

Granger Causality Analysis on Ghana's Macro-Economic Performance and Oil Price Fluctuations

Dogah Kingsley Etonam^{1*} Dogah Denis²

1.Wang Yanan Institute for Studies in Economics, Xiamen University, China

2.Department of Political Science, Simon Fraser University, 8888 university Drive Burnaby, BC, Canada

Email:dogah.kingsley@yahoo.com; ddogah@sfu.ca

Abstract

Oil has had an exclusive position in the world's economic system. It is an essential source of energy, an irreplaceable transport fuel, and a vital raw material in many manufacturing processes. Despite the incredible role oil plays in socio-economic development and most industrial activity, studies on oil price-economy relationship seems to have received little attention from the perspective of developing economies. Although a colossal volume of literature exist on oil prices effects on economic performance, majority of these studies are concentrated on rather developed markets. As Ghana continues her quest to grow into a middle-class economy, it is imperative to secure a reliable supply of energy largely from imports, which is vital for fueling economic growth and development. Consequently, guaranteeing the supply of this all-important resource brings verification of the interconnection between oil price fluctuations in the global market and Ghana macroeconomic performance. Considering the fact that most developing economies are oil dependent for economic growth and industrial productivity, a formal studies on oil price fluctuations and Ghana economy will better position policy makers in taking energy policy issues to address impacts of oil price fluctuations. Against this backdrop, we employ an empirical modelling technique using Granger Causality test to investigate the direction of causation between oil price fluctuations and the Ghanaian economy. The empirical findings of this study suggest that oil price variations have adverse impact on Ghana's macroeconomic performance. We also observe that a uni-directional causality runs from oil price fluctuations to output and economic growth in Ghana. Thus, we recommend that policy action be formulated to expand and refurbish the nation's refinery hub, thereby allowing for home production of finished crude oil products which drains the nation's budget during periods of oil price spikes.

Keywords: Oil price, Ghana, Granger Causality, Macroeconomy.

1 INTRODUCTION.

Energy, by all means, is considered as a lifeline of a country's socio-economic and human development. The importance of fuel in our daily life is quite apparent. Petrol for instance is a strategic fuel for Ghana's economic wellbeing. Its price affects cost of production in a variety of ways as with the increase in prices, cost of transportation of import, export and goods for local consumption. Ghana is one of the developing oil dependent economies in Sub-Saharan Africa with oil accounting for 70% of her total percentage of energy consumption (Lin et al., 2014). Although volumes of studies exist which can help policy makers and investors alike formulating effective energy policies, the available literature suggests that the bulk of these research works have focused on developed economies with little research work done on developing economies like Ghana. We therefore find this research very expedient and timely to provide findings to fill this research gap. A combined UNDP/World Bank Energy Sector Management Assistance Program (ESMAP) report in 2005 on "The Vulnerability of African Countries to Oil Price Shocks; (the case of oil importing countries)" observes that, Sub-Saharan African (excluding South Africa) and East Asia (omitting China) are the most vulnerable to oil price shocks in both 1990 and 2003. According to the ESMAP (2005) report, the vulnerability to oil price shocks in Africa (including Ghana) have surged between the period of 1990 and 2003 by more than the oil price rise. This indicates that oil price shocks have a large impact on economic growth in the continent since most African countries are highly dependent on oil as a source of primary energy. Nearly most developing economies have a complete reliance on imported oil for their productive activities and industrial growth of which Ghana is no exception (IEA Market Report, 2013). This report consequently raises serious economic implications of oil price shocks for macro-economic development in Africa and as a net importer in the case of Ghana, conducting such studies will go a long way to investigate and come out with empirical evidence and recommendations to address some of these alarming revelations. Moreover, a considerable fraction of recent contributions on Africa in terms of oil price-macroeconomic performance have revealed a strong interaction (feedback) between energy use and economic growth (Nnadikwe, 2011). Accounting for this is the large oil intensity in the output of most oil importing economies of which Ghana is no exception. Consequently, fluctuations in the prices of oil which constitutes a major component of energy resources can pose a significant repercussion to economic growth. This constitutes the urgent need to conduct thorough empirical studies to determine the nature and extent of these fluctuations on economic performance in developing countries. Although a great number of studies attempted to

