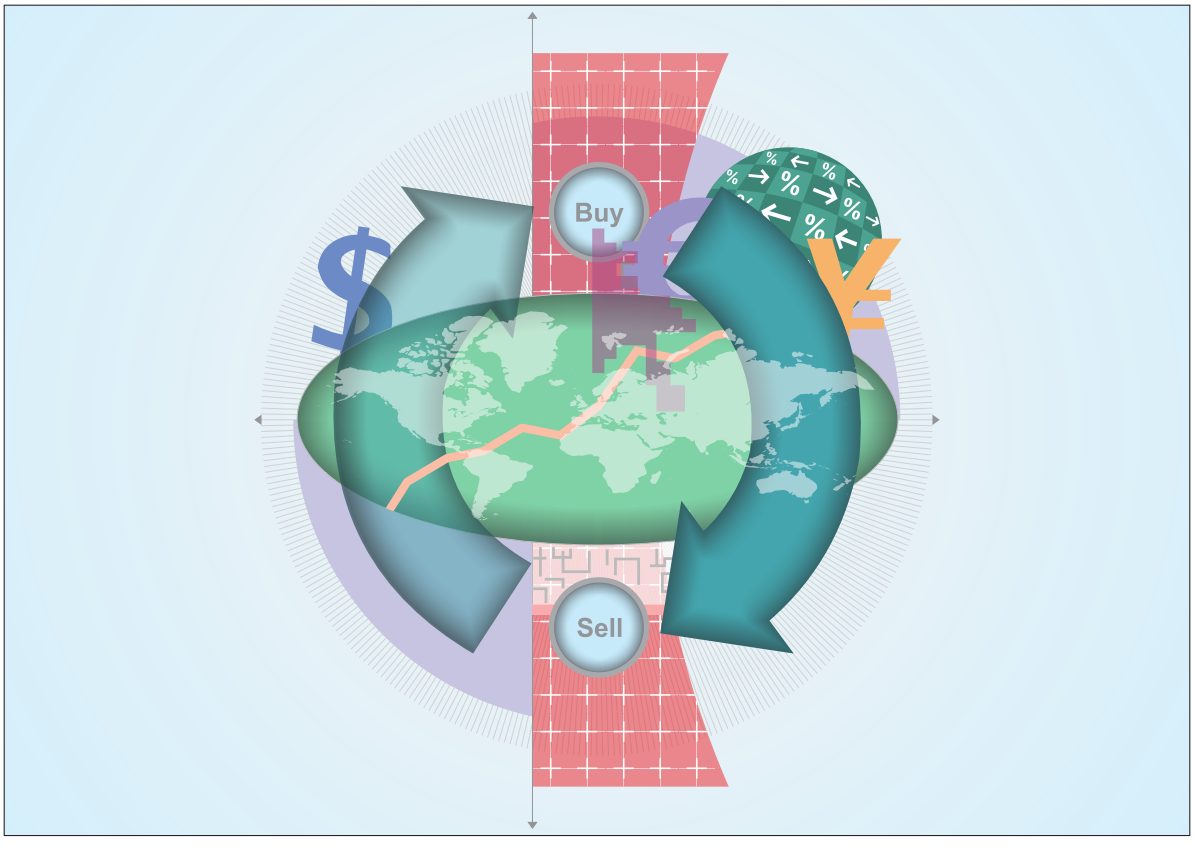

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Global Renewable Energy Consumption and Oil and Gas Export: An Empirical Analysis of the Nigerian Economy

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ABSTRACT

Since after the Arab oil embargo of 1973, net oil importing countries developed the agenda for substituting fossil fuel and to date, renewable energy has become a major power source for most countries. This motivated for a study which analysed the possible impact of global renewable energy consumption on the Nigerian economy (Net Oil and Gas Export) over the period 1980-2008. The empirical results were obtained by analysing the data using the statistical time trend analyses (descriptive) in explaining the problem under investigation. The findings revealed that renewable consumption by Nigeria's major oil and gas importers causes significant negative impact on its economy in terms of reduced crude oil and gas export. The result suggests that Nigeria as a mono-cultural economy should uncover alternative corridors other than oil and gas export to provide revenue in order to accelerate Nigeria's economic growth and development.

