EMPIRICAL ANALYSIS OF THE OIL SHOCKS-STOCK RETURNS RELATIONSHIP: A SECTORAL DISAGGREGATION FOR NIGERIA

Terver Kumeka[1] Oluwatosin Adeniyi[1]*Samuel Orekoya[1]

Abstract

This paper investigated the impact of crude oil price shocks on the returns and volatility of the Nigerian stock market. Since not all industries are expected to be equally affected by oil price changes, we conducted our study at the disaggregate firm level for two sectors namely Banking and Oil &Gas. A bivariate VAR-GARCH model was employed for the daily observations of Brent crude oil price and the closing share values of the 12 firms over the period January 1, 2000 to December 31, 2015. The empirical findings showed that the returns on stock market are significantly affected by their own past values suggesting some evidence of short-term predictability in stock market changes. For the Banking sector past oil shocks drive stock price volatility in all firms, except for ACCESS Bank. The response of stock returns to oil impact is negative in the case of FIRST Bank, UBA and WEMA Bank and positive for GUARANTY Trust Bank, UNION Bank and ACCESS Bank. In the Oil & Gas sector on the other hand, we found that innovations in the oil market had effects on the stock volatility in three firms (BOCGAS, CONOIL and OANDO). The largest response to oil effects was observed in the case of CONOIL followed by BOCGAS. Overall, our findings showed that direct volatility transmission is insignificant for each pair of oil firms, because the volatility transmission runs more often from oil market to firms than from the firms to oil market. Considering the intensity of volatility spillover, it seems to vary from sector to sector, depending especially on their degree of oil dependence and industrial characteristics. The impact has a direct link in the Oil & Gas sector, while in the Banking sector the impact is indirectly linked. This suggests that investors should closely watch the happenings in the oil market to have better forecasts of stock market volatility and make appropriate investment decisions.

Keywords: *Oil prices, Banking sector, Oil & Gas sector, volatility transmission, firm-level, VAR-GARCH model*

JEL Classification: *G110, G320, G210, Q350*

[1] Department of Economics, University of Ibadan, Oyo State, Nigeria*Corresponding author: saino78@yahoo.com; +234 703 3275 062

1.0 Introduction

The stock market has been viewed as a market where most elements that feed into the development of a nation's economy operate. In Nigeria, the Nigerian Stock Exchange (NSE), which is one of the fastest growing stock markets in Africa and among the emerging stock markets in the world, has recorded phenomenal growth. As at 2002, of the eight sub-Saharan markets analyzed, only Nigeria, South Africa and Zimbabwe were considered 'frontier markets' and were thus included in the IFC Global Composite Index (Magnusson and Wydick, 2002). Moreover, the recent global financial crisis that led to a downward movement of stock prices also posed a great threat to an emerging economy like Nigeria. For instance, daily stock prices on the floor of the Nigerian Stock Exchange show that by the last week of June 2008, the prices of bank stocks had decreased by between 15 and 51 percent within a period of one month. The Equity market capitalization as at February 2008 was N12.5 trillion but fell to N9.7 trillion as at August of the same year. The Nigerian stock market witnessed a remarkable turn-around in May 2013 following the Bearish run experienced in April 2013. From a negative growth of 0.29% in April 2013, the market returned 13.02% as indicated by the All Share Index (ASI) during the month of April. This growth almost competes with the position of the ASI in January 2013, the only time the Index appreciated by double digits of 13.44% (NSE, 2013). The activities witnessed in the month of May 2013 resulted in the sale of 8.48 billion shares worth N94.36 billion, which were executed in 123,954 deals.

Consequently, the aggregate volume and value of securities traded from January to May 2013 stood at 48.61 billion and N444.77 billion respectively, indicating 36.81% and 64.27% appreciation when compared with 35.53 billion units of securities worth N270.76 billion traded in the corresponding period of 2012. The favourable improvement in the prices of equities resulted in an appreciation of 13.02% in value of the ASI; a move similar to the performance in January 2013 when the index gained 13.44%. It rose steadily from 33,440.57 points in April 2013 and attained a peak value of 38,016.80 points on 30th May, 2013 before ending the month at 37,794.75 points. The market capitalization of debt securities and the only listed Exchange Traded Fund (ETF) on the other hand, closed lower at N4.658 trillion and N0.862 billion thus recording a decline of 6.21% and 4.52% respectively in May 2013.

Hence, total market capitalization of all listed securities stood at N16.738 trillion during the month, a 6.86% appreciation when compared with N15.664 trillion in the preceding month. Equity market capitalization accounted for 72.16% of May's total market capitalization, up from 68.28% in the previous month. This significantly reduced the coverage of the debt capitalization to 27.83% from 31.71% in April 2013 while capitalization of ETF remained static at 0.01%. Out of

the eleven (11) equities market sector classification of the NSE, the Financial Services, Industrial Goods and Consumer Goods sectors still controlled larger portions in terms of market capitalization, accounting for 32.58%, 29.98% and 28.96% respectively while the other sectors contributed the paltry balance of 8.47%.

Nevertheless, as of the 4th week of January 2015, the NSE All-Share Index and Market Capitalization appreciated by 0.38% to close the week at 23,916.15 and N8.225 trillion respectively. Similarly, all other Indices finished higher during the week, with the exception of the NSE Insurance Index, NSE Consumer Goods Index and NSE Industrial Goods Index that declined by -1.60%,-0.44% and -1.47% respectively, while NSE ASeM Index closed flat. The performance of the NSE ended poorly in 2015 as reflected by the market indicators, the market capitalisation and the All-Shares Index. During the year, the Nigerian Stock Exchange slumped below its three-year low due to what market analysts attributed to dwindling crude oil price, foreign exchange problems and exodus of foreign portfolio investors. A total of 92.90 billion shares worth N952.49 billion were exchanged by investors in 941,602 deals between January and December 2015. This was against 108.47 billion shares valued at N1.34 trillion traded in 1,335,572 deals in the same period in 2014. Data as at December 31, 2015 showed that the equity market dipped by 17.36 per cent year-to-date (YTD) compared with a decline of 16.14 per cent posted in 2014. The All-Shares Index lost 6014.90 points or 17.36 per cent to close for the year at 28,642.25 on December 31, 2015 from the 34,657.15 with which it opened for the year (NSE, 2015; CBN, 2014, 2015). The market capitalization, which opened for the year at N11.478 trillion, lost N1.628 trillion to close at N9.850 trillion on Dec 31, 2015 due to huge price losses by some blue-chip companies (NSE, 2015; CBN, 2014, 2015).

There are a number of different factors that affect financial markets; however, many researchers believe there is a direct relationship between the price of oil and the stock market (Salisu and Oloko, 2015; Babatunde, et al, 2013). In many cases, economic indicators have a positive linear effect on the markets. On the other hand, oil prices are believed to have a negative correlation to the stock markets, which means that as oil prices go down, stock prices go up. Most of the literature showed that oil does not have a positive correlation to the stock markets but instead that financial markets can do well while the price of oil is rising. The majority of studies indicate that the price of oil has a negative correlation to the markets. Negative correlation is the most popularly accepted relationship between oil prices and the stock markets (e.g. Kang, et al, 2014; Fowowe, 2013; Adebiyi, et al, 2012; Papapetrou, 2001).

Therefore, the impact of oil price volatility on the performance of the stock market, much as it has not been adequately explored, should not be ignored. As noted by Okonjo-Iweala (2006), a major challenge for the Nigerian economy was its macroeconomic volatility driven largely by external terms of trade shocks and the country's large reliance on oil export earnings. Moreover, Nigeria's economy ranked among the most volatile in the world for the period 1960 to 2000 (World Bank, 2003). The impact of oil price on stock markets in developing countries has not been sufficiently covered in the literature. Stock markets in emerging markets especially in Africa have gained prominence because the markets have developed a step further to the diversification of risk apart from the primary role of providing an alternative source of capital for investment. In Nigeria, the stock market has been greeted with a high rate of volatility attributable to high risk. Since most investors are risk averse, they tend to shy away from the market due to uncertainty in expected returns. High market volatility increases unfavorable market risk premium (Uyaebo, et al, 2015; Atoi, 2014). Therefore, it is significant to reduce the stock market volatility and ultimately enhance economic stability in order to improve the effectiveness of asset allocation decisions (Poon and Tong, 2010).

In spite of many studies that exist on the dynamic relationship between stock prices and oil prices, few have focused on emerging stock markets in Africa such as the Nigerian Stock Exchange (NSE). Specifically, previous empirical studies about the stock market in Nigeria focused more on the impact of the stock market (as a form of financial development indicator) on economic growth as well as on efficiency and performance (Adjasi and Osinubi, 2003; Adelegan, 2003; Magnusson and Wydick, 2002). However, recently some authors have found that oil price volatility plays an important role in explaining both stock market and economic activities (Papapetrou, 2001). Therefore, our effort to investigate whether changes in stock market volatility over time can be attributed to the volatility of oil price is not only timely but also in the right direction. The examination of the relationship between oil price and stock prices has been well documented in the literature on developed economies. The empirical explanation for this connection was pioneered by Huang et al. (1996)and Jones and Kaul (1996). For instance, Huang et al. (1996)investigate the dynamic interactions between oil futures prices traded on the New York Mercantile Exchange (NYMEX) and US stock prices and they found the return volatility spillover from oil futures to stocks to be very weak. However, a similar submission can hardly be made for emerging and developing markets, as there is still a dearth of research in this area.

Furthermore, most of the studies in the literature consider the relationship between oil price and total (aggregate) stock market indices (Vo, 2011; Balcilar and Ozdemir 2012; Fowowe, 2013; Antonakakis et al, 2014; Mollick and Assefa, 2013; Salisu and Oloko, 2015). Therefore, to the best of our knowledge, no study on Nigeria has examined the effect of oil price changes on individual firms on the Nigerian Stock Exchange. We reckon that aggregate stock market indices may mask the individual characteristics of the activity sectors in relation to oil prices. Therefore, this study examines the relationship between oil price and stock prices at the disaggregate level. We deployed the industrial classification of firms and selected the sectors likely to be most affected by oil prices, namely, the *Banking* and *Oil & Gas* sectors.

Following the introduction in section 1, the remainder of the article is organized as follows. Section 2 discusses the findings of selected previous works on the relationship between oil price and stock markets. Our empirical methodology and data issues are treated in Section 3. Section 4 presents the empirical results and discussion of findings. Section 5 provides the summary and conclusion.

2.0 Literature Review

Many authors argue that oil price effect on stock markets is indirect and is fed through the macroeconomic indicators. According to Bjornland (2009) and Jimenez-Rodriguez and Sanchez (2005), an oil price increase is expected to have a positive effect in an oil-exporting country, as the country's income will increase. The consequence of the income increase is expected to be a rise in expenditure and investments, which in turn creates greater productivity and lower unemployment. Stock markets tend to respond positively to this sequence of events.

The study by Faff and Brailsford (1999) investigated the sensitivity of Australian industry equity returns to an oil price factor over the period 1983-1996. The paper employed an augmented market model to establish the sensitivity. The key findings were as follows. First, a degree of pervasiveness of an oil price factor, beyond the influence of the market, was detected across some Australian industries. Second, they found significant positive oil price sensitivity in the Oil and Gas and Diversified Resources industries. On the contrary, they found significant negative oil price sensitivity in the Paper and Packaging, and Transport industries. Generally, they found that long-term effects persisted, although they hypothesized that some firms had been able to pass on oil price changes to customers as a means to hedge the risk.

Employing an error correction representation of a VAR model, Papapetrou (2001)concluded that oil price is an important factor in explaining the stock price movements in Greece, and that positive oil price shocks depressed real stock returns. Maghyereh (2004)studied the relationship between oil price changes and stock returns in 22 emerging markets, working with a VAR model from 1998 to 2004, without finding any significant evidence that oil prices had an impact on stock index returns in these countries. In contrast to this conclusion, Basher and Sadorsky (2006), analyzing the impact of oil price changes on a large set of emerging market stock returns for the period 1992 to 2005, showed that emerging economies are less able to reduce oil consumption and are thus more energy intense, and more exposed to oil prices than more developed economies. Therefore, oil price changes are likely to have a greater impact on profits and stock prices in emerging economies. Cong et al (2008) applied multivariate vector autoregression methodology to analyze the interactive relationship between oil price shocks and Chinese stock market activity. The authors found evidence that oil price shocks had no significant effect on stock returns except for manufacturing index and some oil companies. Elyasiani et al (2011) examined the impact of changes in the oil returns and oil return volatility on excess stock returns and return volatilities of thirteen U.S. industries using the GARCH (1,1) technique. They found strong evidence in support of the view that oil price fluctuations constitute a systematic asset price risk at the industry level as nine of the thirteen sectors analyzed show statistically significant relationships between oil-futures return distribution and industry excess return. These industries are affected either by oil futures returns, oil futures return volatility or both. In general, excess returns of the oil-user industries are more likely to be affected by changes in the volatility of oil returns, than those of oil return itself. Volatilities of industry excess returns are time-varying, and return volatility for a number of sectors, appear to have long memory.

In addition to the prominent papers considering oil price and stock markets in advanced and other emerging economies, some authors focused on the Nigerian economy. For instance, Adaramola (2012) examined the long-run and short-run dynamic effects of oil price on stock returns in Nigeria over 1985:1–2009:4 using the Johansen cointegration tests. A bi-variate model was specified and empirical results showed a significant positive stock return effect on oil price shocks in the short-run and a significant negative effect in the long-run. The Granger causality test showed strong evidence that the causation runs from oil price shocks to stock returns; implying that variations in the Nigerian stock prices are explained by oil price volatility. In a similar line, Okoro (2014) employed Augmented Dickey Fuller and Johansen Co-integration Tests in which the effect of oil price volatility, crude oil price and stock price was analyzed in a unifying

model, using time series data spanning 1980 to 2013 for Nigeria. The result suggested that oil price volatility affects stock price both positively and negatively. Babatunde et al (2013) applied the multivariate vector auto-regression that employed the generalized impulse response function and the forecast error variance decomposition. Their results revealed that stock market returns exhibit insignificant positive response to oil price shocks but revert to negative effects after a period of time depending on the nature of the oil price shocks. The results were similar even with the inclusion of other variables. Also, the asymmetric effect of oil price shocks on the Nigerian stock returns indices is not supported by the statistical evidence.

Asaolu and Ilo (2012) used Cointegration analysis and the Vector Error Correction framework to analyze the impact of oil prices on the Nigerian stock market performance. They found that oil prices and stock market performance are associated in the long run. A rise in the price of oil leads to a decline in the return performance of the stock market. Somoye and Ilo (2008) examined the Nigerian stock market performance using vector-autoregressive (VAR). The study concluded that among the variables examined in the VAR model, the price of the Nigerian crude oil, exchange rate and inflation had the most significant influence on the aggregate stock market returns. Fowowe (2013) investigated the relationship between oil prices and returns on the Nigerian Stock Exchange. By using GARCH-jump models, he was able to model the volatility of stock returns and also take account of the effect of extreme news events on returns. The empirical results showed a negative but insignificant effect of oil prices on stock returns in Nigeria. Nwosa (2014) studied the relationship between domestic and international oil prices and stock prices in Nigeria with data for the period from January 1985 to April 2010. The test results which used the VECM analysis on quarterly data indicated that in the long run, there was a one-way relation between the two variables, i.e. the domestic oil prices affected stock prices. In contrast, there was no relationship between the domestic and international oil prices and stock prices in the short run. Using another data span, i.e. from January 1995 to December 2011, and a structural vector auto-regression (SVAR) model, Effiong (2014) found that the response of the stock market to oil supply shocks is insignificantly negative. However, the effect was significantly positive for aggregate demand and oil-specific demand shocks. The cumulative effects of the oil price shocks accounted for about 47 per cent of the variation in stock prices in the long run. These results suggest that the origin of oil price shocks is crucial for understanding the volatility in Nigeria's stock market.

Overall, compared to the previous literature, our investigation builds on the recently developed VAR-GARCH model, and moves from the market-level and sector-level analyses to an individual firm-level analysis by taking the stock prices of twelve firms in two sectors (*Banking* and *Oil & Gas*) in Nigeria. This paper, to the best of our knowledge, is a pioneer attempt in this direction in the literature, particularly for Nigeria.

3.0 Methodology and Data issues

3.1 Methodology

In the empirical finance literature, the generalized autoregressive conditional heteroscedasticity (GARCH) model of Bollerslev (1986) is one of the most widely used specifications on modeling and forecasting volatility of commodities prices. Empirical works indicated that the use of such types of models has centered on the evaluation of their forecasting performance (Fariz et al 2016; Uwubanmwe and Omorokunwa 2015; Amin and Amin 2014; Mollick and Assefa 2013; Elyasiani et al 2012; Kang et al., 2009; Sadorsky, 2006) and their application to Value-at-Risk (VaR) estimations (Aloui and Mabrouk, 2010; Giot and Laurent, 2003; Sadeghi and Shavvalpour, 2006).

However, as far as the major concern is about volatility transmission among multiple financial variables, it is commonly accepted that multivariate GARCH specifications such as the BEKK (full parameterization) model of Engle and Kroner (1995), the CCC-GARCH model of Bollerslev (1990) or the DCC- GARCH model of Engle (2002) with dynamic covariances and conditional correlations are more relevant than univariate representations. The superiority of these models and their ability to effectively capture the stylized facts of commodity-price volatility has been extensively confirmed in the literature (see, e.g. Malik, 2007; Agnolucci, 2009; Kang et al., 2009; Arouri et al., 2011, among others).

Nonetheless, the above-mentioned models are excessive in parameters, many of which lack empirical explanations, and often encounter convergence problems during estimation processes especially when additional exogenous variables are introduced to the conditional mean and variance equations. To tackle this problem, the current study uses the multivariate VAR (k)–GARCH (p,q) model proposed by Ling and McAleer (2003) as an interesting alternative. This model has two major advantages. First, it has an analysis advantage since it is relatively less excessive in parameters and allows the modeler to focus more on the estimation of meaningful and interpretable parameters. Second, it permits a multivariate analysis of conditional volatility of the series under investigation as well as of conditional cross-effects and volatility spillovers between the series. This model has previously been used to study the dynamic properties of different

financial and economic phenomena(see for instance, Chan et al., 2005; Abdalla, 2013; Boubaker and Jaghoubi, 2011; Chang et al. 2011; Chaibi and Ulici, 2014; Kumar, 2014; Arouri et al, 2011, 2012).

In this model, the conditional mean equation can be expressed as follows:

$$\begin{cases} R_t = \mu + \Pi R_{t-1} + \varepsilon_t \\ \varepsilon_t = H_t^{1/2} \eta_t \end{cases} \quad (1)$$

Where

$R_t = \left(r_t^s, r_t^o\right)$ with r_t^s and r_t^o being the of returns on the individual firms listed on the NSE stock market under the *Banking* and the*Oil & Gas* sectors and oil market returns at time t respectively.

$\mu = \left(\mu_t^s, \mu_t^o\right)$ is the vector of constant terms.