establish a causal link and impact of oil price fluctuations on macroeconomy after Hamilton's landmark paper in 1983, majority of these studies are based on the most developed economies. These includes (Gisser and Goodwin, 1986; Hanson et al., 1993; Uri, 1996; Amamo and Van Norden, 1998; Papapetrou, 2001; Berument and Tasci, 2002; Rautava, 2004; Jimenez-Rodriguez and Sanchez, 2005; Huang et al., 2005; Lardic and Mignon, 2006; Zhang, 2008; Aydin and Acar, 2011) with a consensus that oil price shocks pose negative effects on economic growth. Few studies that work on developing economies are limited to cases in Asia. Using Cointegration and Granger-causality test, Cunado and Perez (2005) investigate the impact of oil price shocks on both economic activity and consumer price indices of six Asian countries (Japan, Singapore, Thailand, Malaysia, Philippine and South Korea). The authors use quarterly data for the period 1975-2002 and find that oil price shocks has statistically significant impact on both economic activity and price indexes especially when oil price shocks are defined in local currency. They however did not find a cointegrating long-run relationship between oil price shocks and macroeconomic activity even after allowing for structural breaks. Thus, to analyze the short-run relationship, the authors employ a Granger-causality test and argue that oil price shock Granger causes economic growth in Japan, South Korea and Thailand. Furthermore, the authors find an evidence of asymmetric response for the oil-price macroeconomy relationship in some of the Asian countries. Limin Du et al. (2009) examine the impact of the world oil price on China's macroeconomy using the vector autoregressive (VAR) model for the period 1995-2008. The study conducted a Granger causality test and found a uni-directional causality from world oil price to China's macroeconomy. The authors argue that despite China's huge role in the world oil market in terms of its large share of oil consumption, it has not yet gained significant influence of oil pricing in the world oil market. Thus, the world oil price have significant impact on economic growth and inflation in China while China's economic activity does not impact the world oil price. In addition, by employing an impulse response function to both the linear and non-linear impact models, they found for the linear impact model, a co-movement between China's GDP, CPI, and the world oil prices while the non-linear impact model reveals an asymmetric relationship between China's GDP and world oil price. Thus, the positive oil price shocks do not have significant impact, while the negative oil price shocks do significantly decrease economic growth in China. From the structural break test, the authors argue the existence of structural break in the VAR model in 2002, which they attribute to the reforms of China's oil price mechanism. Following the limited literature on this line of study, our work seeks to provide a fresh perspective into the oil price macroeconomy discussion from an African perspective. What makes our work novel among other works is that we employ a more robust empirical estimation to investigate the much debated topic. Consequently, a Granger causality analysis studies on oil price fluctuations and Ghana's economy is an attempt to add to the existing literature by expounding on existing methodological frameworks and analysis.

2 DATA AND METHODOLOGY

2.1 Data

The study makes use of yearly time series data which covers the period from 1972-2012, a total of 40 observations. The variables investigated include oil prices (DO) and three macroeconomic variables namely; real gross domestic product per capita (DLGPC), consumer price index (DLCPI) and exchange rates (DER) of Ghana. The selection criteria for these variables to proxy the macroeconomy of Ghana is based on data availability that spans the considered study period. In this work, we measure economic performance by log difference of real GDP per capita and inflation by the log variation of consumer price index (CPI). Again, difference of nominal exchange rate of the US dollar to Ghana cedis (US\$/GHS), is used to proxy the real exchange rate and the Europe Brent spot oil prices difference (FOB) expressed in Dollars per Barrel is used to proxy real oil price variable. We source the oil price data from the US Energy Information Administration (EIA) database. The exchange rate of dollar to the Ghana cedi data is extracted from the Bank of Ghana yearly publications. The rest of the macroeconomic variables, DLGDP and DLCPI are obtained from the World Development Indicators (WDI) available online at the World Bank website.