Key words: Global renewable energy, empirical analysis, oil and gas export, economic growth

INTRODUCTION

As far back as 4000 years ago, renewable energy has been in use as a source of energy for various human and industrial purposes (Golding, 1955). It began to rise to prominence in the 1970's when oil price recorded its first hike as result of the 1973 Arab oil embargo (Ng *et al*., 2009; Lin *et al*., 2007). Since then, studies on renewable energy sources as means of achieving energy and climate security have received considerable attention globally over the years.

Thus, to ensure non-reoccurrence of the 1973 oil price shock, avoid supply disruption and energy dependence and reduce climate change, countries especially net energy importers promoted alliance on energy policies, diversified energy corridors and means and this led to the birth of energy and climate security question which drive up the research and production of renewable energy as an alternative to the conventional energy source (Abdeshahian *et al*., 2010; Ibeto *et al*., 2011; Vijayaraghavan *et al*., 2010; Belkin, 2008; Yergin, 2006). For that reason, there have been epic quest for substituting fossil fuels that accounts for over 80% of the total world's energy demand. To reduce this dependency, analysts suggest that the only option is to increase renewable energy production and consumption which has been widely debated academically and in the media (Yergin, 2008; Mabro, 2006). Renewable energy comprises of bio fuel, thermal, wind, solar and biomass which has insignificant level of carbon content when compared to the conventional energy sources (Ibeto *et al*., 2011; Kannan and Marappan, 2011; Sambo, 2005). Statistical data and

studies in this area depict continued increase in the level of renewable energy sources in the global energy mix (IEA, 2009). This growth in the supply mostly emanates from net energy importing countries as a result of high demand, environmental concerns and strong governmental support (Vijayaraghavan *et al*., 2010; IEA, 2009; Harte *et al*., 1991). Thus, the EREC (2004) opined that by the year 2040, renewable energy is expected to contribute 50 percent of total global energy supply (EREC, 2004). Also in a related studies, Abdeshahian *et al*. (2010), Gomaa *et al*. (2011), Ibeto *et al*. (2011) and Klass (2003) asserts that crude oil price, environmental and political problems will drive the growth of the renewable energy industry and result in the gradual phase-out of what can be called the fossil fuel era. Other drivers were the continued decline in oil and gas production in Organisation for Economic Co-operation and Development (OECD) countries, agitation for resource nationalism and continued lost of grip of the petroleum industry by the traditional private companies, once known as the seven sisters (Leverett and Noel, 2006; Umbach, 2010). Similarly, the activities of environmental campaigners over the years have informed various governments and other institutions about the need to reduce fossil fuel consumption. These activists advocate for a shift from fossil fuel to increased renewable energy consumption in order to mitigate climate change by decreasing carbon foot-print (Ibeto *et al*., 2011; Parker and Blodgett, 2008). However, the major reasons mostly advanced for exploring renewable energy is providing energy and climate security, control of fossil fuel prices and to a large extent, break the monopoly exercised by oil producing countries (Eneh, 2011b; Klass, 2003; Umbach, 2010). Despite these substantial efforts, there are doubts as to whether the energy output to be sourced from renewable energy is adequate to satisfy the increasing energy world demand as it only accounts for about 17% of the total global energy consumption (EREC, 2004). This means that fossil fuel will continue to play a significant role in the global energy mix despite the multi-facet benefits of the clean fuels. Eneh (2011a, b) argued that petroleum has continued to be a source for energy despite its environmental challenges and the reports of Energy Information Administration (2008) shows that, oil and gas will continue to remain as world's most essential source of energy for the future, even under the most positive of postulations about the pace of development and deployment of renewable technology. For this reason, Mabro (2006) argued that development of renewable energy sources does not represent a potential threat to fossil oil. However, some energy analysts are of the view that bio fuels are the direct substitute for oil. Thus, several countries have initiated and adopted different policies to make bio fuel an energy source in the transport, power, heat, chemicals and other marketable products (Ibeto *et al*., 2011; Marpaung, 2010; Mousdale, 2008). Ibeto *et al*. (2011) also opined that US been the second largest producer of ethanol has mandated its consumption from 7.5 billion gallons annually to 15 billion. Furthermore, a report by the EIA (US Energy Information Administration, 2011) suggests renewables are the fastest-growing source of world energy, with consumption increasing by 2.8% annually due to demand in many countries globally including the US, a major importer of Nigeria's crude oil. Though, Rojagopal and Zilberman (2007) argued that biofuel production is characterized by intensive land, water, energy and chemicals inputs which to serve as a substitute for fossil fuel could be considered a risk to environmental quality and food security. Thus, the implication is that, by the year 2040, when renewable energy is expected to contribute 50% of total global energy supply (EREC, 2004), oil revenues are expected to decline in most net oil exporting countries, including Nigeria. This expected reduction in fossil fuel consumption could have severe impact on Nigeria's foreign exchange earnings as about 90% of export earnings and about 40% of government revenues accrue from it (Energy Information

