The results point to the fact that they have not experienced a high economic growth even in the period of oil boom when there was a heavy influx of foreign exchange. Few of the alternate theories in literature that give different perspectives on lower growth rate in oil exporting countries are enumerated in the succeeding paragraph.

To begin with Birdsall et. al., (1999)[18] propounded that oil rich economies accrue less human capital in comparison to their resource poor counterparts because of inferior education quality affecting their economic growth. Auty and Gelb(2001)[19] and Stevens (2003) found that these countries do not have sustained economic growth as they cannot benefit from the manufacturing sector which is lackadaisical

11 El-Anshasy A, Michael D. Bradley, and Fred Joutzl (2005) "Evidence on the Role of Oil Prices in Venezuela's Economic Performance: 1950-2001". *Working Paper, University of Washington.*

12 Olomola, P., 2006. Oil price shocks and aggregate economic activity in Nigeria. African Economic and Business Review, 4(2): 40-45.

13 Mehrara, M., Oskoui, N. K. (2007) –The sources of macroeconomic fluctuations in oil exporting countries: A comparative study. Economic Modeling 24: 365–379.

14 Francois L. & Valérie Mignon. (2008). *On the Impact of Oil Prices on Economic Activity and Other Macroeconomic and financial Variables.* CEPPI: Centre D`etudes Prospective Information International Working Paper, 05.

15 Berument, Hakan M., Nildag B. Ceylan & Nukhet Doğan, 2010, "The Impact of Oil Price Shocks on the Economic Growth of Selected MENA Countries," The Energy Journal, vol. 31(1), pages 149–76.

16 Sala-I- Martin and Subramanian. (2003). Addressing the Natural Resource Curse: An illustration from Nigeria. IMF working paper, wp/03/139.

17 Smith. (2004). Oil wealth and Regime Survival in the Developing. American Journal of Political Science, 48(2), 232-246.

18 Birdsall.n, Pinckney and Sabot. (1999). Natural Resources, Human Capital and Growth. Carnegie Endowment for International Peace.

19 Auty and Gelb. (2001). Political Economy of Resource Abundant States. Oxford University Press.

and probably lag due to lack of high quality labour and absence of good architecture of government policy which is mandatory for economic development. Fewothers have evidenced the incidental negative impact on growth of these economies through Government agencies which lack quality and suffer from poor fiscal policies. (Sala-I-Matin and Subramanian 2003). Boschini et. al., (2007)[20] proved that the policies in these countries are not manufacturer friendly which has had a negative impact on their economic performance. While Finnis (2000)[21] study indicated that oil price shocks cause decline in utilization of resources, Hooker (1999)[22] studied the stability of oil prices with the GDP and found that the prices affected output during the period from 1954- 1980 but did not do so from 1981- 1995. Backus and Crucini (2000) examined the relationship between Trade Volatility, Oil price Volatility and exchange rates. The results indicated that while trade volatility was related to oil volatility particularly in times of increased oil prices, it was not affected by exchange rate fluctuations.

The entire data of asymmetric relationship between the economic variables was set off after failure of the 1986 oil price fall, primarily caused by prior excess of oil and unstable situation in Middle East, to generate an economic recovery as conflicting to economic slump aggravated by 1973 synthetic oil price surge. This fact has been empirically defended by Mork (1989), who demonstrated that if the data from 1986 oil price fall was included in the period of study the oil price-macro economy correlation as established by Hamilton (1983) would collapse. Aliyu (2009)[23] applied linear and nonlinear condition to examine the relationship between oil price volatility and GDP growth rate in Nigeria. The study found that asymmetric oil price increase has more effect on real GDP growth.

Oil Exporting Countries and the Resource Curse:Husain et. al.(2008)[24] proved that the fiscal policy in oil exporting countries is more procyclical rather than counter cyclical as the government in these economies have major economic power and have control over revenues, investment and development activities. The investment in large projects in period of high oil prices are not sustainable in the long run and have led to higher inflation. This also reduces the pace of economic growth and when the oil price declines, the government is forced to opt for increased borrowings from central bank/ abroad to finance their fiscal deficit to realize their prevailing and recurring obligations thus increasing the inflation even further. Van Winjberger(1984)[25] described that resource curse in oil exporting countries ensues, when the increase in oil revenue triggers stronger exchange rate leading to a less competitive manufacturing sector in the country. Gylfason (2001)[26] further elucidated the paradox that due to this volatility in exchange rate certain ambiguity is created that are detrimental to trade and foreign Investment. Torvok (2002) argued that as the revenue from natural resources increases the number of entrepreneurs in the manufacturing

[20] Boschini, Pettersson and Roine. (2007). Resource Curse or Not: A question of Appropriability. Scandinavian Journal of Economics, 109, 3. pp. 593-617.