2.2 Empirical Estimation

Granger Causality Test

Hamilton (2003) suggests that the regressions of output growth on its own lagged values and lagged oil price changes can have a causal interpretation. Analyzing the case of the US, Hamilton (2003) argues that historically, major oil price shocks are mainly due to political and military events rather than the US macroeconomy, needless to say, Ghana macroeconomy.

To confirm the belief that macroeconomic variables especially in Ghana have no predictive ability in crude oil price changes over the period investigated, we conducted the Granger causality test. The import of this test is to basically, investigate whether oil price shocks have a direct or indirect impact on the macroeconomic activities in Ghana. Granger causality test seeks to ascertain whether or not the inclusion of the past values of a variable, say X, does or does not contribute to better prediction of the present values of another variable Y.

Causality therefore means, the lagged values of a variable X, have an explanatory power in the regression of a variable, Y, on the lagged values of Y and X. Thus, variable X is said to Granger cause Y, if the inclusion of past values of variable X, helps to better predict the present values of variable Y.

This could be specified in functional form as:

$$(1-L) \begin{bmatrix} Y_t \\ CPI_t \\ ER_t \\ O_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \sum_{i=1}^p (1-L) \begin{bmatrix} \beta_{11i} \beta_{12i} \beta_{13i} \beta_{14i} \\ \beta_{21i} \beta_{22i} \beta_{23i} \beta_{24i} \\ \beta_{31i} \beta_{32i} \beta_{33i} \beta_{34i} \\ \beta_{41i} \beta_{42i} \beta_{43i} \beta_{44i} \end{bmatrix} \begin{bmatrix} Y_{t-i} \\ CPI_{t-i} \\ ER_{t-i} \\ O_{t-i} \end{bmatrix} + \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \\ \epsilon_{3t} \\ \epsilon_{4t} \end{bmatrix} \quad (1)$$

Where Y_t is the natural logarithm of economic growth which I proxy by the GDP per capita, CPI_t represents the natural logarithm of inflation which I proxy by the CPI, ER_t is the natural log of exchange rate and O_t represents the log of real oil price. $\alpha_1, \alpha_2, \alpha_3,$ and α_4 denote constant trend, $(1-L)$ is the difference operator and $\epsilon_{1t}, \epsilon_{2t}, \epsilon_{3t},$ and ϵ_{4t} are serially independent random errors with mean zero and finite covariance matrix.

3 EMPIRICAL RESULTS AND ANALYSIS

Granger Causality Test

The following table shows a strong statistical evidence that a causal relationship exist from oil price shocks to GDP whiles no causality is found from GDP to oil price shocks for the linear and non-linear oil price fluctuation specifications.

Table 1 Displays Granger Causality Test on Real Series

Series	Null Hypothesis	F-statistics	Prob.
Linear	DO does not Granger Cause DLGPC	2.872**	0.064
	DLGPC does not Granger Cause DO	0.424	0.901
Non-Linear	D0P does not Granger Cause DLGPC	4.175*	0.021
	DLGPC does not Granger Cause D0P	0.438	0.893
	DON does not Granger Cause DLGPC	3.436*	0.039
	DLGPC does not Granger Cause DON	0.484	0.863

*and** means the coefficient is statistically significant at 5% and 10% significance level.

From table 1 above using the benchmark specification, we test the null hypothesis that oil price shocks do not Granger cause output against the alternative that oil price shocks Granger cause output. Our result show the probability (P-value) to be very small, hence we reject the null hypothesis at the 10% significance level and accept the alternative that oil price shocks Granger cause output.