Π is a (2×2) matrix of coefficients allowing for cross-sectional dependency of conditional mean between stock market and oil prices of the following form:

$$\Pi = \begin{pmatrix} \Pi_{11} & \Pi_{12} \\ \Pi_{21} & \Pi_{22} \end{pmatrix}$$

$\varepsilon_t = \left(\varepsilon_t^s, \varepsilon_t^o\right)'$ is the vector representing the error terms of the conditional mean equations for stock and oil returns respectively.

$\eta_t = \left(\eta_t^s, \eta_t^o\right)'$ is a sequence of independently and identically distributed $(i.i.d)$ random errors;

$H_t = \begin{pmatrix} h_t^s & h_t^{so} \\ h_t^{so} & h_t^o \end{pmatrix}$ is the matrix of conditional variances of stock and oil returns with h_t^s and h_t^o being the conditional variances of r_t^s and r_t^o respectively. Their time series dynamics are modeled as follows:

$$h_t^s = C_s^2 + \beta_{s1}^2 h_{t-1}^s + \alpha_{s1}^2 \left(\varepsilon_{t-1}^s\right)^2 + \beta_{s2}^2 h_{t-1}^o + \alpha_{s2}^2 \left(\varepsilon_{t-1}^o\right)^2 \quad (2)$$

$$h_t^o = C_o^2 + \beta_{o1}^2 h_{t-1}^o + \alpha_{o1}^2 \left(\varepsilon_{t-1}^o \right)^2 + \beta_{o2}^2 h_{t-1}^s + \alpha_{o2}^2 \left(\varepsilon_{t-1}^s \right)^2 \quad (3)$$

According to Equations. 2 and 3, negative and positive shocks of equal magnitude have identical effects on conditional variances. The equations also show how volatility is transmitted over time and across the two markets under investigation. The cross values of error terms, $\left(\varepsilon_{t-1}^o \right)^2$ and $\left(\varepsilon_{t-1}^s \right)^2$, represent the return innovations in the oil market and to the corresponding stock rate at time $(t-1)$, and thus capture the direct effects of shocks transmission. The transfer of risk between the two markets is accounted for by the lagged conditional volatilities, h_{t-1}^o and h_{t-1}^s.

To guarantee stationarity, the roots of the equation $|I_2 - AL - BL| = 0$ must be outside the unit circle where the expressions $(I_2 - AL)$ and BL satisfy some other identifiability conditions as proposed by Jeantheau (1998). L is a lag polynomial, I_2 is a (2×2) identity matrix, and A and B are defined as:

$$A = \begin{pmatrix} \alpha_{s1}^2 & \alpha_{s2}^2 \\ \alpha_{o2}^2 & \alpha_{o1}^2 \end{pmatrix} \text{ and } B = \begin{pmatrix} \beta_{s1}^2 & \beta_{s2}^2 \\ \beta_{o2}^2 & \beta_{o1}^2 \end{pmatrix}$$

The conditional covariance between oil returns and stock market returns in the bivariate VAR (1)-GARCH (1, 1) is modeled as:

$$h_t^{so} = \rho * \sqrt{h_t^s} * \sqrt{h_t^o} \quad (4)$$

where ρ is the constant conditional correlation (CCC) coefficient. Overall, the proposed empirical model simultaneously allows us to capture both return and volatility spillover effects between the crude oil and stock market. Note that the CCC assumption can be viewed as restrictive given that correlation coefficient is likely to vary over time according to changes in economic and market conditions. The quasi-maximum likelihood estimation (QMLE) method of Bollerslev and Wooldridge (1992) is used to estimate the empirical model in order to take into account the fact that the normality condition is often rejected for the majority of macroeconomic and financial series.

3.2 Data Employed

The data set used in this study consists of daily observations of crude oil prices (Brent) and the closing prices of the individual firms listed on the NSE under the*Banking* and the *Oil & Gas* sectors. Both series span the period January 1, 2000 to December 31, 2015. Daily frequency is used because it affords an opportunity to capture the intensity of the dynamics of the relationship between the key variables. Crude oil prices expressed in USD per barrel for Brent spot prices is used to represent the international crude oil market given that this serves as pricing benchmark for two-thirds of the world's internationally traded crude oil supplies (see Alloui et al., 2013; Maghyereh, 2004).

Data on crude oil prices was extracted from the US Energy Information Administration (EIA) database, OPEC database, IMF, and Bloomberg. The data for the NSE index prices are obtained from the NSE database and CashCraft Assets Management. Daily returns on the two variables was computed by taking the difference in logarithm of two successive prices as follows:

$$r_t^o = log\left(\frac{p_t^o}{p_{t-1}^o}\right) * 100 \quad (5)$$

$$r_t^s = log\left(\frac{p_t^s}{p_{t-1}^s}\right) * 100 \quad (6)$$

Here, p_t^o and r_t^o are the daily crude oil prices and their returns respectively. p_t^s and r_t^s denote daily closing prices of the NSE stock market and their returns respectively.

It is pertinent to note that while preparing the data for subsequent analysis, we encountered the problem of non-synchronous trading days. In order to deal with this issue, we carefully traced and removed the asynchronous trading days using Brent (oil market) trading days as the gauge. At the end of this fairly cumbersome exercise, we had 3,633 and 3,628 usable observations for *Banking* and *Oil & Gas* sectors respectively.

4.0 Empirical results and Discussion

4.1 Descriptive Statistics of Stock Market and Crude Oil Prices

In this section, we examine the statistical properties of the returns series and confirm relevant stylized facts about financial time series variables. In essence, we present descriptive statistics and conduct appropriate tests for serial correlation and time-varying autoregressive conditional heteroskedasticity i.e. ARCH effects.

Table 1shows the descriptive statistics augmented with the results for serial correlation using Ljung–Box Q-statistics test and for ARCH effects using ARCH–LM test by Engle (1982). Also included is the result for unconditional correlation between Brent returns and companies' stock returns.

Average daily returns on stock prices are negative for *FIRSTBANK*, *UNITED BANK FOR AFRICA*, *UNION BANK OF NIGERIA* and *WEMABANK* while *ACCESSBANK*, *GUARANTYTRUSTBANK* and *Brent* are positive over our sample period. The stock price of *FIRST* bank realized the worst performance (-0.044), followed by *UNITED BANK FOR AFRICA*, *UNION BANK OF NIGERIA* and *WEMABANK*. Conversely, *Brent*, *ACCESS* and *GUARANTYTRUST* experienced positive average returns, with *GUARANTY* having the highest average stock price return.

From Table 1, all the returns series show wide margins between minimum and maximum values, which suggests the presence of large variance. Meanwhile, as indicated by the standard deviation statistic, *FIRSTBANK* stock appears to be the most volatile of the return series followed by *UNION BANK OF NIGERIA*, while *Brent* appears to be the least volatile return series. In addition, the skewness statistic shows that the return series for *Brent*, *FIRSTBANK* and *GUARANTYTRUST* are negatively skewed while it is positively skewed for *ACCESS*, *UNITED BANK FOR AFRICA*, *UNION BANK OF NIGERIA* and *WEMABANK*.

Moreover, Kurtosis coefficients are important in size and highly significant, indicating that outliers may occur with a probability higher than that of a normal distribution. The kurtosis statistic, which compares the peakedness and tailedness of the probability distribution with that of a normally distributed series, shows that all the return series were found to have a leptokurtic behaviour (i.e., their distributions have fatter tails than corresponding normal distributions). This suggests that each of the mean equations should be tested for the existence of conditional heteroskedasticity. Meanwhile, the Jarque–Bera statistic, which measures normality of the distribution using both the skewness and kurtosis

statistics, shows that we can reject the null hypothesis for normality for all the return series at all conventional significance levels.

We further carry out the stochastic test for autocorrelation and conditional heteroskedasticity to further verify stylized facts on financial time series variables. The ARCH–LM test by Engle (1982)was adopted for testing the significance of time-varying conditional variance (ARCH effects) while the Ljung–Box Q-statistic test was employed for testing the significance of autocorrelation. The results for these tests are also presented in Table 1 and theyshow that we can reject the null hypothesis of no ARCH effects for all the return series at 1% level of significance. In addition, Q-statistic results show that there is statistically significant autocorrelation in the return series for all the stock returns whereas return series for Brent are found to exhibit insignificant autocorrelations. We also compute the unconditional correlations between *Banking* Sector stock returns and oil returns. These correlations are weak on average and positive for *FIRSTBANK*, *GUARANTYTRUST*, *UNITEDBANK FOR AFRICA* and *UNION BANK OF NIGERIA*, while negative for *ACCESS* bank and *WEMA* bank, suggesting that oil price increases over the period were seen as indicative of higher expected corporate earnings for *FIRST* bank, *GUARANTYTRUST*, *UNITED BANK FOR AFRICA* and *UNION BANK OF NIGERIA*, and negative earnings for *ACCESS BANK* and *WEMABANK*. *GUARANTYTRUST* has the highest positive correlation with oil (0.032), while the lowest positive correlation is observed between *UNION BANK OF NIGERIA* and oil market (0.013). *ACCESSBANK* and *WEMA BANK* have negative correlations between the oil market of (-0.014) and (-0.003) respectively.

Table 1: Descriptive statistics and statistical properties of return series for the Banking Sector

	RBR	RAC	RFB	RGU	RUBA	RUBN	RWE
Mean	0.01229	0.03401	-0.04359	0.04053	-0.04009	-0.03755	-0.01663
Median	0.03647	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Maximum	18.1297	68.9808	368.888	228.278	199.243	167.428	90.016
Minimum	-19.891	-31.916	-368.888	-228.278	-193.152	-155.256	-85.866
Std. Dev.	2.269	3.122	11.525	6.168	5.787	6.476	3.736
Skew.	-0.252	2.628	-0.448	-0.200	0.738	5.111	0.222
Kurt.	9.020	75.422	822.280	1035.75	734.032	356.825	173.617
J-B	5525.305	798131.7	1.02E+08	1.61E+08	80896252	18966752	4406558.
Probability	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
ARCH	32.66	4.14	64.20	532.99	786.32	279.98	870.15
LB(Q)	2.59	55.27	426.21	493.15	276.68	258.74	22.48
Corr. with oil	1.000	-0.014	0.022	0.032	0.017	0.013	-0.003
Observations	3633	3633	3633	3633	3633	3633	3633

Notes: The table reports statistics of return series, including mean (Mean), standard deviation (Std. Dev.), skewness (Skew.), kurtosis (Kurt.), ARCH refers to the empirical statistics of the statistical test for conditional heteroskedasticity, LB (Q) is the empirical statistics of the Ljung-Box tests for autocorrelations applied to return series. J-B is the empirical statistics of the Jarque-Berra test for normality based on skewness and excess kurtosis. Corr. Denotes correlation coefficients. RBR, RAC, RFB, RGU, RUBA, RUBN, and RWE stand for returns on Brent, ACCESS, FIRST BANK, GUARANTY TRUST, UNITED BANK FOR AFRICA, UNION BANK OF NIGERIA and WEMA BANK respectively.

In addition, in Table 2, we report basic statistics of the return series for the *Oil & Gas* sector. On average, *FO* stock price realized the highest returns, then *TOTAL* stock, *MOBIL* stock and *Brent* oil market, which are positive. On the flip side, *BOCGAS* stock, *CONOIL* stock and *OANDO* stock all showed negative average returns over the sample period. There are also wide gaps between the minimum and maximum values on all the series. The standard deviation statistic indicated that*OANDO* stock appears to be the most volatile among all the series, which is followed by *FO*, *CONOIL*, *BOCGAS*, *MOBIL*, *TOTAL* and *Brent* is the least volatile, in that order.

Skewness is negative in most of the series, only *BOCGAS* and *FO* stocks being positively skewed. Kurtosis is higher than 3 in all the return series, with *OANDO*

having the highest at (478.59). Statistical tests performed indicate that: i) there is rejection of the normality condition for all return series at 1% level (JB); ii) there is strong evidence of ARCH effects for all return series. By applying the Engle (1982) test, we observe that the null hypothesis of no ARCH effects is rejected at conventional levels in all cases, thus confirming that GARCH modeling is adequate for capturing any persistence in the volatility of stock and oil returns. All these facts support our choice of the quasi-maximum likelihood (*QML*) estimation method to estimate our VAR–GARCH models; iii) there is also significant autocorrelation for six out of the seven series.

We further computed the unconditional correlation between the *Oil & Gas* stock returns and *Brent* oil returns. These correlations are very low, with *BOCGAS* and *CONOIL* stocks having negative correlations, while *FO*, *MOBIL*, *OANDO* and *TOTAL* returns all have positive correlations with *Brent* returns.

	RBR	RBO	RCO	RFO	RMO	ROA	RTO
Mean	0.012	-0.014	-6.68E-05	0.078	0.027	-0.042	0.024
Median	0.036	0.000	0.000	0.000	0.000	0.000	0.000
Maximum	18.130	35.797	39.900	91.707	23.502	120.149	37.168
Minimum	-19.891	-35.797	-39.900	-91.707	-29.779	-145.405	-37.168
Std. Dev.	2.266	2.818	3.048	4.155	2.456	4.415	2.403
Skewness	-0.240	0.148	-0.138	0.056	-1.021	-4.535	-0.135
Kurtosis	9.029	20.037	31.284	219.663	19.019	478.587	35.955
Jarque-Bera	5529.296	43891.91	120945.5	7096225.	39421.61	34203794	164182.3
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ARCH	32.89	726.54	802.22	839.99	233.70	567.12	759.94
LB(Q)	13.07	51.78	57.24	80.96	14.16	71.12	8.44
Corr. with oil	1.000	-0.016	-0.001	0.021	0.008	0.013	-0.010
Observations	3628	3628	3628	3628	3628	3628	3628

Notes: The table reports statistics of return series, including mean (Mean), standard deviation (Std. Dev.), skewness (Skew.), kurtosis (Kurt.), ARCH refers to the empirical statistics of the statistical test for conditional heteroskedasticity, LB (Q) is the empirical statistics of the Ljung-Box tests for autocorrelations applied to return series. J-B is the empirical statistics of the Jarque-Berra test for normality based on skewness and excess kurtosis. Corr. Denotes correlation coefficients. RBR, RBO, RCO, RFO, RMO, ROA and RTO represent returns on Brent, BOCGAS, CONOIL, FORTESOIL, MOBIL OANDO and TOTALOIL respectively.

4.2 Empirical Results

It is now possible to proceed with modeling the response of the *Banking* and *Oil & Gas* stock returns to oil price fluctuations by employing a VAR(1)-GARCH(1,1) model. The proposed model is estimated using maximum likelihood method under the assumption of bivariate normal distributed error terms. The log likelihood function is maximized using Marquardt's numerical iterative algorithm to search for optimal parameters.

4.2.1 Oil market and the Banking sector in Nigeria

The empirical findings from our VAR (1)-GARCH (1, 1) estimation results are reported in Table 3 for the oil-stock market (six *Banking* sector companies) pairs. Primarily, we note that the one-period lagged values of stock price returns are discovered to have a significant explanatory power on their current values in all the series considered in the Banking sector. The one-period lagged terms corresponding to returns on oil market are not significant in all cases, implying that past oil returns do not determine future oil returns.

With respect to the interdependence of returns in the mean equations, the findings showed that lagged oil returns insignificantly affected stock market returns in all the cases under consideration, except for *FIRST BANK*and *UBA BANK*. In the same vein, previous stock returns do not have significant effect on oil market returns. Thus, similar to results obtained for Nigeria by Fowowe (2013); Kuwait by Mohanty et al. (2011); Kuwait, Saudi Arabia, U.A.E. by Arouri et al. (2011); UK by Jammazi (2012); and Bahrain, Kuwait, Oman, Saudi Arabia, UAE by Hammoudeh and Choi (2006), returns on the Nigerian stock market are not affected by oil price returns. The effect of oil on stock prices is positive for five out of six companies in the *Banking* sector with *WEMABANK* being negatively impacted.

Turning to the conditional variance equations, the estimates of ARCH and GARCH coefficients are statistically significant based on generally accepted levels in most cases. We can observe in the stock market that the sensitivity to past own conditional volatility (h_{t-1}^{s}) appears to be significant for *FIRST BANK, UBA, UNION Bank* and *WEMA BANK,* while it is insignificant for *ACCESS BANK and GUARANTY TRUSTBANK* at 1% level. From the results, it can also be seen that the present value of conditional volatility of stock returns in the *Banking* sector also rely on past unexpected shocks $(\varepsilon_{t-1}^{s})^2$ affecting returns dynamics since the

associated coefficients are highly significant in all cases except for *GUARANTY Trust Bank*. However, the relatively large size of ARCH coefficients suggests that conditional volatility changes very rapidly under the influence of returns innovations, and it tends to fluctuate gradually over time as evident from the large magnitude of GARCH coefficients. Furthermore, the past unexpected shocks of stock market $(\varepsilon_{t-1}^{s})^2$is not significant to the oil market for all the series. The past conditional volatility is negative for *FIRST Bank, ACCESS Bank, GUARANTY Trust, UBA Bank and WEMA Bank;* and positive for *UNION Bank.*The stock market past conditional volatility (h_{t-1}^{s}) for *FIRST Bank, ACCESS Bank, UBA* and *WEMA Bank* are significant to the oil market while *GUARANTY Trust* and *WEMA Banks* are insignificant to the oil market. It is negative in *ACCESS, UNION and WEMA banks; and positive in FIRST Bank, GUARANTY Trust and UBA*.

In addition, the past conditional volatility of oil market h_{t-1}^{o} is highly significant in *FIRST Bank, ACCESS Bank, UBA Bank and WEMA Bank* and very insignificant in *GUARANTY Trust Bank and UNION Bank*. The cross-market unexpected past shocks $(\varepsilon_{t-1}^{o})^2$ from oil to stock is significant in all the series except in *ACCESS Bank*.

Next, we consider the volatility spillover effect between oil and stock (*Banking* sector) markets in Nigeria. We first observed that there is direct transmission of volatility h_{t-1}^{o} from oil market to stock market in *FIRST Bank, ACCESS Bank, UBA, and WEMA Bank,* but not in *GUARANTY Trust Bank* and *UNION Bank*. The cross-volatilitycoefficients (return innovation and volatility) are significant at conventional levels. More specifically, past oil shocks $(\varepsilon_{t-1}^{o})^2$ have significant effects on stock market volatility in *FIRST Bank, GUARANTY Trust Bank, UBA, UNION Bank* and *WEMA Bank* except in *ACCESS Bank*. Past oil return volatility strongly affects stock market volatility in *FIRST Bank, ACCESS Bank, UBA, WEMA Bank,* but not in *GUARANTY Trust Bank* and *UNION Bank*. Therefore, our results suggest an intensification of volatility spillovers from oil to the *Banking sector* of the stock market.

Summing up the *Banking* sector as a whole, the observed spillover effects from the oil market to the stock market are significant at the 1% level. This volatility relationship is not unexpected because oil price increases tend to have a serious effect on consumer and investor confidence and demand for financial products, while rising financial stock prices are often indicative of oil consumption due to increasing productive activity.