[21] Finn. (2000). Perfect Competition and effect of Energy Price Increase on Economic Activity. Journal of Money, Credit and Banking, 32, 400-416.

[22] Hooker. (1999). Oil and Macroeconomy Revisited. Federal Reserve Board, Washington D.C.

[23] Aliyu. (2009). Oil Price Shocks and the Macroeconomy of Nigeria: A non -linear approach. MPRA working paper

[24] Husain., Tazhibyeva & Ter-Martirosyan. (2008). Fiscal Policy and Economic Cycles in Oil Exporting Countries. IMF working paper, wp/08/253

[25] Van der Ploeg & Arezki. (2008). Can the Natural Resource Curse be turned into a Blessing? Oxford Centre for the Analysis of Resource- rich Economies, 2008/01.

[26] Gylfason. (2001). Natural Resources, Education and Economic Development. European Economic Review, 45(4-6), 847-859.

sector reduce. In the long run the drop-in income from manufacturing sector is greater than increase in income from oil exports. Exhaustive studies on resource curse paradox were conducted by Casseli and Cunnigham(2009)[27] and Van derPloeg (2011). But the basis for these studies was founded on research by Sachs and Warner (1995)[28] which is considered as a key cross- sectional study. The study explicated that oil rich economies have grown on an average about one percent less during 1970-1989 period even after regulating the variables such as Capital infusion, initial income and trade expansion. With respect to cross country regression studies Anderson and Aslaksen (2008) found that the resource curse paradox was more common in presidential democracies' in comparison to parliamentary system and the reasons were reduced accountability and absence of representation. Another similar study by Tella(1999)[29] proved that in Oil exporting countries corruption is invigorated and there is attrition of legal system.

Oil Exporting Countries and the Growth Rate using Panel Data:Parente and Prescott (1994)[30] suggested that researchers must move from cross country regression to panel data regression. This was also stressed upon by Manzano and Rigabon(2001)[31] when they proved that the impact of natural resource on growth found in cross country regression disappears once it allows for fixed effects.

But a Panel data study on oil price and GDP relationship has been found only in case of Lescaroux and Mignon(2008)[32]. They used the annual data of both oil exporting and oil importing countries the results indicated that oil prices Granger cause GDP of OPEC member countries and did not do so in case of other exporting countries. To bridge this gap this study has adopted panel data estimation method as against the cross- country regression as they suffer from the problem of omitted variable bias.

3. DATA AND METHODOLOGY

Data and definition of variables: This study uses annual data for a panel of four economies over a period of 2006 to 2015. The economies considered in this study are Russia, Saudi Arabia, Venezuela and Nigeria. The other explanatory variables used are inflation rate, Debt and Oil prices. The dependent variable considered in this study is the real GDP growth rate. The annual data for all these variables are obtained from world development indicators provided by the World Bank. This paper assesses the impact of the shocks recorded in the international oil market on the economy in the four sampled countries addressing an economic reality which needs to be explored. The paper is constructed using a Panel Data Analysis to measure the sensitivity of the GDP Growth of crude oil exporting OPEC countries to fluctuations in crude prices. The proposed econometric procedure significantly develops the extent of the impact of oil market price changes on economic activity, as it creates the possibility to take into consideration the specific differences of each of the countries under study, using the Random Effects Technique and FGLS estimator.

27 Casseli and Cunningham. (2009). Leader Behavior and Natural Resource Curse. Oxford Economic papers, 61(4), 528-650.

28 Sachs and Warner. (1995). Natural Resource Abundance and Economic Growth. National Bureau of Economic Research, Working paper 5398.

29 Tella (1999). Rents, Competition and Corruption. The American Economic Review, 89(4).

30 Parente & Prescott. (1994). Barriers to Technology, Adoption and Development, Journal of Political Economy, 102(2), 298-321.

31 Manzano and Rigabon. (2001). Resource Curse or Debt Overhang? NBER Working paper 8390.

32 Lescaroux and Mignon. (2008). On the Influence of Oil Prices on Economic Activity and other Macroeconomic and Financial Variables. CEPII, Working paper 2008-05.