Using the non-linear specification, we observed that both the negative and positive shocks reject the null hypothesis base on the P-values at 5% significance level. Consequently, we infer a uni-directional causality from oil price to GDP in Ghana and conclude that Granger causality exist between oil price shocks and economic activity. Expounding on the granger causality from oil price shocks to economic performance, we argue that the lagged values of oil prices would have a better predictive or explanatory power on the future values of output in Ghana

Granger causality simply helps to determine whether a causal relationship exist among variables or not. The statistical evidence based on our result shows that there is a uni-directional causality from the oil price shocks to output in Ghana whiles no causality exist from output to oil price shocks. This speaks to the nature and extent to which global oil price hikes impede prospects macro-economic performance in developing countries. Contained in this web of global oil price hikes, oil dependent economies in Africa are hardly able to sustain the needed institutional structures for long-term economic development. (e.g the ongoing price shocks forced Nigeria to devalue their currency . Other oil producing countries like Angola, Congo, Sudan, Libya and Gabon, are experiencing the direct impacts of these price spikes in one way or the other). To overcome the multiple hurdles to economic prosperity, developing countries will first have to battle with the structural constraints imposed by the global economy on energy resource development and macro-economic performance at national levels. In summary we argue that the based on the causality test oil price shocks pose significant effect economic activity in Ghana and oil price fluctuations have direct impact on economic growth

4 CONCLUSION AND POLICY RECOMMENDATIONS

As Ghana continues her quest to grow into a middle-class developing economy, it is imperative to secure a reliable supply of energy largely from imports, which is vital for fueling economic growth and socio-economic

development. Consequently, guaranteeing the supply of this all important resource brings authentication of the interconnection between oil price fluctuations and macroeconomy. A key point worth noting however in literature is that, much of the oil-price economic relationship research has been focusing on developed economies and a formal work on developing countries in Africa seems to be lacking. Against this background, we employed an empirical modelling technique using Granger Causality test to investigate the direction of causation between oil price fluctuations and the Ghana economy. The empirical findings of this study suggest that oil price fluctuations have adverse impact on Ghana's economic performance. The study observe that a uni-directional causality runs from oil price fluctuations to output and economic growth in Ghana. This is consistent with what economic theory suggests and such findings also confirms earlier works by Chang and Wong (2003), Cunado and Perez (2005), and Sanchez (2011). Given the recent discovery and the commercial lifting of oil in Ghana, it would provide an interesting debate to examine the degree of oil efficiency as an energy source in Ghana in future studies. Another area for future research would be to explore the relationship between oil prices and the terms of trade (TOT) to examine how changes in oil price impact the TOT. On policy recommendation for Ghana, this study proposes that efforts should be made to expand and invest in the nation's sole refinery hub which has inadequate logistic and also lack storage capacity. This will thereby enable government to take advantage of home production of the crude oil which is already in production. Consequently this initiative will in no small means free government budget from the millions of dollars spend on the importation of finished petroleum products which are relatively expensive. Furthermore government must ensure that revenues from oil proceeds are used judiciously to the betterment of the entire nation. More importantly, these resources should be targeted at developing the non-oil productive sector to foster a broad-based, diversified and strong economic growth in Ghana. This will propel prospects for welfare gains and living standard improvements through a more efficient resource allocation and economic growth.

