ENERGY CONSUMPTION, FINANCIAL DEVELOPMENT AND ECONOMIC GROWTH IN NIGERIA

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Abstract
The study empirically examined the interconnectivity among energy use, financial development and economic growth in Nigeria. It adopts single equation generalized method of moments to estimate the relationship among energy consumption, financial development and economic growth in Nigeria. The result of the study suggests increased energy consumption will boost economic growth in Nigeria. Also this study also confirms the inducement effect of financial sector expansion on energy consumption. This study therefore recommends that government should formulate appropriate policy that will boost power sector that will inturn boost energy consumption with a multiplier effect on economic growth. Government should also know that financial sector expansion will induce energy use and inturn stimulate economic growth.

Keywords: Energy Use, Financial Sector, Gross Domestic Product.

Introduction
Energy has been considered as engine of growth to any economic be it developed or underdeveloped economy. The empirical relationship between energy consumption and economic growth has been discussed extensively (see for example, Apergis and Payne, 2010) Apergis and Tang, 2013, Narayan and Smyth, 2009, Narayan et al, 2010, Sai and Soytas, 2007. There also exist similar studies in Nigeria (Odiambo, 2009, Odularu and Okonkwo, 2008, Atoyebi et al (2012). On the other hand, quite a number of studies have confirmed the positive role of financial development on economic growth in recent years (see for example Ali-Yousif, 2002. Fungi, 2009; Karwta, 2011; Mastern et al, 2008, ). It is also possible to find some empirical evidence from Nigeria (Odularu, 2010, Sakar et al, 2011, Odiambo, 2012 ).

However, empirical studies over the past three decades have concentrated more the link between energy consumption and economic growth but less on the interconnectivity between financial development and energy consumption. As argued by Sadorsky (2011), the theoretical relationship between energy consumption, financial development and economic growth could be resolved through empirical analysis. In energy economic literature, the relationship between financial development and energy consumption has been a topical issue in the recent years. Against the background this study is motivated by energy situation scenario in Nigeria at this present time coupled with the underdeveloped financial market. Therefore the objective of this paper is to examine the interconnectivity between energy consumption, financial development and economic growth in Nigeria.

Selected Existing Literature
Detailed and empirical validation has provided comprehensive empirical evidence on the interconnectivity between energy consumption and economic growth but less on the link between financial development and energy consumption, notable studies on the link between financial development and energy consumption are
(Chirou, 2012) who examined the causal relationship between energy consumption and financial development in Tunisia but found a uni-directional causal relationship from energy consumption to financial development both in the short run and the long run. Similar studies was conducted bylean (2012) on the relationship among energy consumption, financial development and economic growth. His results reveal a long run relationship among the three variables. He however, found a bidirectional causality between financial development and energy consumption which negates Chirou (2012) submission Sadorsky (2010) examined the linkage between financial development and energy consumption in Twenty two emerging economies by employing various indicators of financial development over the period 1990-2006. The results from His study revealed a positive linkage between financial development and energy consumption, similar issues was investigated by Sadorsky (2011) for nine frontier economies of central and Eastern Europe during the period 1990-2006. This He does by dividing financial development indicators into barking related variables and stock market variables. His results reveal that only stock market variables exert a significant positive impact on energy consumption.

In another study conducted by Islam et al (2013) on the relationships among energy consumption, financial development economic growth, they found that both financial development and economic growth impact positively on energy consumption in Malaysia in the long run. Similar studies was also conducted in Malaysia by Tan and Tan (2012) on the relationship among energy consumption, Financial Development and Economic growth. The study found that energy consumption and financial development are positively linked in the long run but energy consumption is a prominent resource for financial development. Xu (2014) examines the interconnectivity between Financial development and Energy consumption during the period 1999 through 2010 using a panel data set of 29 provinces of China. The study adopted system generalized method of moment. The results indicate a positive significant relationship between Financial development and energy consumption when Financial Development is measured using the ratio of loans in Financial institution to GDP and FDI to GDP. On the other hand, the results of Jalil and Peridun (2013) suggested that Financial Development leads to a decrease in environmental pollution in China.

Kakar et al. (2011) also conducted similar study in Pakistan on the relationship between Financial Development and energy consumption. Their result indicates positive association between Financial Development and energy consumption in the long run but this does not exist in the long run. Xu (2014) examined the nexus between Financial Development and energy consumption over the period 1999 through 2009 with a panel data set of 28 countries by using configuration estimation technique. The result indicates a longrun equilibrium relationship between Financial Development and energy consumption. Ozturk and Acaravci (2015) also examined the nexus between energy consumption and Financial Development in Turkey. They provide evidence of the existence of long run equilibrium relationship between per capita energy consumption and Financial Development. They also concluded that while per capita energy consumption causes Financial Development in the short run, Financial Development causes per capita energy consumption in the long run. Mehara and Musa (2014) examined the interconnectivity relationship between per capita energy consumption and Financial Development in the case of Iran over the period 1990-2012. Their result indicates a long run equilibrium relationship and energy consumption. Mielnik and Goldenberg (2014) also examine the linkage between energy consumption and financial development with a panel data set of Twenty developing economies. He however, concluded that foreign direct investment as an indicator of Financial Development exert a significant negative impact on energy consumption of all the sample of Twenty developing economies that were investigated. In the light of this background this study will depart from other studies by taking a country specific study into consideration i.e. providing evidence in the case of Nigeria.