Methodology: Based on the above data, the regression model can be represented as

$$\text{Growth}_{it} = \alpha_1 + \beta_1 \text{ Growth}_{i,t-1} + \beta_2 \text{ Debt} + \beta_3 \text{ OL} + \beta_4 \text{ INFL} + \mu_1 + \mu_t + E_{it} \quad (1)$$

where, GP = real GDP growth rate, DEBT=Debt in currency, OL = Brent oil price, INFL = Rate of Inflation. The factor α_1 is the country specific intercept which may differ across countries; μ_1 is the country specific error term that does not essentially have a zero mean; μ_t is the undetected time-specific effect; and is the white noise error term with zero mean and unit variance. The key intention is to obtain with presence of other control variables in the equation. A bias may result in measurement errors or simultaneity bias, omitted variable bias, and reverse causation if suitable estimation method is not employed.

The first model and the second model, explains GDP growth by combining Debt, Inflation and the Oil prices and the results obtained from the pooled regression and Fixed effects are unsatisfactory because, while the signs of the coefficients are positive and consistent with the theoretically expected result, the only significant coefficient (at a 5% level) is Debt. If, instead, the Random Effects treatment is used with the same set of variables, the estimation improves significantly. This time, the variables also enhance their significance above the 1% level. The coefficient of determination of the Random effects estimate shows a major improvement, compared to the other two models, regression, changing from0.176 to 0.395. Finally, we test the null hypothesis that the use of Panel Analysis does not make a statistically significant difference to the results of the estimate with respect to the pooled regression and to verify the usefulness of using Panel Analysis with Fixed Effects. Both the Effects F test and Chi Square Cross-Section tests do not reject the null, confirming the usefulness of the Random Effects technique to improve the model's estimation.

The Random and GLS estimator employed in this study is designed for small cross-sectional entity and small time periods. General FGLS estimators are based on a two-step estimation process: First an OLS model is estimated, then its residuals $\hat{u}_{it}$ are used to estimate an error covariance matrix more general than the random effects one for use in a feasible-GLS analysis.

This framework allows the error covariance structure inside every group (if effect = "individual") of observations to be fully unrestricted and is therefore robust against any type of intra-group

Heteroskedasticity and serial correlation. This structure, by converse, is assumed identical

Across groups and thus general FGLS is inefficient under group wise heteroskedasticity. In a pooled time- series context (effect = "time"), symmetrically, this estimator can account for arbitrary cross-sectional correlation, if the latter is time-invariant. In this case, the estimator is consistent with respect to the time dimension.

The FGLS estimator is used when case stable variables are left in the composite error term to take into account the fact that disturbances terms for each case will be correlated across time. The GLS estimator requires, the standard deviation to be known for each observation from the sample. But the FGLS estimator is non-linear and more efficient than the OLS estimator. However, FGLS follows the same method as GLS, with the exception that an estimated variance – co-variance matrix for residual is used. The downside to FGLS is that the procedure works well for large samples but the advantages are it allows for heterogeneous variance in the residuals and is the best linear unbiased estimate. It allows for different forms of co-relation in the data.

Serial Correlation and Co-integration Tests: Ignoring cross-sectional dependence of errors can have grave significances, and the incidence of some form of cross-sectional correlation of errors in panel data applications in time- series is likely. Conventional panel estimators such as fixed or random effects can end in ambiguous and even erratic estimators, conditional on the degree of cross-sectional dependence and on whether the source creating the cross-sectional dependence is correlated with repressor's.

Woolridge's method uses the residuals from are gression in first difference, then removing the individual level effect, the term based on the time invariant co-variates and the constant.

$$y_{it} - y_{it-1} = (x_{it} - x_{it-1})\beta_1 + E_{it} - E_{it-1} \quad (2)$$

$$\Delta y_{it} = \Delta x_{it}\beta_1 + \Delta E_{it} \quad (3)$$

where, Δ is the first difference operator.

The Lagrange multiplier (LM) test of Breusch and Pagan tests the null hypothesis that all pair-wise correlations are zero. In this study, both the studentized BP tests and Pesarans CD tests were conducted and the results indicated a Z score of −1.7041 and −1.157 for fixed and random models respectively in case of PCD tests and LM indicated a score of 9.7159. This proved that there is no cross-sectional dependence. The cross-sectional dependence is defined as,

$$CPL_M = \sqrt{\frac{1}{n(n-1)}} + \sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(TP_{ij}^2 - 1) \quad (4)$$

$$CD_P = \sqrt{\frac{2T}{n(n-1)}} + \sum_{i=1}^{N-1}\sum_{j=i+1}^{N}P_{ij} \quad (5)$$

Phillips and Sul (2003) proved that by using the above equation and is the cross-sectional dependence in ignored the efficiency of estimation decreases.