REFERENCE

- Amano, R.A., Van Norden, S., 1998. Oil prices and the rise and fall of the US real exchange rate. *Journal of International Money and Finance* 17, 299–316.
- Ayadi O.F., 2005. Oil price fluctuations and the Nigerian economy. *OPEC Review: Energy Economics & Related Issues* 29 (3), 199-217.
- Bank of Ghana Data Base- www.bog.gov.gh . (Accessed on January 15, 2015)
- Bank of Ghana Annual Report 2012- www.bog.gov.gh (Accessed on January 15, 2015)
- Chang, Y., Wong, J.F., 2003. Oil price fluctuations and Singapore economy. *Energy Policy* 31, 1151–1165.
- Cunado, J., Gracia, P., 2005. Oil prices, economic activity and inflation: evidence for some Asian countries. *Quarterly Review of Economics and Finance* 45.
- ESMAP (Energy Sector Management Assistance Program), 2005. The vulnerability of African countries to oil price shocks: major factors and policy options: the case of oil importing countries. Details available at www.esmap.org Assessed on January 15, 2015
- Hamilton, J., 2001. A parametric approach to flexible nonlinear inference. *Econometrica* 69, 537–573.
- Hamilton, J.D., 1983. Oil and the macroeconomy since World War II. *Journal of political economy* 91, 228–248.
- Hamilton, J.D., 1985. Historical causes of postwar oil shocks and recessions. *Energy Journal* 6, 97–116.
- Hamilton, J.D., 2003. What is an oil shock? *Journal of Econometrics* 113.
- Hamilton, J.D., 2008. Oil and the macroeconomy, In: Durlauf, S.N., Blume, L.E. (Eds.), *The New Palgrave Dictionary of Economics*, Second Ed. Palgrave Macmillan, Houndmills,
- Hanson, K., Robinson, S., Schluter, G., 1993. Sectoral effects of a world oil price shock: economy wide linkages to the agricultural sector. *Journal of Agricultural and Resource Economics* 18 (1), 96–116
- Huang, B.-N., Hwang, M.J., Peng, H.-P., 2005. The asymmetry of the impact of oil price shocks on economic activities: an application of the multivariate threshold model. *Energy Economics* 27, 445–476.
- Jiménez-Rodríguez, R., Sánchez, M., 2005. Oil price shocks and real GDP growth: empirical evidence for some OECD countries. *Applied Economics* 37, 201–228.
- Lardic, S., Mignon, V., 2006. The impact of oil prices on GDP in European countries: An empirical investigation based on asymmetric cointegration. *Energy Policy* 34, 3910–3915.
- Lin, B., Presley Jr, W. K., Micheal, A.O., 2014. Oil price fluctuation, volatility spillover and the Ghanaian equity market: Implication for portfolio management and hedging effectiveness. *Energy Economics* 42 (2014) 172–182. Market Report, February, 2013. IEA: <http://www.iea.org>. Accessed on January 8, 2015.
- Nnadikwe, K., 2011. High Oil Dependence in Ghana: To What Extent is Ghana Vulnerable to Oil Price Shock? Library Resource for CEPMLP, University of Dundee.
- Papapetrou, E., 2001. Oil price shocks, stock market, economic activity and employment in Greece. *Energy Econ.* 23, 511–532.
- Rautava, J., 2004. The role of oil prices and the real exchange rate in Russia's economy—cointegration approach. *Journal of Comparative Economics* 32 (2), 315–327.

- Rodriguez, R.J., Sanchez, M., 2005. Oil price shocks and real GDP growth: empirical evidence for some OCDE countries. *Applied Economics* 37, 201–228.
- Sanchez, M., 2011. Welfare effects of rising oil prices in oil-importing developing Economies. *The Developing Economies* 49 (3), 321–346.
- UNDP/ESMAP (United Nations development programme/world Bank Energy Sector Management Assistance Program), 2005. *The Impact of Higher Oil Prices on Low Income Countries and on the Poor*: <http://www.worldbank.org> (Accessed on June 4, 2013)
- Uri, N.D., 1996. Crude oil price volatility and unemployment in the United States. *Fuel Energy Abstracts* 37, 91.
- Zhang, D., 2008. Oil shock and economic growth in Japan: A nonlinear approach. *Energy Economics* 30, 2374–2390.

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:

<http://www.iiste.org>

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: <http://www.iiste.org/journals/> All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: <http://www.iiste.org/book/>

Academic conference: <http://www.iiste.org/conference/upcoming-conferences-call-for-paper/>

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digital Library, NewJour, Google Scholar