Administration, 2011a). Thus, the Nigerian economy, like any other oil producing and exporting country is exposed to volatility in the crude oil market which at times disrupts macroeconomic performance and stagnate cash inflow due to oil price fluctuations and output unpredictability. Based on the above argument, the objective of this study is to explore the impact of global renewable energy consumption on the Nigerian oil and gas export by taking into account consumption by its dominant oil importers.

MATERIALS AND METHODS

Statistical time trend analyses are applied to study the trend of renewable energy consumption in Nigeria's major oil importing countries grouped by continents to analyse the impact on its oil and gas export. Oil and gas is expected to be negatively related to consumption of renewable since the renewable energy and crude oil are substitutes. However, it depends on whether Nigeria is a net importer or exporter of petroleum products and gas. Though, it is expected to be negatively related to renewable energy since oil and gas exports constitutes over 75% of the total revenue of Nigeria. Thus, the oil revenue generated are used in providing infrastructural facilities and running of government activities that contribute to national growth and development.

Data and method of analysis: This study used annual time series data in which information on all the variables from 1980 to 2008 were collected, in addition to other quantitative information sourced. The variables include the total renewable energy consumption (excluding biofuels) of Nigeria's major oil importers such as North America, Europe and Asia were also used from the year 1980 to 2009. The total renewable energy comprises-solar, wind, geothermal, tidal and wave. Others are biomass, waste and hydro electricity; all measured in billion kilowatt hours ($kW\ h^{-1}$) and Nigeria's gas export (measured in million standard cubic meters) were obtained from the Energy Information Administration website (Energy Information Administration, 2010a), in addition to global biofuels consumption (measured in thousand barrels) which is for 2000-2008. Similarly, Nigeria's annual crude oil export (measured in thousand barrels) by destination were sourced from NPC (2010). While crude oil exports (measured in thousand barrels per day) are from OPEC (2009). The empirical data are analysed using the various descriptive statistics tools-line graphs, bar charts and tables to demonstrate the trend of the variables over time, possible factors responsible for such movements and its impact on oil and gas export are discussed.

Descriptive statistical evidence: Figure 1 illustrate the global renewable consumption excluding biofuels of Nigeria's major oil importers by continents from 1980-2008.

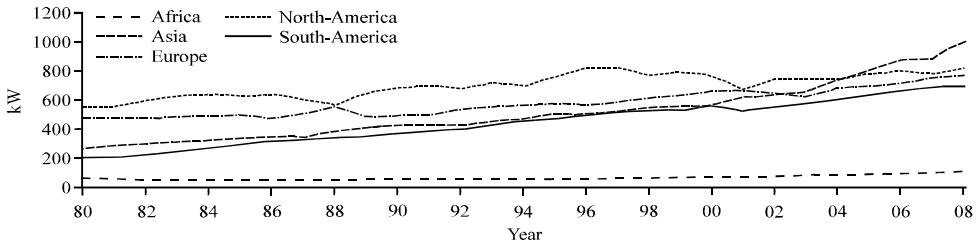

Fig. 1: Global renewable consumption excluding bio-fuels (billion kilowatts (kW)), Author's computation (Data from Energy Information Administration, 2010b)