The estimates for the constant conditional correlation (CCC) between oil and individual firm (*Banking* sector) stocks are found to be positive for all but *ACCESS*

Bank stock returns. This is not surprising, as there existed a negative cross-volatility between oil market and *ACCESS Bank* stock returns. Moreover, on a general note the *CCC* are somewhat low and weak. The positive outcome for *CCC* is in favour of plausible gains from investing in both stock and oil markets.

4.2.2 Oil Market and the Oil & Gas Sector in Nigeria

Estimation results of the VAR (1)-GARCH (1, 1) model for the six oil-stock market pairs for the *Oil & Gas* sector are reported in Table 4. As regards the conditional return generating processes, we find that one-period lagged oil returns insignificantly affected their current values in all cases. Thus, this suggested that there is no evidence of short-term predictability in oil price changes. The autoregressive terms corresponding to stock return equations are also insignificant in all cases except for *FO and OANDO,* implying that past stock returns do not help to better predict future stock returns in most cases. These results are inconsistent with the findings of some recent papers showing that the weak-form efficiency of the crude oil market is rejected (Arouri et al., 2010; 2011b; and 2012).

The estimates of ARCH and GARCH coefficients in the conditional variance equations are statistically significant in most cases at conventional levels. For the oil market segment, the sensitivity to past own conditional volatility (GARCH-term) appears to be significant for all the series. This finding typically suggests that past values of the conditional volatility in the oil market can be employed to forecast its future volatility. However, the current conditional volatility of the oil market does not depend on past shocks affecting return dynamics since ARCH-terms are not significant for all series considered.

A closer examination of the coefficients in Table 4 reveals that in general conditional volatility does not change very rapidly as the ARCH-terms measuring the impact of past shocks on conditional volatility are relatively small in size. On the other hand, the large magnitude of GARCH-term estimates, which capture the impact of past volatility on current volatility, indicates gradual fluctuations of conditional volatility over time.

Turning to the empirical findings regarding the volatility transmission between oil and stock (*Oil & Gas)* returns, we first observed that the conditional volatility of the stock market is affected by innovations in the oil market as indicated by the significance at the 1% level of the coefficients on $(\varepsilon_{t-1}^{o})^2$ in three cases: *BOCGAS, CONOIL* and *OANDO*. Apparently, a shock originating from the oil market leads to increased stock market volatility in those cases. In addition, there is a strong evidence suggesting that past volatility of the oil market is

transmitted to the stock market because the coefficients associated with h_{t-1}^{o} is very much significant except for *OANDO stocks*. On the other hand, the statistical insignificance of the coefficients of $(\varepsilon_{t-1}^{s})^2$ in the conditional volatility equation for oil returns suggests that oil market volatility behaves independently from changes or shocks that occurred in the *Oil & Gas* sector.

Observing the *Oil & Gas* sector as a whole, we concluded that the relationship between oil and stock market is rather unclear. We noticed that there are no cross innovations effects from both oil and stock markets. This finding is thus somewhat surprising given that firms operating in the *Oil & Gas* sector are majorly involved in petroleum-related activities. One would thus expect that these firms will be highly influenced by the changes in the oil market.

As expected, the estimates of *CCC* between oil market and firms in the *Oil & Gas* sector are positive for *CONOIL, FO,MOBIL* and *OANDO* and negative for *BOCGAS* and *TOTAL*. They are small in general, which again suggests the existence of potential gains from investing in both oil and stock markets.

Broadly comparing across the two sectors (*Banking and Oil & Gas*), our findings showed that past unexpected shocks of stock returns do not significantly affect the current value of the oil market volatility in the *Oil & Gas* sector. However, past innovations in only three firms (*BOCGAS, CONOIL and OANDO*) exert significant influence from oil market to stock market volatility. This notwithstanding, there is conditional volatility spillover from both markets (*Oil and Oil & Gas* sector). Considering the *Banking* sector, we found similar results concerning conditional volatility as indicated for the *Oil & Gas* sector above. It is seen that past conditional volatility of stock (*Banking* sector) returns significantly affected the current value of the oil market volatility and vice versa, in all the firms. Oil market unexpected past shocks in all the firms except one (i.e. *ACCESS Bank*) exercise significant influences on stock market volatility, while oil price volatility is unaffected by past stock market shocks in all the firms.

In sum, the intensity of volatility spillover seems to vary from sector to sector, depending especially on their degree of oil dependence and industrial characteristics. It is equally imperative to note that some sectors are subject to indirect impacts of oil price changes. For instance, increases in oil price are likely to exert influence on the *Banking* sector through their effects on monetary policy, interest rates, employment and consumer confidence. Consequently, to better forecast stock market volatility and make appropriate investments decisions, investors need to closely watch what is happening in the oil markets.

Table 3: Estimate of Bivariate VAR (1)-GARCH (1, 1) Model for Six Banking Sector Firms

Notes: The bivariate VAR (1)-GARCH (1, 1) model is estimated for each firm over the period January 2, 2001 to December 31, 2015. The optimal lag order for the VAR model is selected using the AIC and SBC information criteria. Standard errors are given in parenthesis. Oil, Stock and CCC are oil price returns, firm stock returns and constant conditional correlation respectively. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Variables	First Bank		Access Bank		Guaranty Trust Bank		UBA		Union Bank		WEMA Bank	
	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil
Mean Equation												
Constant	-1.9111*** (0.0021)	0.0399*** (0.0116)	-0.0422 (0.0411)	0.0387 (0.0264)	-0.0497* (0.0272)	0.0330*** (0.0008)	-0.4289*** (0.0397)	0.0516** (0.0250)	-0.0278*** (0.0011)	0.0360* (0.0196)	-0.0187*** (0.0026)	-0.0012 (0.0232)
Stock(1)	-0.5262*** (0.0019)	0.0034** (0.0006)	0.1013*** (0.0169)	0.0123 (0.0098)	0.1464*** (0.0001)	-0.0002*** (0.0000)	-0.1768*** (0.0166)	0.0107*** (0.0006)	0.2687*** (0.0041)	-0.0022 (0.0018)	0.1992*** (0.0179)	0.0010 (0.0049)
Oil(1)	0.7466*** (0.0012)	0.0033*** (0.0072)	0.0749*** (0.0217)	0.0417*** (0.0100)	0.0529*** (0.0014)	0.0209** (0.0104)	0.1131*** (0.0210)	0.0036 (0.0155)	0.0213*** (0.0014)	0.0160*** (0.0001)	-0.0277*** (0.0009)	0.0863*** (0.0125)
Variance Equation												
Constant	1.2215*** (0.0674)	0.0050 (0.0020)	2.5369*** (0.0148)	-0.0164*** (0.0015)	22.6227*** (0.0195)	0.0135*** (0.0025)	1.5316*** (0.1491)	-0.0016 (0.0049)	0.7191*** (0.0021)	0.0173*** (0.0026)	0.0011 (0.0008)	0.0595*** (0.0100)
$(\varepsilon^{s}_{t-1})^2$	5.4212*** (0.0069)	-0.0079*** (0.0006)	0.2738*** (0.0095)	-0.0230*** (0.0023)	0.0992*** (0.0070)	-0.0014 (0.0025)	0.4189*** (0.0144)	-0.0063*** (0.0002)	0.2692*** (0.0009)	0.0103*** (0.0029)	0.3054*** (0.0029)	-0.0129*** (0.0037)
$(\varepsilon^{o}_{t-1})^2$	-1.5661*** (0.0179)	0.0492*** (0.0007)	0.0099 (0.0275)	0.0507*** (0.0003)	0.3459*** (0.0059)	0.0511*** (0.0009)	-0.3173*** (0.0165)	0.0472*** (0.0043)	0.3668*** (0.0001)	0.0533*** (0.0009)	-0.1109*** (0.0045)	0.0754*** (0.0033)
h^{s}_{t-1}	0.1146*** (0.0007)	0.8429*** (0.0555)	-0.0451*** (0.0019)	-1.4107*** (0.0158)	-0.0170*** (0.0000)	0.0072 (0.3411)	0.7538*** (0.0075)	0.2889** (0.0382)	0.8228*** (0.0001)	-0.0498 (0.0835)	0.7641*** (0.0019)	-0.5972*** (0.2037)
h^{o}_{t-1}	236.3689*** (2.4683)	0.9464*** (0.0006)	-48.3745*** (0.1317)	0.9233*** (0.0003)	-0.0273 (0.2689)	0.9483*** (0.0008)	-4.8130** (1.9275)	0.9420*** (0.0038)	-0.0992 (0.0656)	0.9455*** (0.0009)	5.1848*** (0.0554)	0.9202*** (0.0020)
CCC between oil and stocks		0.0017*** (0.0000)		-0.0164*** (0.0000)		-0.0002 (0.0018)		0.0228*** (0.0025)		0.0030*** (0.0002)		0.0058*** (0.0003)
Log-likelihood		-20096.9089		-16793.6567		-18590.6015		-17870.7924		-17909.3707		-15477.8730
AIC		11.076		9.257		10.246		9.850		9.871		8.532
SBC		11.105		9.286		10.275		9.879		9.900		8.561
No. of Obrns		3632		3632		3632		3632		3632		3632

Table 4: Estimate of Bivariate VAR (1)-GARCH (1, 1) Model for Six Oil & Gas Firms

Notes: The bivariate VAR (1)-GARCH (1, 1) model is estimated for each firm over the period January 2, 2001 to December 31, 2015. The optimal lag order for the VAR model is selected using the AIC and SBC information criteria. Standard errors are given in parenthesis. Oil, Stock and CCC are oil price returns, firm stock returns and constant conditional correlation respectively. *, **, and *** indicate significance at the 10%, 5% and 1% respectively.

Variables	BOCGAS		CONOIL		FO		MOBIL		OANDO		TOTAL	
	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil	Stock	Oil
Mean Equation												
Constant	-0.0314 (0.0261)	0.0227 (0.0248)	-0.0761 (0.0508)	0.0189 (0.0293)	-0.0009*** (0.0002)	0.0585*** (0.0221)	-0.0211 (0.0326)	0.0267 (0.0292)	0.0069*** (0.0014)	0.0214 (0.0245)	0.0289 (0.0223)	0.0288 (0.0295)
Stock(1)	0.0321 (0.0228)	-0.0056 (0.0112)	0.0868*** (0.0201)	-0.0018 (0.0101)	0.3580*** (0.0089)	-0.0180*** (0.0018)	-0.0283 (0.0182)	0.0147 (0.0120)	0.2109*** (0.0001)	-0.0047*** (0.0005)	-0.0943*** (0.0193)	0.0032 (0.0121)
Oil(1)	-0.0461*** (0.0149)	0.0197 (0.0172)	0.0041 (0.0178)	0.0198 (0.0174)	0.0205*** (0.0056)	0.0238 (0.0149)	-0.0126 (0.0145)	0.0160 (0.0170)	0.0371*** (0.0044)	0.0198 (0.0148)	0.0144 (0.0126)	0.0187 (0.0180)
Variance Equation												
Constant	0.3656*** (0.0497)	0.0043 (0.0046)	1.4627*** (0.2372)	-0.0106 (0.0096)	5.9942*** (0.0000)	-0.0410*** (0.0007)	1.8156*** (0.1985)	-0.0224*** (0.0052)	13.315*** (0.0183)	0.0099*** (0.0025)	0.4637*** (0.0091)	0.0034 (0.0026)
$(\varepsilon^{s}_{t-1})^2$	0.2876*** (0.0210)	0.0033 (0.0046)	0.1865*** (0.0182)	-0.0083* (0.0319)	0.2511*** (0.0000)	-0.0257*** (0.0000)	0.2388*** (0.0244)	-0.0067 (0.0301)	0.2624*** (0.0036)	-0.0039*** (0.0022)	0.2546*** (0.0028)	-0.0141*** (0.0118)
$(\varepsilon^{o}_{t-1})^2$	-0.1280*** (0.0247)	0.0409*** (0.0051)	0.1535*** (0.0046)	0.0434*** (0.0043)	-0.0610*** (0.0010)	0.0402*** (0.0002)	0.0082 (0.0053)	0.0501*** (0.0054)	-0.1096*** (0.0013)	0.0474*** (0.0008)	0.0332*** (0.0048)	0.0525*** (.0010)
h^{s}_{t-1}	0.5342*** (0.0297)	-13.1753 (13.7325)	0.4592*** (0.0570)	57.6308** (24.3517)	0.6844*** (0.0000)	2.5187*** (0.0000)	0.4881*** (0.0485)	114.1257*** (12.6774)	-0.0302*** (0.0000)	0.0329** (0.0241)	0.6625*** (0.0027)	-0.6861*** (0.1767)
h^{o}_{t-1}	-193.8038 (215.2795)	0.9396*** (0.0071)	1103.5516*** (49.3849)	0.9424*** (0.0076)	-112.0223*** (0.0236)	0.9507*** (0.0002)	-94.924*** (56.3998)	0.9330*** (0.0052)	-0.0145 (0.0142)	0.9508*** (0.0008)	-2.8745*** (0.0501)	0.9378*** (0.0009)
CCC between oil and stocks		-0.0012 (0.0014)		0.0002*** (0.0001)		0.0050*** (0.0000)		0.0002*** (0.0000)		0.0309*** (0.0071)		-0.0155*** (0.0007)
Log-likelihood		-16058.8771		-16524.9932		-17233.849		-15844.98		-17719.5798		-15575.9263
						5		45				
AIC		8.867		9.124		9.515		8.749		9.783		8.601
SBC		8.896		9.153		9.544		8.778		9.812		8.630
No. of Obrns		3626		3626		3626		3626		3626		3626

5.0 Summary and Conclusion

This study investigated the dynamic relationship between crude oil price fluctuations and the performance of the Nigerian stock market using two sectors over the period January 2, 2001 to December 31, 2015. The study employed a bivaraite VAR-GARCH model recently developed by Ling and Mcaleer (2003) to simultaneously estimate the conditional mean and conditional variance of returns on crude oil prices and the closing values of 12 firms in the *Banking* and *Oil & Gas* sectors. Empirical results of the conditional mean equations showed that there is evidence of short-run predictability on the firms' stock returns in the *Banking*sector and also revealed that crude oil prices had a significant impact on the *Banking* sector movements only in two firms (*FIRST BANK and UBA*). In the *Oil & Gas* sector on the other hand, our results showed that there is no evidence of short-run predictability in any of the firms (i.e. oil prices had no significant impact in the conditional mean equations). The study also investigated volatility transmission between the two markets (*Brent* and *Banking* and *Oil & Gas* sectors). Based on the conditional variance equations, our empirical findings indicated that the conditional volatility of the returns on the individual firms in the two sectors is affected not only by own volatility, but also by innovations in the oil market.

Our results also show the existence of significant volatility transmission between oil and stock markets in Nigeria, with the spillover effects being more apparent from oil to stock markets. However, it is important to underscore that the observed spillover effects come entirely from spillovers of volatilities, and that spillovers of shocks are mostly insignificant. Consequently, our empirical findings regarding interdependence of the oil and the stock market give an understanding of the true nature of the two markets for policymakers into building proper assets pricing models and to forecasts for the return and volatility of both markets. This will further help, for instance, portfolio managers and policymakers to adjust their activities in order to avert the spreading of market risks in the situation of market downturns. Finally, policymakers can use the results of this study as a starting point in their attempt to curtail higher volatility in the Nigerian stock market.

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EXCHANGE RATE DYNAMICS AND STOCK MARKET PERFORMANCE IN NIGERIA: EVIDENCE FROM A NONLINEAR ARDL APPROACH

Mutiu A. Oyinlola[1]* and Tirimisiyu Oloko[1]

Abstract

This study investigates asymmetry in the impact of exchange rate on the Nigerian stock market using the Nonlinear ARDL model by Shin et al. (2014), and it is the first study to do so. From the trend review, changes in the dynamics of exchange rate - stock market relationship was noticed, and this was accounted for using Bai and Perron (2003) multiple structural breaks test. Empirical findings from this study reveal that there is a long-run but no short-run exchange rate asymmetry effect on the Nigerian stock market. Furthermore, the results suggest that banking sector recapitalization only affects the short-run dynamics of stock-market exchange rate relationship. By implication, the Nigerian stock market adjusts spontaneously or becomes more volatile after banking sector recapitalization. The policy implication from this study is that exchange rate policy cannot be used to correct short-run disequilibrium in the Nigerian stock market, as it takes a long term for the market to respond to changes in the exchange rate. This is regardless of whether the policy being introduced is a revaluation or a devaluation policy.

Keywords: *Exchange rate, Stock prices, NARDL, Asymmetry, Banking sector recapitalization, Nigeria*

JEL classification*: C13, F30, G10*

1.0 Introduction

Investigation on the relationship between stock market and exchange rate is of particular interest to portfolio investors, financial analysts, finance researchers and monetary authorities. This is particularly important to appreciate the appropriate portfolio management and hedging strategies, and the effect of exchange rate policy of monetary authority on the stock market performance. Whether a country practiced a fixed, floating or an intermediate exchange rate regime, a change or shift in exchange rate in the form of appreciation/revaluation or depreciation/devaluation may be expected to impact the stock market performance. But, could positive and negative changes in exchange rate have symmetric impact on stock market performance? In other words, does the stock market react symmetrically to an

[1] Department of Economics, University of Ibadan, Oyo State, Nigeria
*Corresponding author email: mutiu_oyinlola@yahoo.com

equal magnitude of exchange rate appreciation/revaluation and depreciation/devaluation? It may be interesting to investigate this.

Both from the theoretical and empirical points of view, the relationship between exchange rate and stock market have been mixed and inconclusive. The two theoretical models often used to explain this relationship are the portfolio balance or stock models by Branson (1983) and Frankel (1983) and the monetary or flow model by Dornbusch and Fischer (1980). These two models support different direction of relationship and causality between the two markets. According to the stock model, the causality is from stock market to exchange rate. The model proposed that higher stock returns will attract foreign investors and lead to increase in demand for domestic currency. Hence, a negative relationship ensues as higher stock market returns lead to lower exchange rate[2].

According to the flow model, however, it is assumed that the causality moves from exchange rate to stock market. Accordingly, it proposed that exchange rate depreciation increases the international trade competitiveness of firms, and their present value of cash flow and stock returns by implication. Hence, a positive relationship is evident as higher exchange rate leads to higher stock returns (see Salisu and Oloko, 2015). In the finance literature, other theories that could explain the effect of exchange rate of stock prices include Efficient Market Hypothesis (EMH) developed by Fama (1970) and the Arbitrage Pricing Theory (APT) developed by Ross (1976).[3] Meanwhile, as exchange rate depreciation would also make import prices more expensive, and potentially lead to lower stock returns, Bahmani-Oskooee and Saha (2016) concluded that the overall effect of changes in exchange rate could be positive or negative, depending on whether firms are export-oriented or largely dependent on imported inputs.