Overview of Energy Situation in Nigeria

The economy, heavily dependent on the export of oil products, grows at an average of 6% annually. The country enjoys a tropical rainforest and savanna climate in the south and central belt respectively as well as an arid/semi-arid climate in the north. It is blessed with enormous natural resources; crude oil and natural gas, tin, iron ore, coal, limestone, lead. Zinc, arable land, solar (particularly in the north), hydropower (incl. 277 small hydro identified sites with a cumulative potential of 3,500MW) and wind (mainly in the north and along the coastal line). According to the statistics from the International Agency (IEA), total Nigerian primary energy supply was 118,325 Kilotonne of Oil Equivalent ( ktoe) - excluding electricity in 2011. As depicted in figure below, biomass and waste dominated with 82.2%. Renewable energy source only
accounted for a small share of the energy supply. For instance hydropower only accounted for 0.4%. Wind and solar are utilized, but at an insignificant level at present. Figure 2: Energy supply by source in 2012 (in %)

![Energy supply by source in 2012 (in %)](image)

Source: Ener data (2012)

Biomass is the dominant energy source in Nigeria due to the huge reliance on the energy source for cooking and heating purposes by majority of the Nigeria people. According to the global initiative on accessible, clean and efficient energy- Sustainable Energy for All (SE4ALL), little progress has been made with regards to providing access to non-solid cooking fuels since 1990. As visible in the figure below, in 2010, only 26% of the population had access to non-solid cooking fuels with a big difference between urban and rural area.

Figure 3: Access cooking fuels in rural and urban areas in 2012 (in %).

![Access cooking fuels in rural and urban areas in 2012 (in %)](image)

Source: Ener data (2012)

Energy consumption
As per the below, in terms of the distribution of the energy demand, in 2012, the total final consumption was 116,457 ktoe, of which the residential sector accounted for most of the energy consumed. Figure 4. Energy consumption by economic sector in ktoe

![Energy consumption by economic sector in ktoe](image)
Consumption (Total 116,457 ktoe)

Source: BP (2013)

Energy Balances

Table 1. Energy balances for Nigeria in 2012 Kilotonne of oil equivalent (ktoe)

<table>
<thead>
<tr>
<th></th>
<th>Coal and peat</th>
<th>Crude oil</th>
<th>Oil products</th>
<th>Natural Gas</th>
<th>Hydro</th>
<th>Biofuels and waste</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>30</td>
<td>129,409</td>
<td>0</td>
<td>33,645</td>
<td>487</td>
<td>108,142</td>
<td>271,712</td>
</tr>
<tr>
<td>Imports</td>
<td>0</td>
<td>0</td>
<td>8.440</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>8440</td>
</tr>
<tr>
<td>Exports</td>
<td>0</td>
<td>-126,413</td>
<td>-755</td>
<td>-21,032</td>
<td>0</td>
<td>0</td>
<td>-148,201</td>
</tr>
<tr>
<td>International marine bunkers</td>
<td>0</td>
<td>0</td>
<td>-397</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-397</td>
</tr>
<tr>
<td>International aviation bunkers</td>
<td>0</td>
<td>0</td>
<td>-186</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-186</td>
</tr>
<tr>
<td>Stock changes</td>
<td>0</td>
<td>1830</td>
<td>538</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2368</td>
</tr>
<tr>
<td><em><em>TPES</em> Total Primary Energy supply</em>*</td>
<td><strong>30</strong></td>
<td><strong>4,825</strong></td>
<td><strong>7,640</strong></td>
<td><strong>12,613</strong></td>
<td><strong>487</strong></td>
<td><strong>108,142</strong></td>
<td><strong>133,736</strong></td>
</tr>
<tr>
<td><strong>TPES (%)</strong></td>
<td>0.02%</td>
<td>3.61%</td>
<td>5.71%</td>
<td>9.43%</td>
<td>0.36%</td>
<td>80.86%</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Source: Ener data (2013)

Empirical model and data

Following Blundel and Bond (2005), the study adopts recently developed generalized method of moments estimation techniques that has the advantages over other methods due to its ability to resolve endogeneity and reversal causality issues in dynamic model. But this is a single equation generalized method of moments because of its specify nature of the study. In this paper we examine the relationship among Energy consumption, Financial Development and Economic growth in Nigeria during the period 1980 through 2014.
In line with Sardosky (2014), the empirical model is a dynamic panel model of energy demand where energy consumption is expressed as a function of income (y) is per capita and financial development (fd) $Ec_t = α_t E_{c,t-1} + Ψ_1 y_t + Ψ_{12} Fd_t + Ψ_{13} p_t + Ε_t$. Where t indicates the time period (t = 1980……… 2014), we employed annual data on energy consumption, real GDP per capita, energy prices and financial development indicators for the period of 1980 – 2014. The data on energy consumption is measured as energy use in kg tonne of oil equivalent per capita. While the real GDP per capita is measured in constant 2005 dollars. Real oil prices are represented by energy prices. The model is augmented to include foreign direct investment as an indicator of financial development. All data are sourced from the World Bank Development indicators. We divide financial development indicators into two categories namely stock market variables and banking variables.