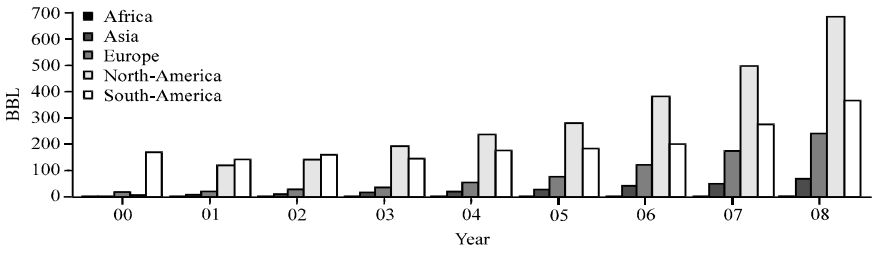

Fig. 2: Global bio-fuels consumption (Thousands barrel (BBL)/Day), Author's computation (Data from Energy Information Administration, 2010b)

Figure 2 shows the renewable consumption profile of Nigeria's major oil importers from 2000-2008. From the periods under review, it could be observed from Fig. 1 and 2 that the global consumption of renewable energy has been on the increasing trend since the 1973 oil price shock as a result of the Arab embargo. Other factors that might explain increased consumption of renewable energy include; unpredictable political climate in the Middle East such as the gulf war, the Iraq Invasion. This region control about 40% of the world's oil and gas reserves (OPEC, 2009) and thus plays a critical role in meeting global energy demands. Other factors that could have attributed to increased renewable energy consumption include: volatility in some major oil and gas producing countries such as Nigeria, Libya, Egypt, Bahrain, Venezuela and the OPEC syndrome. Moreover, environmental concerns arising from environmental watch-dogs, pressure groups and global policy on climate security have in recent years contributed significantly towards the growth of non-fossil fuels production and consumption (Eneh and Agbazue, 2011; Ibeto *et al*., 2011). As evidenced from the graphs, the consumption of non-fossil fuels is dominated by Europe and North America. These regions, being net oil importers have been pushing towards providing alternatives for fossil fuel consumption to attain energy security (Umbach, 2010; Klass, 2003). For instance, about 42.3, 23.8 and 10.6% of Nigeria's crude oil exports goes to North America, Asia and Europe (NNPC, 2008). As shown in Fig. 2, these regions being Nigeria's dominant oil importers, an average of about 175 Billion Kilowatts of renewable energy was produced and consumed in 1980 and since then, it has continued to increase significantly reaching a peak of about 800 billion kilowatt in Asia in 2008. However, a slight fall in consumption of renewable energy can be observed between 2000 and 2003 in Europe and North America while Asia and South America showed an increasing trend. It was suggested that the consumption of bio fuels increased during the period 2000-2008. This increase was more significant in North America and Europe, followed by Asia. Most of these countries have various support policies and targets on bio fuel production and consumption. These includes bio fuels tax incentives and subsidies to producers as well as consumers of these products (Ibeto *et al*., 2011; Marpaung, 2010). It could be argued that, biofuels are the most potential substitute for oil and an increase in their consumption means reduction in fossil fuel use. The trend in renewable energy production and consumption is projected to rise by the year 2040 where it is estimated that energy from these sources would account for about 50 percent of the total global energy demand (EREC, 2004).

RESULTS AND DISCUSSION

Figure 1 and 2 suggest that the demand for and supply of cleaner energy has been on continued increase over the years globally. This upward movement points to the fact of un-relented commitments on the part of governments, environmental watch dogs, new technology and

consumer's attitude towards the use of cleaner energy especially in net energy importing countries. As reported by IEA (2009), the demand and supply of renewable energy will continue to grow between 6.7 and 8.2% annually and by the year 2040, it is projected to account for about 50% of the total world's energy requirement. Similarly, the growth of the use of the renewable energy could be viewed as a substitution effect arising from the increase in the use of non-fossil energy. This argument is supported by findings of Umbach (2010) and Klass (2003), who suggest that oil and gas consumption in most net energy importing countries is expected to decrease.