A majority of the empirical studies on exchange rate – stock market relationship have not only found mixed results but also focused on the determination of the direction of causality. For instance, Aftab (2015) found that exchange rate and stock price are negatively related in China. Abdalla and Murinde (1997) investigated exchange rate – stock market dynamics in India, Korea, Pakistan and the Philippines, and found a unidirectional causality from exchange rates to stock prices in three out the four countries considered. Dahir et al. (2017) investigated exchange rate – stock market nexus for BRICS and found mixed

[2] Exchange rate is defined here as the units of domestic currency per unit of foreign currency. Hence, a lower exchange rate is appreciation while a higher exchange rate is depreciation.

[3] See Ajaz et al. (2017) for a review.

results; ranging from positive and negative relationship to uni-directional, bi-directional and no causal relationship. And also, Noman et al. (2012) investigated the causality between stock market and exchange rate in Bangladesh and found no causality between the two markets.

However, with the increasing recognition of nonlinearity in the exchange rate effect, recent studies are beginning to investigate non-linearity in the effect of exchange rate on stock market. The non-linearity effect of exchange rate has been observed on inflation (see Caselli and Roitman, 2016; Baharumshah et al., 2017), on export (see Verheyen, 2013) and on macroeconomic fundamentals (see Junttila and Korhonen, 2011; Kempa and Riedel, 2013). The few studies that have observed non-linearity effect of exchange rate on stock market include Ho and Huang (2015), Bahmani-Oskooee and Saha (2016) and Ajaz et al. (2017).

Basically, Ho and Huang (2015) investigated non-linearity and asymmetry in the causal relationships between the stock indexes and exchange rates of Brazil, Russia, India, and China (BRIC) using LM test for causality in variance. Bahmani-Oskooee and Saha (2016) investigated exchange rate asymmetric effect on stock market of Brazil, Canada, Chile, Indonesia, Japan, Korea, Malaysia, Mexico, and the U.K. using Nonlinear ARDL approach. They found that exchange rate changes have asymmetric effects on stock prices in the short run. Also, Ajaz et al. (2017) investigated asymmetric effect of exchange rate and interest rate on the stock prices of India using Nonlinear ARDL approach. They found that exchange rate does not have same and equal effect on the stock prices of Indian. Meanwhile, no study has been done to account for nonlinearity effect of exchange rate on stock prices in respect of an African country.

This study proposed to fill this gap by examining the effect of exchange rate nonlinearity on the stock prices of Nigeria. Nigeria is the largest economy in Africa and her stock market is one of the best three in Africa. According to Oloko (2017), The Nigerian stock market provides potential portfolio diversification gains for US and UK portfolio investors. More importantly, Nigeria is one of the oil-exporting countries practising managed floating exchange rate regime, hence, the inference from this study could be beneficial to policymakers and investors in other similar countries such as Algeria and Iran.Meanwhile, some of the past studies on the dynamic relationship between stock market and exchange rate in Nigeria such as Oyinlola et al. (2013), Zubair (2013) and Salisu and Oloko (2015) found evidence suggesting non-causality from exchange rate to the Nigerian stock market. Meanwhile, as these studies assume linearity in exchange rate, their results may have been exaggerated.

Nonlinearity in the effect exchange rate on Nigerian stock prices may be significant as the Nigerian stock market has performed differently under different changes in the exchange rate. For instance, between January 1985 and August 1991, December 1991 and March 1993 and December 1998 and December 2003, exchange rate depreciation was correlated with increase in stock prices. In contrast, between November 2008 and November 2011, and October 2014 and April 2017 exchange rate depreciation was correlated with negative stock prices. As Nigeria is practising the managed float exchange rate system, this presupposes that the effect of exchange rate depreciation/devaluation on stock prices could be positive or negative. Exchange rate appreciation/revaluation was only observed between December 2003 and February 2008, and was correlated with increase in stock prices. The 2004 banking sector recapitalization was also observed to have changed the dynamics of stock market – exchange rate relationship in Nigeria.

This study examines the nonlinearity effect of the exchange rate on stock market performance of Nigeria using Nonlinear Autoregressive Distributed Lag (ARDL) model. This will be similar to Bahmani-Oskooee and Saha (2016) investigated exchange rate asymmetric effect on stock market of Brazil, Canada, Chile, Indonesia, Japan, Korea, Malaysia, Mexico, and the U.K. using Nonlinear ARDL approach. However, this study will be different by testing and accounting for the significance of structural break for Global Financial Crisis (GFC) and Nigerian banking sector recapitalization policy. The finding from this study will provide useful information to domestic and foreign portfolio investors in Nigeria, portfolio managers, investment analysts and the Nigerian government.

The remainder of this study isorganized as follows. Section 2 discusses data and preliminary analysis. Section 3 deals with model specification. Section 4 focuses on the presentation and interpretation of results, while Section 5 concludes the paper and discusses policy recommendation.

1. Data and Trend Analysis

This study uses the monthly Nigerian All-Share Index (ASI) and the Naira USD exchange rate (EXR) for the period 1985M01 to 2017M07. The data were obtained from the Central Bank of Nigeria (CBN) database. EXR is the official monthly average exchange rate per USD. By definition, a positive change in exchange rate will mean depreciation while a negative change will imply appreciation. Figure 1a shows the relationship between the Nigerian exchange rate and stock index over the period under consideration while figure 1b shows

the relationship under difference episodes of changes in exchange rates. The relative quantitative changes are presented in Table 1.

From figure 1a, it appears that a positive relationship existed between exchange rate and stock prices before the stock market crash of 2008, which was prompted by the contagion effect of the US-originated Global Financial Crisis. Apparently, it appears that as exchange rate depreciates, stock market prices increases before the stock market crash. However, after the stock market crash, the relationship appears vague; exchange rate depreciates consistently but stock market prices appreciate and depreciate under the period of exchange rate depreciation.

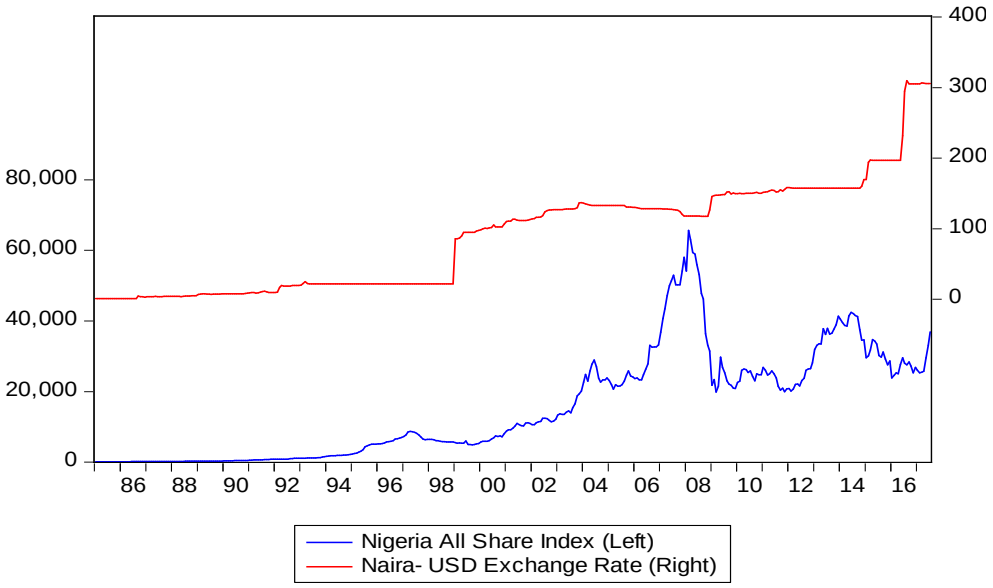
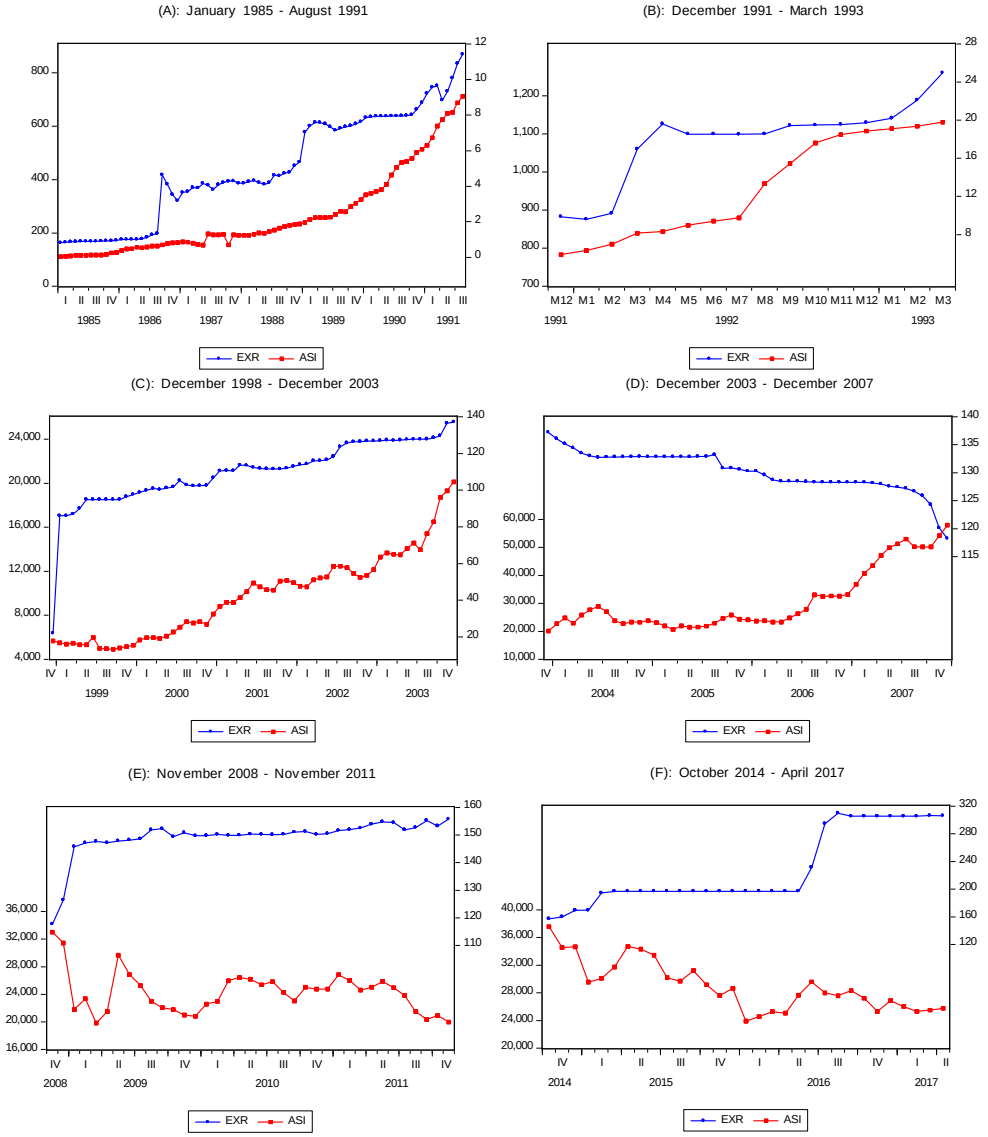


Figure 1a: Exchange rate and Stock market dynamics in Nigeria (1985M01 to 2017M07)

Meanwhile, to visualize the effect of positive and negative changes in the exchange rate on stock prices, the dynamics relationship between stock prices and the exchange rate was examined under different quadrants of exchange rate dynamics (see Figure 1b). As evidenced from the figure, Naira-USD exchange rate depreciates for most of the period under consideration, as the exchange rate only appreciates in one out of the six quadrants identified. Specifically, the exchange rate only appreciates under quadrant D which corresponds to the period from December 2004 to December 2007.

Figure 1b: Disaggregated exchange rate and stock market relationship in Nigeria



Source: Compiled by the authors

Table 1 presents the quadrants analyses in quantitative terms to facilitate easy analysis. As may be observed, between January 1985 and August 1991, December 1991 and March 1993 and December 1998 and December 2003, the exchange rate depreciation was correlated with an increase in stock prices.

Specifically, the exchange rate depreciated by 93% under Panel A, by 83.9% under Panel C and by 30.7% under B, while stock prices appreciated by 93%, by 71.8% and by 60% under the respective Panels. This presumes that a higher rate of exchange rate depreciation is correlated with a higher rate of increase in stock prices. This may not however be sacrosanct, as stock prices fell by 65% and 45.7% under Panel E and F respectively, while the exchange rate depreciated by 24.4% and 48.7%.

Exchange rate appreciation/revaluation was only observed between December 2003 and February 2008, and was correlated with an increase in stock prices. Particularly, the exchange rate appreciated by 16.1% while stock prices increased by 69.3%. As both exchange rate appreciation and depreciation lead to increase in stock prices, two possibilities may be suspected. It is either that stock prices do not respond to changes in the exchange rate or that stock prices respond symmetrically to changes in the exchange rate, which will imply that nonlinearity is not significant. However, this needs to be examined empirically.

Table 1: Partitioned stock market – exchange rate relationship

	January 1985 to August 1991		
Panel A	Start	End	% Change
Stock Prices (Index)	111	712	84%
Exchange Rate (N/USD)	0.8	11.4	93%
	December 1991 to March 1993		
Panel B	Start	End	% Change
Stock Prices (Index)	783	1131	30.70%
Exchange Rate (N/USD)	9.9	25	60%
	November 2008 and November 2011		
Panel C	Start	End	% Change
Stock Prices (Index)	5673	20129	71.80%
Exchange Rate (N/USD)	22	137	83.40%
	December 2003 and February 2008		
Panel D	Start	End	% Change
Stock Prices (Index)	20129	65652	69.30%
Exchange Rate (N/USD)	137.2	118.2	-16.10%

	November 2008 and November 2011		
Panel E	Start	End	% Change
Stock Prices (Index)	33026	20003	-65.00%
Exchange Rate (N/USD)	118	156	24.40%
	October 2014 and April 2017		
Panel F	Start	End	% Change
Stock Prices (Index)	37550	25759	-45.70%
Exchange Rate (N/USD)	157	306	48.77%

Source: Compiled by the authors.

Furthermore, the dynamic relationship between the exchange rate and the Nigerian stock market appears to be consistent under the first three and the last three quadrants. Basically, a positive relationship appears to be dominant under the first three quadrants while negative relationships are dominant under the last three quadrants. Meanwhile, as the point of diversion corresponds to the 2004 banking sector recapitalization, it may be interesting to empirically examine whether the 2004 banking sector recapitalization introduceda significant change in the dynamic relationship between the Nigerian exchange rate and stock prices.

Notably, the Central Bank of Nigeria (CBN) pronounced in July 2004 that the capital base of Money Deposit Banks (MDBs) in Nigeria be increased from N2billion to N25billion (See Kanu and Hamilton, 2015). This arrangement resulted in unprecedented cases of mergers and acquisition among banks and monumental issues of primary and secondary share capital by the surviving banks. Eventually, 89 Commercial Banks in Nigeria came down to 25 banks through mergers, acquisition and liquidation, while the Nigerian stock market also witnessed unprecedented patronage (See Kanu and Hamilton, 2015). According to Adegbaju and Olokojo (2008), this banking recapitalization increased the level of financial liberalization of Nigeria and exposed the fragility and vulnerability of the Nigerian financial system. Hence, the observation that the relationship between the stock market and the Nigerian exchange rate dynamics changed after the Banking sector recapitalization should be ignored.

Table 2 presents the descriptive statistics for exchange rate and stock prices under the full sample, as well as under the period before and after the 2004 banking sector recapitalization policy. From the number of observations, it is evident that the period covered before Recapitalization is more than the period covered after Recapitalization. The full sample period analysis reveals that the

average value of exchange rate between 1985M01 and 2017M07 is N90.07/USD, while the average value of the Nigerian stock index is 15295.25 basis points. Meanwhile, comparing this average values with the corresponding average values before and after the Banking sector recapitalization, it appears there was an increasing rate of exchange depreciation and stock market appreciation after Recapitalization.

Table 2: Descriptive Statistics

	Full Sample		Before Banking Recapitalization		After Banking Recapitalization	
Statistics	**ASI**	**EXR**	**ASI**	**EXR**	**ASI**	**EXR**
Mean	15295.25	90.07	4694.62	41.57	31094.91	162.37
Median	9591.60	111.60	1989.70	22.00	26874.62	151.86
Maximum	65652.38	309.73	28887.40	137.22	65652.38	309.73
Minimum	111.30	0.82	111.30	0.82	19851.89	117.72
Std. Dev.	15116.24	75.72	5612.19	46.38	10218.57	48.27
Skewness	0.87	0.58	1.74	0.98	1.34	2.07
Kurtosis	3.04	2.97	6.53	2.20	4.16	6.59
Jarque-Bera	49.59	21.60	240.37	43.51	55.89	196.06
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Observations	391	391	234	234	157	157

Source: Computed by the author

Furthermore, the rate at which the maximum values deviated from the mean and medium values for both ASI and EXR is very large after Recapitalization, compared to under full sample and before recapitalization. This indicates that the prices of ASI and EXR are relatively higher after recapitalization. The exchange rate specifically, recorded relatively the highest level of skewness and kurtosis after the recapitalization. This indicates a higher probability of peakedness (relative to kurtosis) and skewness above the average (positive skewness). By implication, exchange rate appears to depreciate more than the normal after recapitalization. Hence, the decision to partition the empirical analysis into pre- and post-banking sector recapitalization can be further justified.

2.0 Methodology

Notably, this study employs the Nonlinear ARDL model proposed by Shin et al (2014) to examine the asymmetry in the effect of the exchange rate on the Nigerian stock market. The NARDL model is a recently developed method of cointegration analysis that accounts for asymmetry in the relationship between dependent and explanatory variables. It is an extension of the ARDL model by Pesaran et al (2001) which assumes a symmetric relationship. To account for asymmetry, Shin et al (2014) assumed nonlinearity in the model, and therefore decomposed the nonlinear explanatory variable into positive and negative values, which are calculated as a partial sum of positive and negative difference, respectively.

For this study, the basic model explaining the effect of the exchange rate on the stock market is specified as below.

$$InASI_t = \alpha + \beta InEXR_t + \gamma InLDR_t + \varepsilon_t \quad (1)$$

where $InASI_t$ is the log of the Nigerian All Share Index, $InEXR_t$ is the log of official Naira/USD exchange rate and $InLDR_t$ is the log of prime lending rate for Nigeria. Lending rate is included to a control variable in the model. While the coefficient of exchange rate (β) could be positive or negative, depending on whether the majority of firms are export oriented or largely dependent on imported inputs (Bahmani-Oskooee and Saha, 2016), the coefficient of lending rate (γ) is expected to be negative, as lending rate serves as cost to the firm which would tend to reduce firms' returns when high.