Serial correlation in panel-data models biases the standard errors and leads to incorrect estimates. A test for serial correlation in random- or fixed-effects one-way models derived by Wooldridge (2002) is an efficient one as it can be applied under general conditions and is easy to implement.

In this study, the Breusch-Godfrey/Wooldridge test for serial correlation in panel models was conducted and the results indicated the absence of serial correlation in idiosyncratic errors on the random model ($p = 0.002$) and pooling model ($p = 0.00$) and plm model ($p = 0.00$).

Granger Causality: Granger Causality test determines whether one time series is useful in forecasting another and is considered a test for predictive causality. It can predict the future value of time-series using prior value of another time-series. Since it is time-series data, time does not run backward and so we can make stronger statements about causality. The conventional Granger Causality test is an unrestricted bar framework on the assumption that the underlying variables are integrated of order zero in nature. The paper examines the causality between the macro-economic growth of countries and variables such as oil price debt and inflation in the respective countries. This study therefore establishes that there is uni-directional causality running from oil price shocks to macro-economic growth in case of linear model. The Granger causality also reveals that inflation and the long-term debt fails to affect the country's economic growth.

Panel Unit Roots Test: All the data series were tested for stationarity to forestall the possibility of drawing conclusions based on statistically spurious relationship. As in the case of time series data, in estimating the panel data model, it may also be possible that the time-series properties of cross-section have an important influence on the specification of the econometric model. Thus, a stationarity test in the panel data is crucial. We perform the panel unit root tests belonging to the first generation for stationarity in panel data provided by Levin, Lin and Chu (2002), and Im, Pesaran and Shin (2003).The unit root test results are presented in Table 1.

Table 1
Unit Root Tests

Variables	*LLC*	*IPS*	*Order of integration*
GP	–3.8471(0.00)	–2.0162(0.00)	I (0)
DEBT	–3.2241(0.00)	–2.2763(0.002)	I (0)
OL	–2.879(0.00)	–2.2812(0.022)	I (0)
INFL	–2.8133(0.00)	–3.6377(0.00)	I (0)

The first stage of the empirical analyses involved examination of the statistical properties of all the variables under consideration., oil price volatility, real GDP, Debt and level of Inflation. The result suggests that the null hypothesis of the presence of unit root in the variables in levels could be rejected indicating that all the variables are integrated of order I (0).

Empirical Results: This section shows the empirical results wherein this paper analyses the extent of economic growth and how other macroeconomic variables impact economic growth for the panel of 4 oil exporting countries. Table 2 presents the descriptive statistics for the variables under consideration. The average GDP growth rate for the sample is about only 11.94% percent which is moderate. The average value of other macroeconomic variables such oil, debt and inflation are 1.95, 2.55 and –0.09% respectively. The value of skewness and kurtosis indicates all the variables under consideration are normally distributed at 0.10 significance. This is confirmed by the statistically significant Jarque-Bera statistics.

Table 2
(a) Summary Statistics

Particulars	*Mean*	*Standard Deviation*	*Skewness*	*Kurtosis*	*J-B Test*	*Probability*	*Observations*
GP	11.94	0.2728	–0.062	1.439	4.085	0.129	40
Debt	2.585	0.44478	–0.702	2.5873	3.569	0.167	40
OL	1.900	0.1418	–0.331	1.498	4.492	1.105	40
INFL	–0.9066	0.54249	0.227	2.2864	1.192	0.551	40

Table 2
(b) Mean of Data

	INFLATION	*DEBT*	*GDP*	*OIL*
Before 2010	-0.06572	2.532792	11.97737	1.890279
After 2010	-0.03745	2.549406	11.90991	1.910629

On analyzing the mean of the data in two time zones viz. before 2010 and after 2010, it was found that while there was not much difference in the mean with respect to Debt, GDP and OIL, there was

significance difference in the average of Inflation. The average before 2010 was −0.06572 increased to −0.03745 post 2010. This proves the Dutch Disease cursed is ease theory (Corden & Neary 1982). It clarified the adverse effects the higher oil prices have on the economic growth of oil exporting countries. They support oil and related sectors and are against the primary and trading sectors in times of higher oil prices. This is because, the huge influx of foreign currency in times of increased oil prices leads to greater imports of intermediate and consumer goods. The domestic industries in turn suffer due to competition with imported goods in times of higher oil prices and cannot supplement their manufacturing capacity during the times when imports decline due to reduction in oil prices. Consequently, the inflation which was higher in times of huge oil revenues augments more even after the decline in oil prices.