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
<th>VARIABLE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>DBA/GDP</td>
<td>Deposit money bank assets to GDP</td>
<td>SMTR</td>
<td>Stock market turnover ratio</td>
</tr>
<tr>
<td>FD/GDP</td>
<td>Financial deposit to GDP</td>
<td>SMCGDP</td>
<td>Stock market capitalization to GDP</td>
</tr>
<tr>
<td>LL/GDP</td>
<td>Liquid liabilities as a share of GDP</td>
<td>SMVG</td>
<td>Stock market value traded to GDP</td>
</tr>
<tr>
<td>PCR/GDP</td>
<td>Private credit to GDP</td>
<td>LISTCOPC</td>
<td>Number of listed companies of per (10,000) people</td>
</tr>
</tbody>
</table>

Table 2: Summary of Variables and Descriptions

Source: Author variable descriptions (2016)

Descriptive statistics

To estimate the equation above we employ the recent two-step dynamic panel data approach to determine the relationship among energy consumption, financial development, and economic growth. The lagged values of energy consumption in the equation are treated as endogenous in the equation above.

<table>
<thead>
<tr>
<th></th>
<th>Obs</th>
<th>Min</th>
<th>Mean</th>
<th>Max</th>
<th>Std.dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980-2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In Energy</td>
<td>35</td>
<td>2.690</td>
<td>2.313</td>
<td>4.150</td>
<td>0.322</td>
</tr>
<tr>
<td>In GDP</td>
<td>35</td>
<td>3.730</td>
<td>2.264</td>
<td>5.180</td>
<td>0.1523</td>
</tr>
<tr>
<td>In Price</td>
<td>35</td>
<td>2.512</td>
<td>1.730</td>
<td>1.720</td>
<td>0.113</td>
</tr>
<tr>
<td>Fdi</td>
<td>35</td>
<td>2.621</td>
<td>2.334</td>
<td>14.710</td>
<td>4.323</td>
</tr>
<tr>
<td>Bank index</td>
<td>35</td>
<td>-15.071</td>
<td>5.173</td>
<td>6.415</td>
<td>2.092</td>
</tr>
<tr>
<td>Stock Index</td>
<td>35</td>
<td>-4.32</td>
<td>3.122</td>
<td>2.302</td>
<td>1.333</td>
</tr>
</tbody>
</table>

Source: Authors computation (2016)

Table 3
Two step system GMM single equation regression results for the whole period 1980-2014

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Ln energy_t$</td>
<td>0.822*** (0.000)</td>
<td>0.893*** (0.000)</td>
<td>0.921*** (0.000)</td>
<td>0.948*** (0.000)</td>
</tr>
<tr>
<td>$Ln oil price_t$</td>
<td>-0.0218 (0.000)</td>
<td>0.0245 (0.000)</td>
<td>-0.212 (0.000)</td>
<td>-0.0186 (0.000)</td>
</tr>
<tr>
<td>$Ln gdg_t$</td>
<td>0.0811 (0.030)</td>
<td>0.0912 (0.0013)</td>
<td>0.0662 (0.098)</td>
<td>0.0512 (0.0213)</td>
</tr>
<tr>
<td>Fd_t</td>
<td>0.000892**</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Empirical results and discussion:

The two step GMM dynamic panel approach that was developed by Blundell and Bond (2005) was used. The result reveals that systems of two simultaneous equations are in levels and the other in first difference largely improves both consistency and efficiency (Roodman, 2009b, Doytch and Uctum, 2011). From the empirical results, the estimated coefficients on the lagged variables are less than unity in absolute value in the periods which confirmed steady state assumption suggested by Roodman (2009) in favour of the validity of the instruments used by GMM approach. In other way round, deviations from long term values are not systematically correlated with fixed effects. We can infer from the above estimation that real GDP per capita has the expected sign and also the magnitude of FDI as an indicator of financial development also have the expected sign suggesting that expansion of financial development will induce energy consumption.

Conclusion and Recommendations

This study examined the interconnectivity among energy consumption, financial development and economic growth in Nigeria. The study realized that energy consumption is a strong determinant of economic growth in Nigeria and should therefore be accorded more relevance by seizing the sector’s opportunity to improve economic growth. This study however confirm the positive connectivity between energy consumption and economic growth. This study also confirmed the relevance of financial development proxy by FDI. This study realized that a 1 percent increase in FDI will however induced energy consumption by 0.01 percent which suggests an inducements. This study again observed that energy resources are available in Nigeria but development and utilization is lacking. Therefore policy reform should focus on the financial sector expansion in order to boost energy consumption. The study noted that energy resources could be maximally utilized with well developed power sector and financial sector base.

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