In the original framework of Pesaran et al (2001), the ARDL empirical specification for equation (1) can be presented as below:

$$\Delta InASI_t = \rho InASI_{t-1} + \beta InEXR_{t-1} + \gamma InLDR_{t-1} + \sum_{i=1}^{N1} \lambda_{1i} \Delta InASI_{t-i} + \sum_{j=0}^{N2} \lambda_{2j} \Delta InEXR_{t-j} + \sum_{j=0}^{N3} \lambda_{3j} \Delta InLDR_{t-j} + \varepsilon_t \quad (2)$$

Equation (2) is a standard ARDL model, which comprises both long-run and short-run estimates. The long-run parameters for the intercept and slope parameters are computed as; $-\frac{\alpha_0}{\rho}$, $-\frac{\beta}{\rho}$ and $-\frac{\gamma}{\rho}$ for intercept, coefficient of exchange rate and coefficient of lending rate respectively, since

$\Delta InASI_t = \Delta InEXR_t = \Delta InLDR_t = 0$ in the long run. However, the short-run estimates are obtained as λ_{1i}, λ_{2j} and λ_{3j} for All share index, exchange rate and lending rate, respectively. Meanwhile, as the variables in first differences can accommodate more than one lag, optimal lag length for the ARDL model is using Akaike Information Criterion (AIC). The preferred ARDL model is used to test for long-run relationship in the model. This approach of testing for cointegration is referred to as Bounds testing as it involves the upper and lower bounds. The test follows an *F* distribution and therefore, if the calculated F-statistic is greater than the upper bound, there is cointegration; if it is less than the lower bound, there is no cointegration and if it lies in-between the two bounds, then, the test is considered inconclusive.

To determine the speed of adjustment in a cointegrating ARDL model, equation (2) can be re-specified to include an error correction term as follows:

$$\Delta InASI_t = \delta \upsilon_{t-1} + \sum_{i=1}^{N1} \lambda_{1i} \Delta InASI_{t-i} + \sum_{j=0}^{N2} \lambda_{2j} \Delta InEXR_{t-j} + \sum_{j=0}^{N3} \lambda_{3j} \Delta InLDR_{t-j} + \varepsilon_t \quad (3)$$

where υ_{t-1} is the lagged error correction term calculated as $\upsilon_{t-1} = InASI_{t-1} - \alpha_0^* - \beta^* InEXR_{t-1} - \gamma^* InLDR_{t-1}$, and α_0^*, β^* and γ^* equal $-\frac{\alpha_0}{\rho}$, $-\frac{\beta}{\rho}$ and $-\frac{\gamma}{\rho}$, respectively.

However, considering Nonlinear ARDL to account for asymmetry in the effect of the exchange rate on the Nigerian stock market, the exchange rate is decomposed into positive and negative changes following Shin et al (2014). Accordingly, positive exchange rate ($InEXR_t^+$) and negative exchange rate ($InEXR_t^-$) is defined as follows:

$$InEXR_t^+ = \sum_{j=1}^{t} \Delta InEXR_j^+ = \sum_{j=1}^{t} \max\left(\Delta InEXR_j, 0\right) \quad (4)$$

$$InEXR_t^- = \sum_{j=1}^{t} \Delta InEXR_j^- = \sum_{j=1}^{t} \min\left(\Delta InEXR_j, 0\right) \quad (5)$$

Hence, the nonlinear form of equation (2) can be expressed as:

$$\Delta InASI_t = \alpha_0 + \rho InASI_{t-1} + \beta_1 InEXR^-_{t-1} + \beta_2 InEXR^+_{t-1} + \gamma InLDR_{t-1} + \sum_{i=1}^{N1} \lambda_{1i} \Delta InASI_{t-i} + \sum_{j=0}^{N2} \left(\lambda^-_{2j} \Delta InEXR^-_{t-j} + \lambda^+_{2j} \Delta InEXR^+_{t-j} \right) + \sum_{j=0}^{N3} \lambda_{3j} \Delta InLDR_{t-j} + \varepsilon_t \quad (6)$$

and the short run error correction model will be:

$$\Delta InASI_t = \tau \xi_{t-1} + \sum_{i=1}^{N1} \lambda_{1i} \Delta InASI_{t-i} + \sum_{j=0}^{N2} \left(\lambda^-_{2j} \Delta InEXR^-_{t-j} + \lambda^+_{2j} \Delta InEXR^+_{t-j} \right) + \sum_{j=0}^{N3} \lambda_{3j} \Delta InLDR_{t-j} + \varepsilon_t \quad (7)$$

where the error correction term,

$$\xi_{t-1} = InASI_{t-1} - \alpha^*_0 - \beta^*_1 InEXR^-_{t-1} - \beta^*_2 InEXR^+_{t-1} - \gamma^* InLDR_{t-1}$$

and, α^*_0, β^*_1, β^*_2 and γ^* represent $-\frac{\alpha_0}{\rho}$, $-\frac{\beta_1}{\rho}$, $-\frac{\beta_2}{\rho}$ and $-\frac{\gamma}{\rho}$, respectively.

Given this definition, therefore, the long run model would be specified as:

$$InASI_t = \alpha^*_0 + \beta^*_1 InEXR^-_t + \beta^*_2 InEXR^+_t + \gamma^* InLDR_t + \delta D\_BCAP \quad (8)$$

Hence, λ^-_{2j} and λ^+_{2j} capture the short-run impact of negative and positive changes in the exchange rate respectively, while β^*_1 and β^*_2 capture the long-run impact of negative and positive changes in the exchange rate respectively. In this study, negative changes in the exchange rate indicate appreciation while positive changes indicate depreciation.

Meanwhile, as this study also proposed to examine whether there is a change in the dynamic relationship between the Nigerian stock market and exchange rate as suggested by our trend review, it would be essentially important to introduce dummy variables for structural break around the periods of banking sector recapitalization in Nigeria to examine this effect. To account for structural break for the banking sector recapitalization in the NARDL model, equations (7) and (8) are modified to produce equations (9) and (10), which indicate short-run and long-run NARDL models respectively.

$$\Delta InASI_t = \tau\xi_{t-1} + \sum_{i=1}^{N1}\lambda_{1i}\Delta InASI_{t-i} + \sum_{j=0}^{N2}\left(\lambda_{2j}^{-}\Delta InEXR_{t-j}^{-} + \lambda_{2j}^{+}\Delta InEXR_{t-j}^{+}\right) + \sum_{j=0}^{N3}\lambda_{3j}\Delta InLDR_{t-j} + \sum_{j=0}^{N4}\delta_j\Delta D\_BCAP_{t-j} + \varepsilon_t \quad (9)$$

$$InASI_t = \alpha_0^* + \beta_1^* InEXR_t^- + \beta_2^* InEXR_t^+ + \gamma^* InLDR_t + \delta^* D\_BCAP_t \quad (10)$$

where D_BCAP is the dummy for bank recapitalization; it takes the values of 0s before the period of recapitalization and 1s thereafter. The coefficient for this dummy, δ^* represents the rate of change in stock prices after bank recapitalization. If this is found to be negative and significant, it shows that stock prices decrease on average after bank recapitalization; if it is found to be positive and significant, it implies that stock prices increase on average after bank recapitalization; and if it is not signification, it implies that there is no significant change in the dynamics of stock prices in the pre- and post-banking sector recapitalization.

Meanwhile, as equations (9) and (10) only explain the case of Asymmetric model, equations (1) and (3) can be modified with dummy for bank recapitalization, hence, the linear (symmetric) model would be specified as;

$$\Delta InASI_t = \tau\xi_{t-1} + \sum_{i=1}^{N1}\lambda_{1i}\Delta InASI_{t-i} + \sum_{j=0}^{N2}\lambda_{2j}\Delta InEXR_{t-j} + \sum_{j=0}^{N3}\lambda_{3j}\Delta InLDR_{t-j} + \sum_{j=0}^{N4}\delta_j\Delta D\_BCAP_{t-j} + \varepsilon_t \quad (11)$$

$$InASI_t = \alpha_0^* + \beta^* InEXR_t + \gamma^* InLDR_t + \delta^* D\_BCAP_t \quad (12)$$

Equations (11) and (12) thus present the symmetric model for the analysis. The variables and parameters of the model remain as previously defined. This model becomes the optimal model when there is no significant difference between the estimates for negative and positive changes in the exchange rate. This would imply that the assumption of nonlinearity is invalid, implying that the linear (symmetric ARDL) model is appropriate.

3.0 Empirical Result and Discussion

The empirical analysis of this study is based on the estimation of equations (9) and (10) and equations (11) and (12) for nonlinear asymmetric and symmetric

models respectively. Basically, equations (11) and (12) present the short-run and long-run models for symmetric (linear) ARDL, while equations (11) and (12) present the short-run and long-run models for asymmetric (nonlinear) ARDL model. Meanwhile, to empirically determine the period of bank recapitalization, Bai and Perron's (2003) multiple structural break test is employed[4]. The structural break result as presented in Table 3 identified five significant structural breaks, among which is 2006M08. This period may be suspected as the beginning of the impact of the period of the banking recapitalization policy, which was introduced in 2004M07. Of course, period lag is expected to exist between policy implementation and impact period. Hence, the dummy for banking recapitalization in the model was defined as 0s before 2006M08 and 1s from and after 2006M08.

Table 3: Result of structural break test

Break Test	Break dates	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	1995M03	164.93	494.79	13.98
1 vs. 2 *	2001M04	79.87	239.60	15.72
2 vs. 3 *	1990M04	102.75	308.25	16.83
3 vs. 4 *	2012M10	20.71	62.12	17.61
4 vs. 5 *	**2006M08**	**70.07**	**210.20**	**18.14**

Source: Authors' computation

Table 4 presents the estimation result for the main analysis. It comprises the results from symmetric and asymmetric models under full sample, before recapitalization and after recapitalization. The table is also sectionalized to report separately the short-run, critical bounds, long-run and model diagnostics. While the short-run and long estimates present the main empirical analyses, critical bound and model diagnostics examine the existence of cointegration and robustness of the model, respectively.

Under the full sample analysis, both symmetric and asymmetric models confirm that the exchange rate does not have significant short-run impact on the Nigerian stock market. However, in the long-run, the exchange rate appears to have significant impact on the stock market. Basically, under the symmetric model, the exchange rate has a significantpositive effect on the Nigerian stock market. This implies that a higher exchange rate leads to higher stock market

[4]Bai and Perron (2003) can detect more than one significant structural break. See Salisu et al. (2016) for review and model specification of this test.

prices. In order words, stock market appreciates and exchange rate market depreciates, and vice versa. This result suggests that exchange rate depreciation attracts more demand for Nigerian stocks and boosts Nigerian stock market in the long-run and not in the short-run. This result is still partially in line with the findings of Oyinlola et al (2013) Zubair (2013) and Salisu and Oloko (2015) found evidence suggesting non-causality from exchange rate to the Nigerian stock market, as their studies only considered short-run analysis. By implication, this result is suggesting that the exchange rate policy cannot be efficient to correct short-run disequilibrium in the Nigerian stock market.

In addition, although the structural break for bank recapitalization is significant in the short-run, it is negative but not statistically significant in the long-run. This implies that stock market performance declined on average after recapitalization, but not at a statistically significant magnitude. This is confirmed by both symmetric and asymmetric models. Meanwhile, the asymmetric model addresses the basic fact of examining whether negative and positive changes in exchange rate have equal magnitude of effect on the stock market. Empirical evidence suggests that this is the case in the short-run but not in the long-run. Evidently, in the short-run, both negative and positive changes in exchange rate have no significant impact on the Nigerian stock market. But, in the long-run, the impact is asymmetric. While positive changes in exchange rate have significant positive impact on stock market, negative changes in the exchange rate have negative but insignificant impact on stock market. By implication, 1 percent depreciation in the exchange rate increases stock market performance better than 1 percent exchange rate appreciation. The appreciation in the Nigerian stock market due to both appreciation and depreciation in exchange rate is alarming; however, this was also noted in our trend review in section 2.

Moreover, the significance of the banking sector recapitalization dummy only in the short-run implies that banking sector recapitalization only affects the short run dynamics of the stock – market exchange rate relationship. And notably, the result evidently shows that long-run relationship does not exist after banking sector recapitalization unlike before recapitalization. This is judged by the upper bound testing critical values, which are lower than the Bound test F-statistic for the pre- banking sector recapitalization and higher for the post-banking sector recapitalization. By implication, the Nigerian stock market adjusts spontaneously or becomes more volatile after banking sector recapitalization. This result may not pose a significant surprise as the market tends to respond to a lot of external financial and real shocks after banking sector recapitalization. This includes the 2007-2008 Global Financial Crises and the 2007 and 2014 Oil price crash.

4.0. Conclusion

This study investigates asymmetry in the impact of the exchange rate on the Nigerian stock market using the Nonlinear ARDL model, and it is the first study to do so. From the trend review, it was noticed that the dynamics of exchange rate stock market relationship has changed after the banking sector recapitalization policy introduced by the Central Bank of Nigeria in 2004. As an additional contribution to the literature, this study examines the significance of this break using the Bai and Perron (2003) test, and also accounts for the break in the estimation model. Empirical findings from this study reveal that there is long-run but not short-run exchange rate asymmetry effect on the Nigerian stock market. Evidently, in the short-run, both negative and positive changes in exchange rate have no significant impact on the Nigerian stock market. But, in the long-run, the impact is asymmetric. While, positive changes in exchange rate have a positive significant impact on the stock market, negative changes in the exchange rate have a negative but insignificant impact on stock market.

Furthermore, the results suggest that banking sector recapitalization only affects the short-run dynamics of stock – market exchange rate relationship. This is judged by the upper bound testing critical values, which are lower than the Bound test F-statistics for the pre- banking sector recapitalization and higher for the post- banking sector recapitalization. By implication, the Nigerian stock market adjusts spontaneously or becomes more volatile after banking sector recapitalization.

The policy implication from this study is that the exchange rate policy cannot be used to correct short-run disequilibrium in the Nigerian stock market, as it takes a long time for the market to respond to changes in the exchange rate. This is regardless of whether the policy being introduced is a revaluation or a devaluation policy.

Table 4: Estimation results

Variables	Full sample		Before Bank Recapitalization		After Bank Recapitalization	
	Symmetry	Asymmetry	Symmetry	Asymmetry	Symmetry	Asymmetry
Short run model: Dependent variable - D(lnASI)						
ARDL optimal lags	(3,0,1,1)	(3,0,0,1,1)	(2,0,3)	(2,0,0,3)	(1,0,1)	(1,0,0,1)
D(lnASI(-1))	0.1090**	0.1101***	0.1614***	0.1621***	-	-
D(lnASI(-2))	0.1394***	0.1411***	-	-	-	-
D(LnLDR)	-0.1567***	-0.1614***	-0.1209***	-0.1258***	-0.6633**	-0.7087
D(lnLDR(-1))	-	-	-0.0203***	-0.0177	-	-
D(lnLDR(-2))	-	-	-0.1587***	-0.1565***	-	-
D(D_BCAP)	0.1499**	0.1496**	-	-	-	-
CointEq(-1)	-0.0128***	-0.0148***	-0.0102***	-0.0126***	-0.0283	-0.0330
Bound Testing						
Model F-stat	5.0953***	4.2793**	10.3333***	8.2915***	1.6406	1.4184
Critical Upper Bounds: Case II – Restricted Constant and No Trend						
Significant	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
10%	3.20	3.09	3.35	3.20	3.35	3.20
5%	3.67	3.49	3.87	3.67	3.87	3.67
1%	4.66	4.37	5.00	4.66	5.00	4.66
Long run model: Dependent variable - LnASI						
lnEXR_NEG	-	-0.4227	-	-0.6452	-	4.8772
lnEXR_POS	-	0.7849*	-	0.6674*	-	0.2334
lnEXR	0.9616***	-	0.8125**	-	-1.0424	-
lnLDR	0.7607	0.1393	1.3557	0.4611	7.8125	5.4188
D_BCAP	-0.3891	-0.4870	-	-	-	-
Constant	3.7342	4.7321	2.9892	4.4559	-6.4524	-0.0619
Model Diagnostics						
Durbin-Waston	2.0359	2.0358	2.0357	2.0345	2.0123	2.0241
Ljung Box Q(2)	0.1766	0.1731	2.7621	2.8376	2.6636	7.3398**
Ramsey RESET	1.6178	1.5410	0.2441	0.0569	0.4093	0.5362
No. of obs. Included	388	388	256	256	120	120

Source: Compiled by the author

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INSTITUTIONS, HUMAN CAPITAL DEVELOPMENT AND PRODUCTIVITY GROWTH IN SELECTED SUB-SAHARAN AFRICA COUNTRIES

Abidemi C. Adegboye[1]* and Tope R. Oziegbe[1]

Abstract

In this study, the relationship between institutions, human capital and growth of labour productivity in selected sub-Saharan African countries is investigated using a panel data set of 20 countries and covering the period 1996 to 2015. The system GMM estimation technique was employed in the estimation of the relationships. We find that institutions positively affect both human capital development and productivity growth in the region. In particular, it is found that with political and educational institutions quality, the effects of education spending on growth outcomes increases significantly. Also with corruption control and efficient political institutions, health expenditure effect on output rises. Thus, better institutions were shown to lead to better use of human capital development resources. The study also found that improving institutional quality has higher effects on human capital output than increasing spending. Moreover, institutional quality, especially corruption control, government effectiveness and political structure were also found to have direct effects on productivity growth in the region and also tends to strengthen the effects of human capital on productivity growth in the region.

Keywords: Institutional quality, human capital, productivity growth, sub-Sahara Africa

JEL Classification:*I15, I25, J24, O43*

1. Introduction

Diverging growth paths between LDCs and advanced economies have been an issue of concern in economic theory and policy. Findings have shown that vast amounts of capital - which is expected to both augment and supplement the large endowment of resources in these countries - have flowed to developing economies, especially in the last few decades. The reality, however, is that capital accumulation alone has not produced the desired growth results, especially in African economies. Moreover, growth models that followed Solow's work have included human capital as a fundamental factor that both generates and stimulates long-run growth processes. The initial perspective on economic growth with human capital (such as Lucas, 1988; Romer, 1990; Mankiw, Romer and Weil, 1992) was that human capital development was enough to explain differences in productivity growth

[1]Department of Economics, Adeyemi College of Education, Ondo State, Nigeria
*Corresponding author email:cornabi@gmail.com; +2347033227614

among countries. Countries that invest more in human capital development (along with physical capital accumulation) were expected to grow faster than those with less investment (Polimeni, Polimeni & Trees). Essentially, technology spillovers (whether from R&D or from FDI) are more easily internalized in countries with more developed human capital. This would then lead to higher workers' productivity in these countries.