To test the stationary property of the panel variables the unit root test developed by Levine Lin and Chu (2002) (LLC) and Im, Pesaran and Shin (2003) (IPS) were performed. The LLC and IPS panel unit root tests indicate that all the variables are stationary at level I (0)(Table 2).

To decide between fixed or random effects model a Haussmann Test was run where the null hypothesis is that the ideal model is random effects vs. the substitute the fixed effects.

Table 6
Other Tests

Haussmann Test: chisq = 2.2999, df = 3, *p*-value = 0.5125
Pesaran Cd Test for Cross-Sectional Dependence in Panels(1): z = −1.7041, *p*-value = 0.08836
Pesaran Cd Test for Cross-Sectional Dependence in Panels(2): z = −1.157, *p*-value = 0.2473
Studentized Breusch-Pagan Test: BP = 9.7159, df = 6, *p*-value = 0.1371
Lagrange Multiplier Test - (Honda): normal = 11.24, *p*-value < 2.2e-16
Lagrange Multiplier Test - (Breusch-Pagan): chisq = 126.33, df = 1, *p*-value < 2.2e-16
Breusch-Godfrey/Wooldridge Test for Serial Correlation in Panel Models(1): chisq = 32.005, df = 10, *p*-value = 0.0003997
Breusch-Godfrey/Wooldridge Test for Serial Correlation in Panel Models(2): chisq = 27.586, df = 10, *p*-value = 0.002102
Breusch-Godfrey/Wooldridge Test for Serial Correlation in Panel Models(3): chisq = 32.413, df = 10, *p*-value = 0.0003417

Source: Author's estimation using R

It tests whether the unique errors (u_i) are associated with the regressors; the null hypothesis is they are not. The results of the test with chi-square = 2.2999 and *p* value = 0.5125 indicated that random model is preferable. A test to check the cross-sectional dependence of variables in a panel data was conducted via the studentized BP tests and Pesarans CD tests. The null hypothesis of the tests that residuals across the countries are correlated was rejected. The Woolridge test of serial correlation was also conducted and the output indicated the absence of serial correlation. This provided the validity for our model specification.

In the regression models, we use three macroeconomic variables such as rate of Inflation, oil rate and Debt as potential explanatory factors to the level of economic growth. It is observed that except inflation the other two variables turned significantly affect the level of economic growth. The insignificant coefficient for inflation is not surprising and consistent with many previous studies (see Beck et. al., 2000; Christopoulos and Tsionas, 2004). As expected, the level of Debt and Oil prices are positive and Debt is highly significant in explaining the level of economic growth. This is in concurrence with findings of

Lescaroux and Mignon, 2008; Du, He and Wei, 2010; Cunado Jiménez-Rodríguez and Sánchez, 2005and Gracia, 2005 who reiterate that oil exporting economies are negatively impacted by oil price decline.

With respect to significance of Debt, though the fiscal pressures can partly be mitigated with reserve assets, not all oil exporting countries have substantial buffers and since the decline has been consistent for the past few years substantial fiscal, external, macroeconomic and financial modifications was required. This has resulted in higher debt in the sample oil exporting countries. However, Inflation is not significant in determining economic growth. The theory of a declining inflationary impact of oil price shocks is also supported by a study that examines the data of 19 industrial countries by Chen (2009).

When the regression is performed country wise for the panel data the results indicate that the oil prices were highly significant with economic growth and the impact was less till 2009 when the oil prices were stable and from 2010 till 2015 the oil prices have tremendous impact on the economic growth of the country.

Table 3
Instrumental Variable estimation Country wise

	Estimate	*Std. Error*	*T-Value*	*P-Value*
OL	6.2253	0.2714	22.939	<2e-16***
DEBT	0.4782	0.1669	2.865	0.00783**
INFL	0.2062	0.1308	1.577	0.12600
Factor(year)2006	–0.3912	0.2155	–1.815	0.08024
Factor(year)2007	–0.3997	0.2014	–1.984	0.05714
Factor(year)2008	1.7522	0.2357	–7.434	4.27e-08***
Factor(year)2009	0.3313	0.1858	1.783	0.0855542
Factor (year)2010	–1.1023	0.2145	–5.139	1.90e-5***
Factor year 2011	–2.0141	0.2160	–9.326	4.39e-10***
Factor (year)2012	–2.1906	0.2191	–9.996	9.70e-11***
Factor year 2013	–1.7282	0.2242	–7.707	2.14e-08***
Factor year 2014	–1.8205	0.2148	–8.474	3.25e-09***

Source: Authors Estimation using R

This is in congruence with the results demonstrated by Hooker and Federer who proved that volatility in oil prices has an influence on the economic growth of OECD countries. This is due to declining revenues from exports combined with inability to adjust the government spending and imports with the buffers available, mounting debt and interest payments.