Also, supported by the trends of the data analysed which also conform to previous studies made on the continued increase of renewable energy could have negative impact on oil dependent economies such as that of Nigeria. Since the discovery of oil in 1956, Nigeria remained a mono cultural economy, depending substantially on oil revenues (Nwokeji, 2007). Over the years, oil has remained the major source of foreign exchange earnings and accounts for over 40% of government revenues (Energy Information Administration, 2011a). From the year 1970 to 1999, Nigeria realised about $231 billion revenue from oil (Joy, 2009). Also, report by NNPC (2009), shows that Nigeria exported about 8,556,570,151 billion barrels from 1999 to 2009 to the international energy market. This when converted to monetary terms, could run to trillion of oil revenue for the period of 10 years alone. Joy (2009) further argued that since 1974, these oil rents have accounted for between 21 and 48 percent of GDP. For instance, in the third quarter of 2009 alone, Nigeria exported 191 million bbl of crude oil and received about $11.3 billion based on an average price of $59 a barrel (NNPC, 2009). However, despite these enormous revenue, Nigeria's economy still bewildered with double digit inflation and degenerating infrastructure and more worrisome of all is that about 70.8% of the 150 million population lives on less than $1 a day (Eneh, 2011c, d; Anyiwe and Oziegbe, 2006). These quest to attained economic development resulted to compromising the sustainability of the environment especially in the oil producing regions of the Niger-Delta (Eneh and Agbazue, 2011; Eneh, 2011e).

Based on Fig. 3 and 4, it is evident that Nigeria's crude oil and gas export to the international market is on the downward trend since 2007. For instance, between 2000 and 2002, crude oil export decline by approximately 126,203,208 thousand barrels; this accounts for about 16 percent. Similarly, between 2005 and 2008, Nigeria recorded a significant reduction of 153, 597,553 thousand barrel which amounts to 18%, higher than that of the 2000-2002. Thus, this decrease in the researchers view is caused by both internal and external factors such as crisis in Niger Delta, expansion in renewable energy and effect of the financial recession amongst others. However, in the year 2004, there was increase in oil export but the increase is as a result of rise

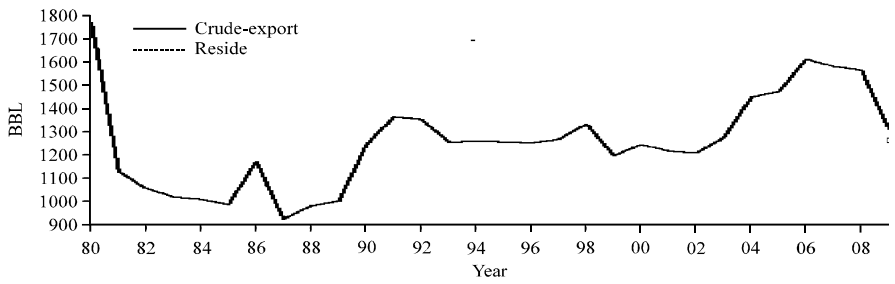

Fig. 3: Nigeria's crude oil exports (Thousands barrel (BBL)/Day), Author's computation (Data from OPEC, 2009)

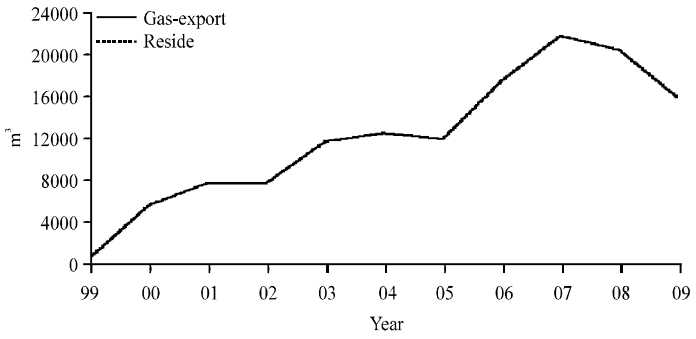

Fig. 4: Nigeria's gas export (million standard cubic meters (m^3)), Author's computation (Data from Energy Information Administration, 2011b)