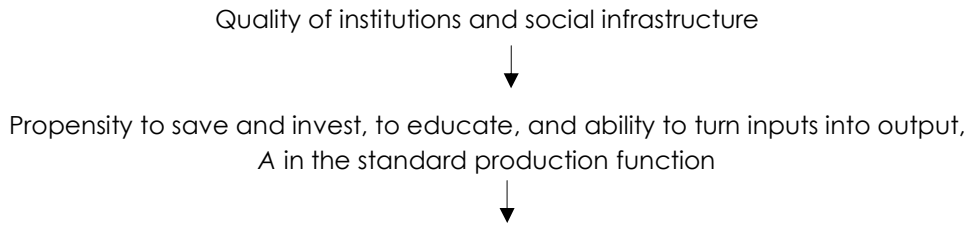
The argument however, is that if investment in physical and human capital are the main determinants of productivity levels across countries, pertinent questions may arise including 'why do some countries invest more than others in human capital? And 'why are some countries so much more productive than others? Hall and Jones (1999) posed these questions in their argument that a one-step-deeper explanation could be found, at least partly, in differences in 'social infrastructure' or 'institutions'. By social infrastructure, they mean 'the institutions and government policies that determine the economic environment within which individuals accumulate skills and firms accumulate capital and produce output' (Sorensen & Whitta-Jacobsen, 2010).

Africa countries have some of the lowest institutional quality indicators among the regions of the world. In the recently adopted governance indicators drafted by the World Bank, most African countries had negative estimate scores for institutional issues. The literature on the relationship between human capital, institutions, and economicgrowth emphasizes the importance of good institutions as a key factor in determining income levels and economic/productivity growth, and in stimulating economic rewards that favor input accumulation. Institutions are also referred to as the "fundamental" determinants of economic performance. However, the links through which institutions impact factor accumulation, particularly human capital, is still the subject of ongoing debate.

The main objective of this study is to investigate the effects of institutional quality on both human capital development and productivity growth in a group of sub-Saharan Africa countries. We show that human capital development is a veritable channel through which institutional quality affects productivity growth in Africa. The paper is thus structured into five sections, including this introductory section. In section two, literature which is pertinent to the issues within the study is reviewed, while the analytical and theoretical framework for the study is provided in section three. The empirical analysis of the study is conducted in section four and conclusive remarks are made in section five.

2. Literature Review

Institutions as enhancing factors for sustainable long run growth were only considered as implicit in initial standard economic theory (Acemoglu, Gallego and Robison, 2014). These theories did not consider the systematic evidence on whether and how institutions influenced economic development either as a process or a destination. More importantly, theoretical insights on why institutions differ across countries and how they evolve are essential for developing a comprehensive approach to growth and development models (Acemoglu, et al., 2014). Indeed, the relevance of institutions in economic performances and progress can be quite broad and encompassing. An essential aspect that makes institutional effects on growth intertemporal is that once institutions are built, economic, social, and political mechanisms generated as a byproduct of those institutions are expected to set constraints on future institutional changes, so that those early institutional arrangements tend to persist over time (La Porta *et al.,* 1999; Acemoglu *et al.,* 2001; and Engerman and Sokoloff, 2005; Tebaldi and Elmslie, 2008). Thus, institutions have both direct and indirect linkages with the inputs as well as outcomes of the growth processes. The general idea can be illustrated as follows (Sorensen and Whitta-Jacobsen, 2010):



The causality indicated by the second arrow is exactly the content of the Solow-type model with human capital having the overall conclusion that the basic parameters of human and physical capital are decisive for productivity growth. The first arrow represents the idea that the quality of institutions affects these basic parameters. Putting it all together implies a positive influence of the quality of institutions on workers' productivity.

Apart from the broad considerations of the influences of institutions on growth, particular channels have been explored. Such studies relating institutions to economic growth and productivity have often encountered challenges with respect to measurement and channeling of the influences. This empirical challenge is difficult because institutions are endogenous and develop *in*

tandem with other potential determinants of long-run economic performance (Acemoglu et al, 2014), but their evolution and presence across countries is not easily inferred.

The main approach in highlighting institutions as a growth stimulating factor is either to focus on particular segments of the system, or device an instrumental variable for capturing its effect. Acemoglu et al. (2001), following in the footsteps of initial research by Knack and Keefer (1995) and Hall and Jones (1999), adopted the second approach. They exploited a historically-determined consideration for institutional quality by focusing on the colonization policies used by Europeans in the modern world which created different sets of institutions. Such institutions, they claimed, could either be rent-seeking (and anti-growth) or standard European-based (and growth enhancing). The authors in 2005 showed that that such institutions could affect growth through human capital development.

Dias and McDermott (2006) also developed a model that associated efficiency of public institutions and the market incentive for input accumulation. They noted that government efficiency plays a key role in setting up the levels of productive inputs in the economy – which are educated labor and entrepreneurs. Under this theory, government efficiency was shown as the mechanism that sets up the long run growth process of the economy. In this direction, economies plagued by rent seekers will possess "the wrong institutions" and experience slower growth than their counterparts.

Another aspect of institutions relationship with human capital and growth that has been investigated (as shown in Acemoglu, 2005) is from a political-economy perspective. Lane and Tornell (1999) showed that certain political arrangements could result in institutions that tend to inhibit growth through rent seeking. Fan, Lin and Treisman (2012) have expanded this strand of argument with implications for political decentralisation to include institutional quality. They showed that decentralisation will lead to less corruption: 'closer contact between decision-makers and beneficiaries allows the latter more control and leads to stronger accountability on the part of the former, while at local level decisions are made in a more transparent manner than in central ministries'. This outcome seems to be corroborated by other studies (see Fisman and Gatti, 2000; and Padovano, Fiorino and Galli, 2011).

However, de Grauwe and Lugaz (2011) noted that decentralisation can also open space for more corruption: because of proximity, arrangements between corrupt parties can more easily be created. In addition, it demands great

courage to criticize local decision-makers, partly because watchdog groups are generally more focused on central-level corruption. Thus, studies on this relationship present contrasting perspectives; some confirm the risk of a link between decentralisation and increased corruption while others discover that decentralization leads to lower levels of corruption.

The role and implications of human capital as an institutional factor in decentralization have also been studied (see Davies, Harber and Dzimadzi, 2003; Hallak and Poisson, 2006; and Hubard, 2007). In particular, Reinikka and Svensson (2007) examined the extent to which allocated funds reach the designated first schools via regional institutions in Uganda. The results showed that, in Uganda, the share of the grant to reach schools increased significantly (from 20 to 90 per cent) after an information campaign in the press and an obligation for districts and schools to post amounts in public places. More recently however, Hubard (2007) found that the amount of such funds has decreased in spite of such campaigns. Indeed, the obligation to post budget information in public places is not always effective if the information is not easily understandable and if traditions of autocratic decision-making are strong (De Grauwe, 2014). These effects are also applicable to health delivery in which institutions that are set up by political arrangements have either improved or prohibited effectiveness of such activities (Kimenyi, 2009).

The role of human capital as a fundamental input in long run productivity growth has been show to facilitate the essence of technological progress in societies. In their study, Hammouda et al (2009) included human capital (measured as secondary school enrolment rate) as explanatory variable for total factor productivity in Africa and found that though the variable is essential for productivity enhancement, the coefficient was not significant in the model. In this direction, Danquah and Ouattara (2014) examined the contribution of human capital to productivity growth, innovation and adoption of technology for a sample of SSA countries between 1960 and 2003. They confirmed the results of Hammouda et al. but found that after decomposing total factor productivity into its main components, the effect of human capital on efficiency change is positive and statistically significant.

3. Model and Methodology

3.1 Theoretical Framework

The standard macroeconomic growth model that incorporated human capital as a fundamental factor was initially developed by Mankiw et al, (1992) by making generalisations to the Solow growth model. However, the role of human

capital in growth was developed in Lucas (1988) study of the basic growth ingredients for long run development. He recognized the stock of human capital as an augmenting factor in stimulating productivity and long run growth. The framework in this study therefore draws from the theoretical presentations by Lucas (1988) on human capital accumulation process and Mankiw et al (1992) on growth with human capital. Hall and Jones' (1999) contribution on institutional effects are also introduced to develop the simultaneous equations set-up for the empirical model in the study. Using a production function, in per capita terms, of the form

$$y = Ak^{\alpha}[u(t)h) \quad (1)$$

Lucas (1998) showed that human capital is an effective factor in the determination of long run growth in an economy. To devise the accumulation of human capital, Lucas (1988) presented the technology of human capital development by relating the growth of human capital, *h(t),* to "the level already attained and the effort devoted to acquiring more." The formulation is of the form:

$$\dot{h}(t) = h(t)^{\gamma}G[1 - u(t)] \quad (2)$$

where G is increasing, with *G(O)* = O. Lucas showed that human capital cannot serve as an alternative engine of growth to the technology term *A(t)* in the production function used for the growth model. Thus, just like Solow formulated the equation for physical capital accumulation and presented it as an integral aspect of the growth process, Lucas emphasized the inclusion of physical capital by explicitly formulating a human capital accumulation equation.

The "effort devoted to acquiring human capital" or the determination of human capital accumulation was more explicitly demonstrated in the study by Mankiw et al. (1992) using more simplified and empirically testable models. Their model showed that the decision of the representative agent not only involves savings and physical capital investment, but also investment in human capital. Thus, the agent is faced with the decision to distribute savings between physical capital investment (I_t^K) and human capital investment (I_t^H). Taking the variables in per capita terms (with human capita per man as *h* and physical capital per man as *k*), the model suggested that the evolution in the capital stock in the economy be given as:

$$\dot{k}(t) = I_t^K - \delta k(t) \quad (3)$$

$$\dot{h}(t) = I_t^H - \delta k(t) \quad (4)$$

The model shows that both physical and human capital depreciate at the same rate, δ. To address the pattern of human capital accumulation, the model of Mankiw et al. assumed that, just like physical capital in the Solow model, a given and constant fraction, $s_h$of income (y) is devoted to human capital investment. The accumulation of physical and human capital in the economy is thus given as

$$I_t^K = s_k y_t; \qquad 0 < s_k < 1 \qquad (5)$$

and

$$I_t^H = s_h y_t \qquad 0 < s_h < 1 \qquad (6)$$

Where s_k is the proportion of income devoted to physical capital investment. Substituting (3) and (4) into (5) and (6) respectively, the process of physical and human capital accumulation is derived as:

$$\dot{k}(t) = s_k y_t - \delta k(t) \qquad (7)$$

$$\dot{h}(t) = s_h y_t - \delta k(t) \qquad (8)$$

Assuming that population grows at a constant rate, n and technology processes at the rate, g, then, (7) and (8) can be re-written as:

$$\dot{k}(t) = s_k y_t - (n + g + \delta)k(t) \qquad (9)$$

$$\dot{h}(t) = s_h y_t - (n + g + \delta)k(t) \qquad (10)$$

Solving for the steady-state level of capital accumulation, the economy converges based on the following equations:

$$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{n+g+\delta}\right)^{1/(1-\alpha-\beta)} \qquad (11)$$

$$h^* = \left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{n+g+\delta}\right)^{1/(1-\alpha-\beta)} \qquad (12)$$

Equations (11) and (12) show the long run determination of physical and human capital accumulation. For the human capital equation, it can be seen that its accumulation is positively correlated with the savings rate (s_k+s_h) and negatively correlated with population growth rate. Taking natural logarithms of (12), human capital model becomes,

$$lnh = \frac{\alpha}{1-\alpha-\beta} ln(s_k) + \frac{1-\alpha}{1-\alpha-\beta} (lns_h) - \frac{1}{1-\alpha-\beta} ln\,(n + g + \delta) \quad (13)$$

Equation (13) is a linear form of the human capital equation that can be estimated.

For the productivity growth (or income per head) derivation, Mankiw et al., presented a human capital augmented version of the Solow aggregate production function in the form

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} (A(t)L(t))^{1-\alpha-\beta} \qquad 0 < \alpha < 1, \beta = 1-\alpha \quad (14)$$

Where *Y* is output, *K* is capital, *L* is labour, and *A* is the level of technology. Also, *L* and *A* are assumed to growth exogenously (as demonstrated in Solow's model). The model could further be presented in per capita terms as

$$y(t) = k(t)^{\alpha} h(t)^{\beta} A(t)^{1-\alpha-\beta} \quad (15)$$

Substituting the steady state solutions for physical and human capital into the production function (12) gives the equation for income per worker (note that A grows at a natural rate, g) as

$$y = \left(\frac{s_k^{\alpha} s_h^{\beta}}{n+g+\delta}\right)^{\alpha/(1-\alpha-\beta)} + \left(\frac{s_k^{\alpha} s_h^{\beta}}{n+g+\delta}\right)^{\beta/(1-\alpha-\beta)} + A(0)e^{gt} \quad (16)$$

Taking natural logarithms and solving further,

$$lny = lnA(0) + gt + \frac{\alpha}{1-\alpha-\beta} ln(s_k) + \frac{\beta}{1-\alpha-\beta} ln(s_h) - \frac{\alpha+\beta}{1-\alpha-\beta} ln\,(n + g + \delta) \quad (17)$$

Equation (17) is Mankiw et al formulation of the growth model with human capital. In the model, $\frac{\alpha}{1-\alpha-\beta}$ is the elasticity of productivity with respect to s_k, $\frac{\beta}{1-\alpha-\beta}$ is the elasticity with respect to s_h, and $-(\frac{\alpha+\beta}{1-\alpha-\beta})$ is the elasticity with respect to $(n+g+\delta)$. Equation (17) states that income per worker is dependent on population growth, accumulation of physical capital, and accumulation of human capital. The model shows the role of human capital other variables in the determination of productivity growth.

In empirical terms, Mankiw et al showed that equation (17) could be estimated in another form, depending on data availability. The model in (17) uses rate of investment in human capital to represent the development of human capital. However, the equation could be re-formulated using the level of human capital

(h^*) to represent human capital development. In this form, the productivity equation becomes

$$lny = lnA(0) + gt + \frac{\alpha}{1-\alpha-\beta} ln(s_k) + \frac{\beta}{1-\alpha-\beta} \ln (h^*) - \frac{\alpha+\beta}{1-\alpha-\beta} ln (n + g + \delta) \quad (18)$$

This modified formulation corresponds more precisely with the type of data used in the evaluation of human capital development in developing countries.

Equations (13), (17) and (18) are the fundamental equations that we present in simultaneous form for empirical analysis in this study. Note that, though not explicitly stated, *y* is endogenous in the human capital equation (13) since

$$s(t) = y(t) - c(t) \quad (19)$$

Where *s* is savings, *y* is income and *c* is consumption. Thus, savings is a function of income per capita and the s_k and s_h variable inherently possess the *y* variable.

On the place of institutions in the human capital and productivity equation, recall that Sorensen and Whitta-Jacobsen (2010) hoed that institutions affect growth through the channels of proportion of savings devoted to investment in physical capital and education and through technology. These are the sources of growth in labour productivity. Thus, institutions affect *y* in the model through s_k, s_h and A. Our model thus shows that inclusion of human capital in the productivity equation intensifies the positive effect of institutions. Quality institutions initial improve growth through improvement of physical capital accumulation and technology. The addition of human capital in the model extends the positive effects of institution on productivity growth.

3.2 The Model

The empirical model specified for the productivity function follows the framework developed above. Based on the simultaneous equations framework and the models developed by Hall and Jones (1999) and Romer et al. (1992), we estimate a reduced form equation for productivity growth with a general form given as:

$$y_{it} = a_0 + a_1 hcap_{it} + \gamma_i inst_{it} + X\beta + \eta + \delta_t + \varepsilon_{it} \quad (20)$$

where *y* is productivity growth, *hcap* is the measure of human capital development, *inst* is the measure of institutions, *X* is a vector of regressors that influence productivity growth and also enhance robustness of the relationship

in a country, α, β, and γ are coefficients to be estimated, η, δ_t and ε_{it} are country specific, temporal, and idiosyncratic error terms respectively.

Theoretical and empirical underpinnings also suggest strong effects of institutions in realizing quality human capital base in a country. In this study, we argue that human capital development is a major channel through which institutions affect productivity growth in Africa. In order to show the influences of institutions on human capital development therefore, we follow the papers of Dreher et al. (2003) and Michaelowa and Weber (2006) and propose a simple model of education (health) output function in which institutions are additional explanatory variables in the output equation. We estimate reduced form equations for education and health sectors. The general form of this equation is given as:

$$h_{it} = \alpha_0 + \alpha_1 inst_{it} + X\beta + \eta + \delta_t + \varepsilon_{it} \qquad (21)$$

where h_{it} is output in the education or health sector, *inst* is institutional factors that are related to the education or health sector, X is a vector of regressors that influence education (health) output in a country, and α, β, and γ as well as η,δ_t and ε_{it} are as earlier explained.

3.3 Variables in the Model

The variables included in the specified models are based on theoretical and specific considerations. Generally, growth rate of average labour productivity is best defined as growth in real GDP per hours worked (Obadan and Odusola, 2000). But for most LDCs, data for GDP per hour worked is not available, hence in most studies (such as ILO, 2008; Aghion, Braun and Fedderke, 2008; Hammoud et al., 2010; and Naanwaab and Yeboah, 2013) real GDP per person employed is used as the measure of labour productivity. Since, all individuals employed in both formal and informal sectors are used in the computation (World Bank, 2013), then this variable extensively captures the labour input factor, especially in developing countries (ILO, 2008).

In this study, human capital is considered as output from education and health sectors (see Diagne, 2009; Todaro and Smith, 2009; and Hanushek, 2013). In relating human capital development to institutional factors, this study measures human capital in terms of output and expenditure in order to show if there are underlying institutional implications that may enhance spending towards achieving output targets. For the expenditure variables, we use government expenditure on education as proportion of GDP (for education) and health

expenditure per capita (for health). We expect that each human capital factor has a positive impact on growth rate of productivity.

The output variables employed are secondary school enrolment (for education) and life expectancy (for health). Vros (1996) defines educational output indicators as variables that measure the extent to which immediate programmes or objectives of educational development are achieved. The "immediate objective of educational development may be to raise coverage of the educational system (as measured through enrollment rates), improve its internal efficiency (retention rates) and/or raise the skills and knowledge of graduates" (p.16). Output is therefore different from outcomes, which are used to capture broader development objectives of education, such as higher labour productivity, better health and enhanced capabilities of individuals to participate in modern society. Applying the same evaluation to health output, Carvalho and White (1994) noted that indicators measure immediate effects of health development programmes, including life expectancy and maternal mortality rates. Health outcomes on the other hand evaluates life-long returns of health investment, such as higher productivity. The choice of secondary school enrolment and life expectancy is also based on studies like Gyimah-Brempong and Asiedu (2008), Hammouda et al. (2000), and Ghura and Hadjimichael (1996).

The measures of institutions used in the study are based on the World Bank World Governance Indicators (WGI) estimates. Two institutional variables that capture the capacity of the government to effectively formulate and implement sound policies [namely, government effectiveness (*goveff*) and regulatory Quality (*regulation*)] and two variables that show the respect of citizens and the state for the institutions that govern economic and social interactions among them [namely, rule of Law (*rule*) and control of corruption (*corruption*)] are employed.

Besides the standard institutions measures above, political systems in the process of economic activities in Africa has been a source of considerable research over many years. In this paper, following Moral-Benito (2009), among others, we hypothesize that political arrangements that proxy for decentralized political power will significantly enhance institutional capacity and human development. Federal structures are assumed to be more decentralized in terms of allocation of resources to the subordinate entities than unitary states. Hence a dummy that takes 1 for federal system and 0 otherwise is used to capture political system in a country is included in the model.