Table 4
Pooling, Fixed and Random Model with FGLS Estimator

Variables	*Model 1*	*Model 2*	*Model 3*	*Estimator*
GP	0.321	0.176	0.395	0.748
OL	0.0134’.’	0.013	0.122’.’	0.029’.’
DEBT	0.463***	0.478***	0.358***	0.077***
INFL	0.187	0.206	0.056	-0.0005

Variables	*Model 1*	*Model 2*	*Model 3*	*Estimator*
Constant	10.733	10.7333	10.787	2.389
No of observations	40	40	40	16
F value	5.67969	4.72	7.85355	2531.25
Probability	0.0027	0.017	0.0003	2.22e-16***

Source: Authors Estimation using R

The FGLS estimator clearly indicates a negative impact on GDP growth due to reduction in oil prices. The panel regression, however, do not provide us the direction of causality i.e., whether the reduction in oil prices causes economic growth or not and *vice-versa*. To check the direction of causality granger causality tests were conducted and the results are presented in Table 5. It can be observed from this Table that there exists a one-way causation that runs from oil prices cause the changes in economic growth of a country and not vice versa. The null hypothesis of oil prices does not homogenously "cause" economic growth could not be rejected. Thus, it can be concluded that while oil prices significantly cause economic growth in oil exporting country no causality is evident from growth to oil prices.

Table 5
Causality Tests

Null Hypothesis	*P-Value*	*Test F*
OL does not granger cause GP	0.0150*	3.6367
GP does not granger cause OL	0.06682	2.4185
GP does not granger cause DEBT	0.9966	1.1314
DEBT does not granger cause GP	0.8172	0.5288
INFL does not granger cause GP	0.1917	1.6508
GP does not granger cause INFL	0.6911	0.6952

Source: Authors Estimation using R

4. CONCLUSION

In this study, we re-examined the nexus of economic growth in oil exporting countries along with other potential determinants of economic growth such as Debt, Inflation and Oil prices. For the empirical analysis, the paper analyzed annual data over the period of 2006 to 2015 on a sample of four major oil exporting countries. Methodologically the process included controls for simultaneity biases, reverse-causation by adopting FGLS method. Secondly the paper checks the stationarity of the variables using a recently developed unit root test by Pesaran (2007) and the Granger causality test. The relative importance of the oil industry with respect to the national GDP in each country should impact the country's economic growth. However, when the data for an econometric analysis includes different countries and not many longitudinal data, OLS method is inept to find that oil prices are significant determinants of GDP Growth. For that reason, this study proposes the utilization of Panel Data Analysis with Random Effect to combine idiosyncratic differences and hypothetically omitted variables by letting different intercepts for each country.

Consistent with the previous studies, our analysis indicates that economic growth is significantly impacted by the level of Debt and change in Oil prices. The GDP of these countries have been negatively

impacted by increase in oil prices. As a primary exporter of oil, the decrease in oil prices causes the GDP to decline explaining the causality analysis of oil granger causing GDP of these 4 countries. This implies that oil plays an extensive role in influencing their GDP. Further since they are non-co-integrated series, the outcomes echo a counter-intuitive view of oil prices causing a change in GDP.

The finding is robust for all the four countries and specifically the oil prices has a significant influence on the economic growth of all the countries after 2009.The GDP growth is diminishing as export proceeds are falling. Further these countries have tried to compensate for the decreased prices by producing and exporting more so as not to lose too much export revenue which has led to further price decreases in recent months.

It is also found that excluding inflation, all the variables have major impact on the level of economic growth. The insignificant measurement for inflation is consistent with many previous studies. Further it is found that there is a unidirectional causation from Oil prices to economic growth in oil exporting countries. In this study, the advantages of using Panel Data Analysis with Random Effects are evident and corroborate the statistical significance of both oil price variations and the relative importance of the oil sector for the determination of economic growth in OPEC countries. Concrete steps aimed at reducing the Debt must be taken immediately. These countries must create a well-planned financial policy for accelerating the level of economic growth during this turbulent period.

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