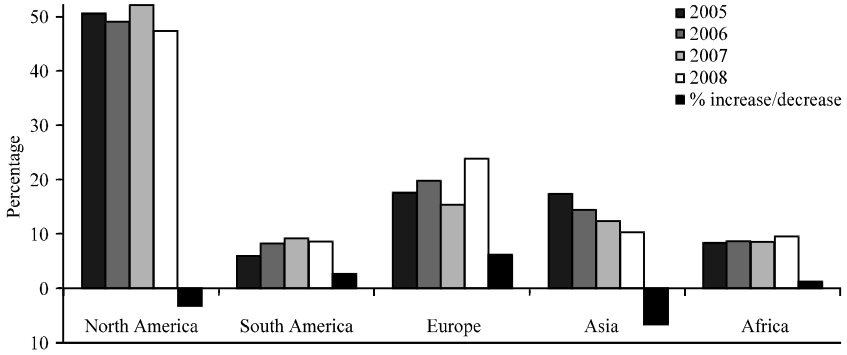

Fig. 5: Nigeria's crude oil export by destination (%), Author's computation (Data from NNPC, 2005, 2006, 2007, 2008)

in price of crude oil, high demand from emerging economies led by China and India and a number of other developing countries. Moreover, there was high demand from USA, due to disruptions to its oil installations in the Gulf Coast (NNPC, 2005). Similarly, gas export shows a cyclical trend, reaching a peak in 2007, where 20,000 Million Standard Cubic Meters was exported to the energy market. This upsurge is largely as a result of demand from European countries which is a shift from their traditional gas supplier-Russia (IEA, 2009). Since then, oil export from Nigeria has been on a declining trend, despite the government's target of achieving 4 million barrels per day (NPC, 2010).

In addition, as shown in Fig. 5 below, most of the Nigeria's crude oil exports go to North America, EU and Asia. In 2007 alone, about 55, 15 and 13% of Nigeria's crude oil were exported to these countries respectively (NNPC, 2007). Also, it is evident from Fig. 5 that Nigeria's crude oil export has been declining especially to Asia and South America. Thus, this reduction of Nigeria's crude oil export could be as a result of the substitution effect and other related factors and has resulted to significant loss of revenue to the Nigerian government.

Base on the foregoing analyses, it is evident that Nigeria's oil and gas export has been in continues decline especially to North America and Asia. This can be attributed to the development of and consumption of renewable energy resources by Nigeria's dominant oil and gas importers particularly North America, Europe and some part of Asia as opined by IEA (2009). Similarly, the literature reviewed indicate that, most countries in the world today, especially the net oil importers

are shifting towards renewable sources of energy to satisfy their energy demands (Abdeshahian *et al*., 2010; Gomaa *et al*., 2011; Ibeto *et al*., 2011; Eneh and Agbazue, 2011; Umbach, 2010).

CONCLUSION

The study presents a detailed empirical analysis of the impact of global renewable energy consumption on the Nigeria's oil and gas export. The empirical analysis reveals that consumption of renewable energy by Nigeria's dominant energy importers impact negatively on the Nigerian economy. The negative impact is evident in the declining trend of Nigeria's oil and gas export in recent years. Thus, it has justified the effectiveness of the policies, targets and incentives adopted by Nigeria's major oil importers towards the growth of non-fossil fuel. Therefore, depending on oil revenue alone in this age of global shift towards cleaner fuel have severe economic, political and social consequences on Nigeria in the long run when a substantial percent of the world's energy for all purposes could be powered by non-fossil fuels. Going by this global passion for renewable energy sources, Nigeria's almost neglect of its non-oil sector is likely to pose a serious challenge to its year 2020 economic vision of becoming among the 20 most developed economies in the world. At this juncture, it is worthy to note that diversifying revenue corridors to lessen the dependence on oil rents would lead to accelerated economic growth and development and since there are other potential sources of revenue windows, there is the need to harnessed these areas and be integrated into the nation's economic plan so that the revenue disruption arising from oil price and output volatility currently experienced could be put to an end and the Dutch disease suffered by the economy for decades could be remedied for better transformation and performance.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

The empirical results suggest that these renewable energies particularly the consumption by Nigeria's major oil importing countries had a significant negative impact on its oil and gas export which in turn affects world oil price and Nigeria's economy. Therefore for Nigeria to reduce the impact, it needs to diversify the economy away from oil dependence, through meaningful reforms policy and programmes on its non-oil sector of her economy.

Diversification of energy mix to reduce over dependence on subsidized fossil fuel which has been generating controversies between the government and pressure groups should be pursued. Promotion and support of local technology that would fully exploit renewable energy potentials of Nigeria and making it available at a subsidized cost, since the so called developed countries also do subsidized. This can be achieved by funding the existing energy research centres and also incorporating renewable energy studies into Nigeria's higher institutions curriculum.

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