In addition to this basic model, geographical-related factors, which are also 'intrinsically linked' to institutions (Diaz and Tebaldi, 2011), are controlled for by adding country dummies that take resource wealth into consideration. The dummy (*resource*) takes the value of one for a resource-wealthy country and 0 for a non-resource wealthy country. Also, we have used the growth rate of labour force (*labfg*) as a primary fixed, but not a geographic factor, that could have an effect on productivity and human development. Given that a cross-country analysis is done in the study, a factor of initial condition – the lagged value or real GDP ($rgdp_{t-1}$) for each country – is included. Finally, it has been noted that most economies in the Sub-Saharan Africa region are quite open in order to accommodate increasing government consumption spending (Alesina and Perotti, 1997; Hall and Jones, 1999). Hence, trade openness (*open*) has been included as a robustness check in the model.

For the human capital equation (21), we use human capital output as dependent variables while institutional factors - explained above - are the main explanatory variables. For the education equation, these variables include per capita income, expenditure on education and pupil/teacher ratio. These are the variables that have been used by earlier researchers to investigate the determinants of educational output (e.g. Dreher et al., 2006). For the health output equation, the variables in the X vector include lagged health output, per capita income, health expenditure, income per capita, and population growth rate (see Mishra and Newhouse, 2007).

3.4 Data and Estimation

Data used covers 20 sub-Sahara African countries (excluding South Africa) for which data are available. Annual data for the period 1996 to 2015 are sourced for each of the countries in the sample. The main source of the data is the World Bank *World Development Indicators* for 2015. Education data were also augmented from the UNESCO Ebsco data on Education. Data on trade openness and real GDP were obtained from the Penn World database and Central Bank Statistics from the individual countries. The institutions estimate for each country were obtained from the database of the *WGI* website made available by the World Bank. Information on system of government was obtained from the Wikipedia website.

The productivity growth and human capital/institutions equations we estimate have endogenous regressors (see Sorensen and Whitta-Jacobsen, 2010) as well as country heterogeneity. Under these circumstances, researchers have either used an instrumental variable (IV) or Generalised Method of Moments (GMM)

estimators to consistently estimate the growth equations. Since institutions have been included in the models, we avoid the use of IV techniques in this study. A consistent estimator that has been used by researchers to estimate cross-country growth regressions in a panel format is the expanded system GMM estimation technique (e.g. Caselli, Esquivel, and Lefort, 1996; and Panizza, 2002). Consequently, this study focuses on the system GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). The system GMM estimator is computed by combining moment conditions for the equations in first-differences using suitably lagged variables as instruments, with additional moment conditions for the equations in levels provided these first-differences are uncorrelated with the within-sample effects.

A key additional assumption for the system GMM estimator requires the first differences of *the variables* to be uncorrelated with the individual effects. This assumption is guaranteed to be valid if the variablesseries have constant means over time or are stationary. Hence, the panel unit root and cointegration tests are conducted on the data. Both tests' results are presented in the appendix. The results strongly indicate that the variables are non-stationary in level but stationary in first differences. This finding is supported by both the homogenous and heterogenous panel unit root tests. The outcomes of Pedroni's and Kao panel cointegration tests on the series also show that the series are cointegrated.

4. Empirical Analysis

In this section, we present and analyse the results of the estimated models in the previous section. As noted, the system GMM estimator is employed for estimating the equations. It should be noted that the results for equation (21) – the human capital output equation are two (one for education output and the other for health output. The empirical analysis begins with a note on some stylized facts on institutions, human capital and productivity growth in the countries in our sample.

4.1 Some Stylized Facts on Institutions, Human Capital and Productivity Growth in Africa

Here, we show the initial patterns of relationships between institutions and both human capital development and productivity growth. These are shown in scatterplots with regression coefficients which are presented in Appendix 1. The results from the charts can easily highlight two points, namely, the relative effects of human capital output and expenditure on productivity growth; and

the relative importance of institutional improvement and expenditure growth on productivity and human capital. We consider the slope of the line of best fit for each of the relationships (in logs) shown in the charts. Essentially, these results show that output is more relevant for growth processes than expenditure. Focusing on increasing expenditure on human capital development without appropriate recourse to the requisite output would not translate to improvement in productivity.

In particular, we show the relative importance of institutions and expenditure on education and health output for two periods (2005 and 2015). and answer the question 'would increase in expenditure on human capital deliver higher effects on output than improving institutions in the countries?' There is a clear indication that the slope coefficients for the lines of best fit for the relationship between institutions and human capital output in each of the periods is higher than the ones for the relationship between expenditure and output. For instance, in 2005, 10 percent rise in spending led to a rise by 3.32 and 3.36 percentage points in education and health output respectively. The results were also similar for 2015, except for health output. Thus, the results show that improving the quality of institutions generates more human capital development results than increasing spending. In order words, the cost of poor institutions on education and health output in the region is higher than the cost of poor funding.

4.2 Estimated Results

The results of the estimated models from the equations in the previous section are reported and explained in this section. The results are presented in accordance with the equations in the study.

4.2.1 Productivity Growth Results

The results of the estimation of the productivity equation are shown in Table 1 below. There are eight estimations performed based on the productivity growth equations. In equation one, the human capital output variables are singled out without any controls. The results show that education and health outputs have quite significant and positive impact on productivity, with the health output having the higher effect. Pupils-to-teachers ratio however fails the significance test. We also single out the effects of education and health spending on productivity growth as shown in equation 2. Education spending actually has a negative coefficient while that of health is positive, although quite low. Thus, spending in education is seen to have debilitating effects on productivity and as

Prawda (1993) also noted, this effect could result from the high mismanagement of appropriated funds to the education sector.

In the third equation, we included the controls within the expenditure factors and find that the negative effect of education spending persists while the positive effects of health spending increases. This suggests that health expenditure, as it relates to productivity growth may actually differ across countries based on political and economic factors, but the effects of education spending remain the same across the region. The fourth equation also shows human capital output with control variables. It indicates that when size and other factors are controlled for, education output has no significant impact on productivity growth, but health output does. Another issue of relevance in the result is the negative coefficient of labour force growth on productivity growth among the countries. This indicates that rising labour force reduces productivity growth in SSA. This may perhaps be due to poor human capital accumulation that would generate the expected value added from labour, or the dearth of essential capital to complement and stimulate labour contribution.

The effects of institutional factors on productivity growth are identified in model five. The results show that each of the institutional factors has a significant impact on productivity growth. Only the coefficient of rule of law is negative, suggesting that adherence to rule of law may not actually stimulate productivity growth among the countries. Also, government effectiveness appears to have the strongest impact on productivity growth; when governments' basic institutions possess the necessary quality to administer its functions, productivity will grow faster. The general outcome in this model is that government effectiveness, regulatory quality and corruption are strong factors that promote productivity growth in Nigeria. The sixth column in the results shows that when controlling for resource richness, openness, political system and initial conditions, only control of corruption and government effectiveness are significant among the institutional variables. This suggests that the other factors may play strong roles in improving or reducing the effect of institutions on productivity growth in SSA.

In the seventh column, the results for institutions and human capital are reported. In the result, educational spending still has a negative and significant coefficient while educational output and health expenditure both pass the significance test and are positively signed. Only the rule of law (negative) and control of corruption are significant among the institutional factors. This result demonstrates the role of corruption reduction on growth; stronger control of corruption improves productivity growth irrespective of economic or political

system in the country. In the same vein, heightened necessity to improve on institutions tends to increase human capital influence on growth.

Table 1: Results of System GMM Estimates; dependent variable is productivity growth

Variable	1	2	3	4	5	6	7	8
Constant	--	7.52*** (-74.1)	6.52*** (8.26)	3.17 (1.63)	7.87*** (53.6)	1.24** (2.2)	3.66 (-1.09)	5.28** (-3.43)
education output	0.32*** (7.23)	---	--	0.05 (1.04)	--	--	0.26** (-2.11)	-0.06 (-0.63)
lpupils-ratio	0.12 (1.22)	--	--	0.18* (1.88)	--	--	--	0.073 (0.77)
education exp.	--	-0.02* (-1.93)	-0.19** (-2.66)	--	--	--	-0.38*** (-4.33)	-0.18* (-1.90)
health exp	--	0.01*** (-6.39)	0.34*** (6.49)	--	--	--	0.13* (-1.95)	0.09** (2.55)
labfg	--	--	--	-0.73*** (-18.4)	--	-0.82*** (-8.79)		-0.74*** (-6.17)
health output	1.59*** (13.7)	--	--	0.41** (1.99)	--	--	0.88 (1.02)	0.49** (2.31)
regulation	--	--	--		0.33** (2.18)	-0.1 (-0.71)	0.11 (0.49)	-0.26 (-1.55)
rule of law	--	--	--		-0.78*** (-3.99)	0.05 (0.47)	-0.72** (-2.65)	0.018 (0.14)
corrupt-control	--	--	--		0.23* (1.68)	0.66*** (6.31)	0.6*** (3.29)	0.54*** (3.82)
gov_effective	--	--	--		0.78*** (4.07)	0.31** (-2.09)	0.381 (1.28)	-0.073 (-0.47)
pol_system	--	--	--		0.18 (1.03)	0.17 (1.35)	0.139 (0.55)	0.281** (2.24)
edu_system	--	--	--		--	-0.21*** (-3.05)	-0.031 (-0.16)	-0.243** (-2.67)
resource_rich	--	--	-0.44** (-2.92)	-0.346* (-1.84)	--	-0.38*** (-5.39)	--	-0.422*** (-4.28)
Lopen	--	--	-0.339** (-2.19)	-0.112** (-2.09)	--	-0.14* (-1.61)	--	-0.180** (-2.17)
lrgdp(-1)	--	--	0.218*** (4.16)	0.853* (1.81)	--	1.05*** (16.9)	--	0.944*** -8.52
Adjusted R-squared	0.17	0.06	0.45	0.54	0.49	0.61	0.36	0.65

Overidentification test (p-value)	0.26	0.37	0.11	0.22	0.62	0.48	0.026	0.64

*Note: *, **, *** indicate significance at 10, 5 and 1 percent respectively*

In the final results, all variables are included in the model. In the model results, education and health expenditure, health output, corruption control and system of government are the significant variables among those of interest. It can be seen that control of corruption emerges as the strongest institutional factor that can expand the productivity growth in future. Given the configuration of the political system dummy, the results suggest that more decentralized political set-ups tend to deliver more productivity effects among the countries. With respect to the coefficients of the other control variables - resource riches, and trade openness – they persistently posed negative coefficients, suggesting that resource wealth actually tends to generate more rent-seeking activities and thereby dampen productivity growth. Trade openness also has a negative effect and it indicates that external sector expansion can hamper domestic productivity of labour.

The implications of the results confirm the positive effects of health, rather than education on productivity growth within the SSA region. Thus, there is need to step up the current drive towards health expenditure increases and extension to more individuals among African countries. Also, controlling corruption has been shown to be the strongest institutional factor in the study. Country specific factors have been shown to play effective roles in the quantifying the impacts of human capital and institutions on productivity growth in Nigeria.

4.2.2 Human Capital Results

The results of the estimation for education is reported in Table 2 below. In the result education expenditure and per capita income are significant in explaining human capital outcome for education (measured as school enrolment rate). Thus, it is seen that barring all other effects, a 10 percent increase in spending results in a 0.6 percent increase in school enrolment rates. It can also be seen that human capital outcome for education has a higher elasticity with respect to per capita income level (0.905) than education expenditure. In the second column of the results, the impact of institutional factors is shown. The results indicate that only government effectiveness and control of corruption are significant when the effects of spending and income are controlled for. However, when all variables are included in the results, corruption control, educational system and political system become the only significant institutional factors. Thus, the results show that the system of

education in a country matters in the educational output. Also, less decentralized political systems are shown to exert negative influence on educational output. This suggests that political structures that give more power to the subordinate units will likely possess better educational output, perhaps through more efficient use of budgetary resources to education. Education spending in the results is shown to have a positive impact on output, even when institutional effects are controlled.

These results therefore give implications that in SSA, spending on education can increase educational output, especially when institutional quality is high within the system. It is seen from the results that the coefficient of educational spending increased from 0.06 to 0.11 when the institutional controls where included in the model. Thus, with quality institutions (especially ones that address political distribution, educational system and corruption), the spending on education would produce higher rates of return for the region. The robustness check for the result indicate that the degree of over-identification test has coefficients that suggest correct specification and use of instruments in the model.

Table 2: Human Capital Results

Variable	*Dependent variable: School enrolment rates*		
	1	**2**	**3**
Constant	-4.421***	3.611	-3.701***
	(-3.79)	(15.02)	(-3.27)
Ledexp	0.063***		0.108***
	(4.75)		(4.73)
Lpupils	0.099		0.129
	(0.75)		(0.67)
Lgdppc	0.905***		0.798***
	(7.65)		(5.59)
Corrupt		-0.689*	-0.820**
		(-1.91)	(-2.79)
Goveff		1.212***	0.219
		(3.47)	(0.77)
Rule		-0.146	0.343
		(-0.36)	(1.04)
Regulation		0.045	0.231
		(0.13)	(0.84)
Edusys		0.117	0.353**

		(0.53)	(2.01)
Govt		-0.180 (-1.05)	-0.472*** (-3.19)
adjusted r-squared	0.28	0.22	0.34
overidentification test (p-values)	0.39	0.11	0.11

*Note: *, **, *** indicate significance at 10, 5 and 1 percent respectively*

Finally, we report the results for health output in Table 3 below. In the first column the effects of traditional health determinant factors are shown. Health spending, lagged health output and per capita income are strong factors in explaining health output in the region. The effects of institutional factors are shown in the second column and it shows that control of corruption tends to improve health output while more centralized political arrangements tend to inhibit these outcomes in the region. This is similar results with that of education where centralization was shown to reduce health output. In the model with combined effects, the effect of health expenditure is still positive and significant and has indeed increased from 0.017 to 0.022. This shows that improvement in institutions will help to increase the impact of spending on health output. Apparently, these institutional effects would come through adequate monitoring both during budgetary processes and direct application of funds. With the controls from health spending and lagged output, institutional factors of corruption control and rule of law are still shown to have significant positive effects on health output in the SSA region.

Table 3: Human Capital Results II

variables	*Dependent variable is health output*		
	1	**2**	**3**
constant	0.058*** (3.56)	4.09*** (165.2)	0.078** (2.39)
lhexp	0.017*** (3.35)		0.022** (2.93)
llexp(-1)	1.001*** (287.0)		0.992*** (105.9)
llabf	0.009 (1.27)		0.038** (1.79)
lgddpc	0.080*** (4.56)		0.072** (2.28)
corrupt		0.113*** (3.32)	0.059** (1.83)
goveff		0.005 (0.11)	-0.079 (-1.38)

rule		0.039	0.042*
		(1.29)	(1.90)
regulation		0.031	-0.015
		(1.15)	(-0.89)
Govt		-0.092***	0.011
		(-3.45)	(0.33)
adjusted r-squared	0.99	0.37	0.99
	0.62	0.08	0.398

5. Conclusion

In this study, the relationship between institutions, human capital and productivity growth of labour in sub-Saharan Africa was investigated. We argued that institutions can have both direct and channeled effects on productivity growth in Africa, with the channel of effect being primarily human capital development. The theoretical growth model developed in this paper demonstrates the importance of the interaction between human capital and institutions for explaining the growth process. Institutions play a key role in setting up the path of human capital accumulation, which fosters technology and productivity growth. By considering human capital development in spending and output dimensions, the study sought to highlight the comparative effects of spending, output and institutional quality on human capital development and productivity growth.

Data on twenty countries in the sub-Saharan Africa region covering the period 1996 to 2015 was used in the empirical analysis and the system GMM estimation technique was employed in the estimation of the relationships. The empirical estimates corroborate some insights from the theoretical model. We find that institutions positively affect both human capital development and productivity growth in the region. In particular, it was found that with political and educational institutions quality, the effects of education spending on output increases significantly. Also with corruption control and efficient political institutions, health expenditure effect on output rises. Thus, better institutions were shown to lead to better use of human capital development resources. In another set of analysis within the study, the results showed that improving institutional quality has better effects on human capital output than increasing spending. Institutional quality, especially corruption control, government effectiveness and political structure were also found to have direct effects on productivity growth in the region. Moreover, the presence of these institutions

also tended to strengthen the effects of human capital on productivity growth in the region.

The major policy implications of the results are that the establishment and sustenance of quality institutions in SSA is the major means of attaining effective linkages between spending and output in human capital. The age-long complaint about the poor human capital levels emanating from the region can be largely addressed by focusing on strengthening institutional capacity either in structural levels, political systems or with particular relations to human capital building. In the same vein, institutional quality can explain to a large extent, the effects of human capital on productivity growth. It can therefore be implied that the efficiency of labour input in growth would be improved if adequate attention is paid to development of appropriate institutions in the SSA region. This is because if institutions are poor, then the process of absorbing and internalizing knowledge (i.e., technology transfer, even from foreign participation) will be low and thus reduce productivity growth.

Finally, although the methodology in the study demonstrates that endogeneity issues are addressed, the role of human capital (and even productivity) in improving institutions has no theoretical doubts. There is therefore need to extend this study further by both identifying these effects and showing the extent to which they occur. This will likely produce a compact analysis for the institutions-human capital-growth nexus for the SSA region.

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Appendix 1:
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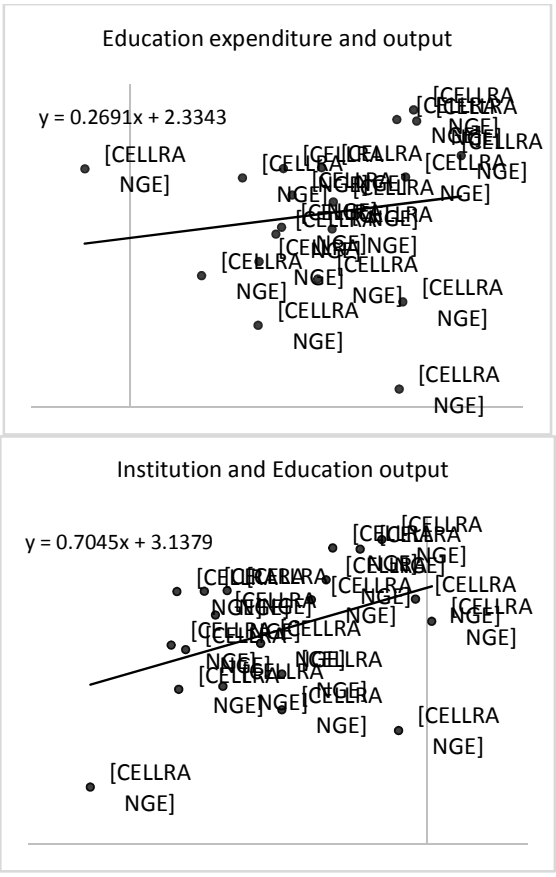
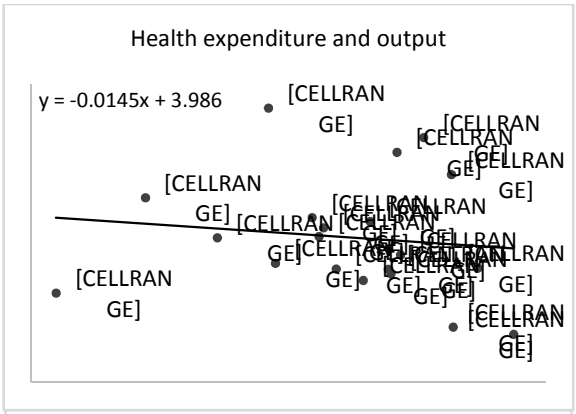
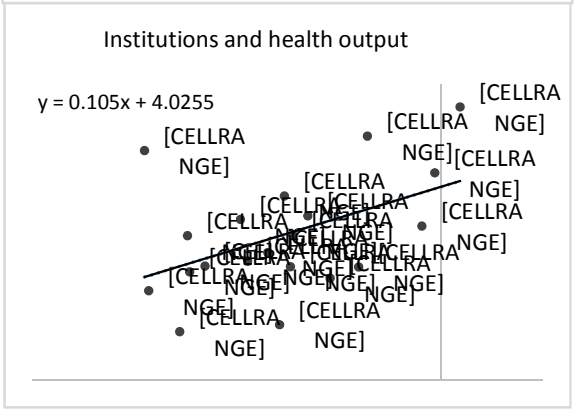
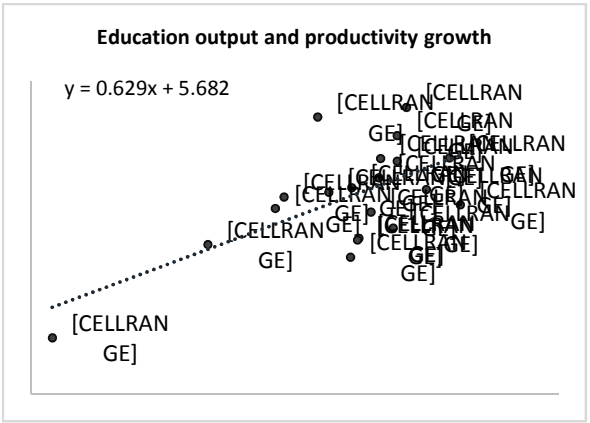
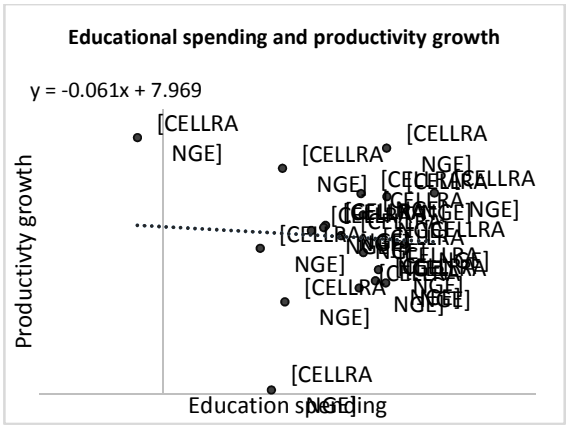

Education expenditure and output
y = 0.2691x + 2.3343
Institution and Education output
y = 0.7045x + 3.1379





Results for 2015




Educational spending and productivity growth
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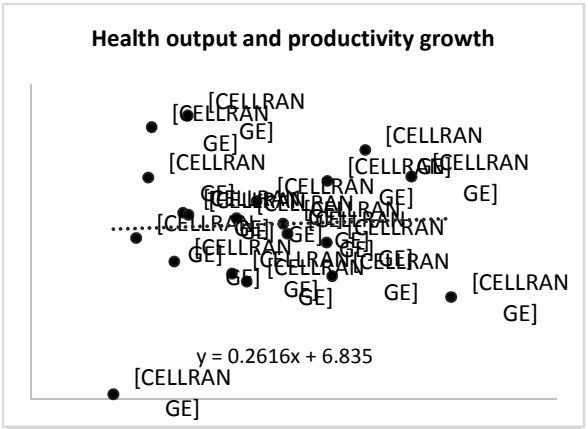
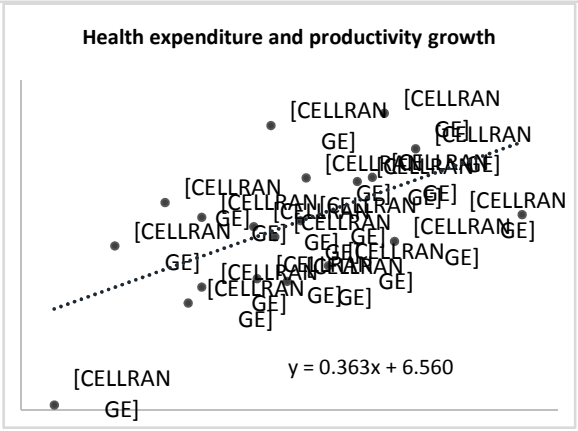
Productivty growth
Education spending


Health output and productivity growth
y = 0.2616x + 6.835


Health expenditure and productivity growth
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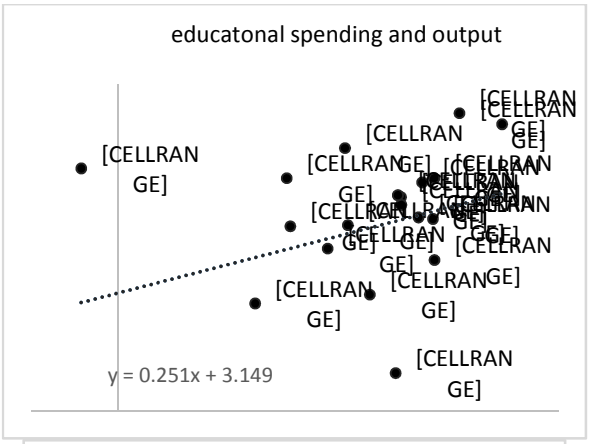
educatonal spending and output
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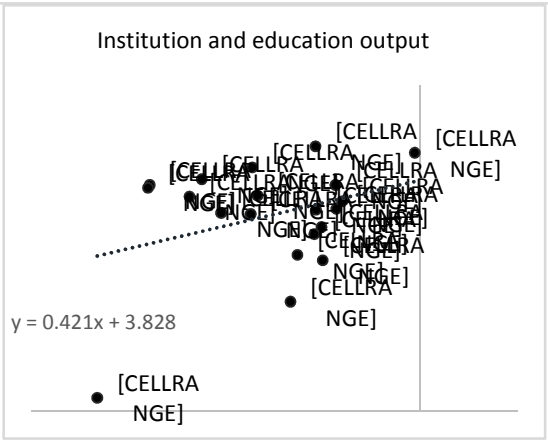
Institution and education output
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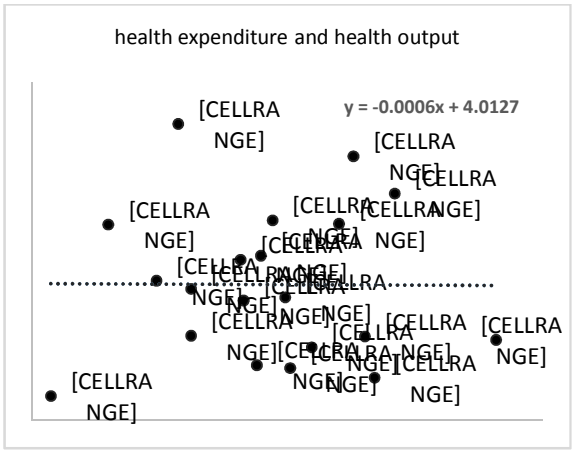
health expenditure and health output
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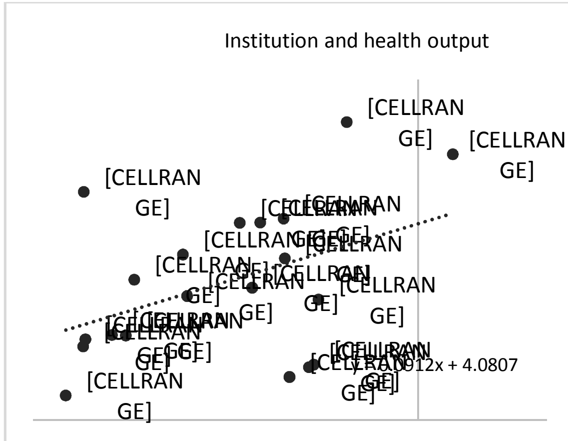


Appendix 2: Panel unit root and cointegration results

Panel Unit Root Result

	Homogeneous Unit Root Process				Heterogeneous Unit Root Process			
	Level		1st Diff		Level		1st Diff	
Variables	**LLC**	**Breitung**	**LLC**	**Breitung**	**IPS**	**ADF-Fisher**	**IPS**	**ADF-Fisher**
productivity growth	11.11	5.32	18.19	-3.00***	4.32	74.56	-16.07***	400.09**
senrol	18.49	14.56	-4.49***	1.74	14.73	30.86	-9.73***	289.4***
life expectancy	-3.01	-1.19	-9.69***	-11.85***	-2.45	101.8	-20.18***	475.40***
edu_exp	-2.37	-2.30	-20.32***	-17.40***	-1.64	93.50***	-24.51***	602.00***
health_exp	-3.42	-3.99	-23.53***	-20.00***	-3.80	127.82	-27.82***	890.95***
Pupil/teach	0.63	2.58	-21.05***	-12.16***	0.76	64.37	-19.41***	454.07***
labfg	-8.60	-7.33	-22.59***	-15.81***	-7.56	185.47	-27.11***	654.89***
open	8.72	12.23	-9.44***	-3.99***	12.65	22.45	-11.68***	265.53***
rgdp	-18.86	-16.40	-33.38***	-19.20***	-23.16	550.86	-45.50***	1704.6***

*Note: *** indicates significant at 1%; IPS = Im, Pesaran & Shin; LLC = Levin, Lin & Chu*

Panel Cointegration Test Result

Series for Cointegration Test: productivity growth equation					
Within-Dimension			**Between-Dimension**		**Kao (ADF)**
	Statistics	**Weighted Statistics**		**Statistics**	
Panel v	-2.72**	-3.49***	Group rho	-2.56***	-1.52*
Panel rho	-2.90***	-1.84**	Group PP	-2.73***	-----
Panel PP	-0.85	-2.45***	Group ADF	-2.14**	-----
Panel ADF	13.43	1.27			
Series for Cointegration Test: human capital equation					
Within-Dimension			**Between-Dimension**		**KAO (ADF)**
	Statistics	**Weighted Statistics**		**Statistics**	
Panel v	-1.24	-2.30**	Group rho	1.11	-1.40*
Panel rho	1.69	0.40	Group PP	-3.73***	-----
Panel PP	-1.49*	-3.36***	Group ADF	0.52	-----
Panel ADF	0.85	0.13			

*Note: ***. **. * are the level of significance for 1% 5% and 10% respectively.*

Appendix 3: Countries used in the study and abbreviations

Abbreviation	*Country*	*Abbreviation*	*Country*
ANG	Angola	MOZ	Mozambique
BKFO	Burkina Faso	NGR	Niger
CAM	Cameroon	NGA	Nigeria
CDR	Congo D.R.	SEN	Senegal
CIV	Cote d'ivoire	SUD	Sudan
ETH	Ethiopia	TAN	Tanzania
GHA	Ghana	UGA	Uganda
KEN	Kenya	ZAM	Zambia
MAD	Madagascar	ZIM	Zimbabwe
MALW	Malawi		
Mali	Mali		

A-RECONSIDERATION OF OKUN'S LAW: AN APPLICATION OF SYMMETRIC AND ASYMMETRIC APPROACHES ON NIGERIAN DATA

Isiaka Akande Raifu[1]*and Aminu Alarudeen[1]

Abstract

This study tests the validity of the symmetric and asymmetric Okun's law on Nigerian data spanning the period from 1970 to 2014. Considering different models – first, difference and output gap models – and using both linear and nonlinear autoregressive distributed lag methods, we documented the existence of long-run symmetric and asymmetric Okun's law in Nigeria in the output gap model based on Hodrick-Prescott data filtering method. More specifically, our findings showed that unemployment rate responds more to output cyclicality than ordinary movement in output. Based on the findings, it is recommended that appropriate fiscal and monetary policies be implemented to shorten the period of economic fluctuation or recession to minimise job loss while safety net and retraining programmes are put in place to reduce the income loss and skill obsolescence when workers lose their jobs.

Keywords: Output, Unemployment, Symmetric and Asymmetric ARDL, Nigeria.
JEL Codes:C22, E24, E32

1.0 INTRODUCTION

The task of investigating the relationship between economic performance and unemployment was first undertaken by Arthur Okun in 1962 using data from the United States. Employing two methods to measure real GNP (first difference and gap methods), he postulated an inverse relationship between unemployment and output. Since then his finding has been termed Okun's law. To be more specific, Okun states that if unemployment rises by 1 per cent, output loss would be about 3.3 per cent and vice versa. Since his postulation, there are batteries of studies seeking to test the validity of Okun's law in different countries. Such studies have produced mixed empirical results.

The mixed empirical findings might stem from different methodologies employed overtime to model unemployment-output nexus or trade-off. Apart from this, such mixed findings might be connected with the fact that empirical

[1]Department of Economics, University of Ibadan, Oyo State, Nigeria
*Corresponding author:heritagetiamiyu@gmail.com; +2348069829396

studies in this area are usually either country-specific or multi-country most of which belong to the same geo-economic zone characterised by different macroeconomic fundamentals and institutions. As regards methodologies, two cogent issues are often put forth for discussion in empirical studies: the appropriateness of the econometric techniques used to compute output gap and whether modelling unemployment-output trade-off linearly or non-linearly will provide better results. While the early studies have concentrated on modelling the relation linearly, recent studies have focused on studying the relation using the nonlinear approach. This is because it has been argued that time series data (particularly macroeconomic data) often exhibit non-linear characteristics or behaviour over the phases of business cycle (Neftci. 1984). Consequently, it is expedient to model Okun's law in a nonlinear manner. Doing so, as argued, provides plausible explanations for the high degree of variability in effectiveness of macroeconomic policies aimed at stabilising the economy. Besides, examining Okun's law in an asymmetric manner helps in minimising a forecasting error which usually occurs when the law is modelled linearly and therefore assists in solving the problems associated with aggregation of macroeconomic data. Moreover, testing asymmetric nature of Okun's law helps in providing explanations for discrimination among the theories of joint labour market and goods markets (Shin, Yu and Greenwood-Nimmo, 2014). In fact, asymmetric approach to modelling macroeconomic relation or nexus is anchored on the assumption that the response of dependent variable to positive and negative changes in the independent variable is not the same as in linear models.

As aforementioned, there exists vast literature testing the validity of Okun's law in Nigeria. Most of these studies, to the best of our knowledge, assume that unemployment and economic growth are linearly related, employing different econometric approaches which range from ordinary least squares to linear autoregressive distributed lag methods. Their studies show that Okun's law is not valid in Nigeria (See Babalola, Saka and Adenuga, 2013; Bankole and Fatai, 2013; Udude and Nnachi, 2017). In the face of recent studies on Okun's law, therefore, this study is revisiting Okun's law in Nigeria, using both linear and nonlinear ARDL approaches developed by Pesaran Shin and Smith (2001) and Shin et al. (2014) respectively. The justification for applying the two methods is to determine a better and of course robust way to modelling unemployment-output trade-off in Nigeria.

The present study contributes to the extant body of knowledge in three ways. First, the study extends existing data such that it covers the post-civil war period and the current democratic era (from 1999), that is the period from 1970 to

2014. Previous studies, particularly in Nigeria, employed data that begin from the 1980s.By extending the data, we were able to cover different economic episodes and show how the unemployment and economic growth relate over the course of these economic episodes (the response of employment to negative and positive output growth). Second, the study considers the two approaches that Okun used in his study, that is, first difference and output gap methods. In particular two data filtering methods were used to obtain the output gap. The first is the Hodrick-Prescott method and the second is the Band-Pass method. The two methods of data de-trending were employed to ensure a robust analysis as regards the response of unemployment-output coefficient to different methods of estimating output variables. Third, the study computes dynamic multipliers which show the adjustment of unemployment in response to output movement or cyclicality. This (computation of dynamic multiplier) has not been carried out in Nigeria except for Eurozone by Tang and Bethencourt (2017).

The study's findings are summarised as follows: the validity of Okun's law in Nigeria rests on the model (first difference or gap model) and estimation techniques employed. The study finds that Okun's law does not hold in Nigeria both in the short-run and in the long-run using a linear ARDL approach with first difference model. However, when the gap model is used, it is found that Okun's law holds both in the short-run and long-run. In the NARDL approach, results from first-difference model also show that unemployment only responds to the change in positive output lagged in one period in the short-run. In the gap model, both positive and negative changes in output have negative impacts on the unemployment when the H-P data filtering method is employed. These findings show that unemployment rate only responds to economic fluctuations.

The rest of the study is structured as follows: Section 2 presents a brief overview of the relationship between unemployment rate and economic growth rate in Nigeria. Section 3 briefly reviews related studies. The econometric methods employed and data sources and its descriptions are presented in Section 4. Section 5 presents and discusses the empirical findings. The final section summarises the findings and offers policy recommendations.

2.0 Stylised Facts of Unemployment Rate and Economic Growth in Nigeria

Until the second quarter of 2016 when the Nigerian economy relapsed into recession, the economy had experienced a remarkable growth, growing on average, at 4.07 per cent over the period under consideration. Breaking down the growth path of the economy, Table 1 reports two periods of highest

economic growth. The first period is between 1970 and 1974 when economic growth rate, on average, stood at 8.53 per cent. Prior to this period, crude oil was discovered in commercial quantity at Oloibiri in the present day Bayelsa State. Partially accompanied by agricultural production, exportation and sales of the crude oil became a major driver of the economy. However, since the sales of crude oil are subject to ups and downs in crude oil prices and the oil production politicking in the international arena, the same crude oil became inimical to sustainable economic growth. For instance, the economy experienced slow growth of about 2.17 per cent between 1975 and 1979. This slow growth finally resulted in economic recession or downturn in the 80s.[2] Coming out of the recession in 1985, Nigeria continued to experience slow but positive economic growth up till 1999. These periods of slow growth are not unconnected with periods of the military junta which scuttled the third republic democratic government. After these periods of protracted slow economic growth, the country returned to democracy in 1999. With return of democracy and the accompanied economic reforms, the economy experienced the second round of growth between 2000 and 2004 as the growth rate stood at 11.52 per cent. This remarkable economic growth during the period was driven by the services sector of the economy as the fortunes of agriculture sector and those of the crude oil as drivers of the economy appear to have dwindled drastically. Following this, the economy continued to grow, albeit at a decelerating rate as depicted in Table 1

As touching unemployment rate, available statistics as revealed in Table 1 shows that between 1970 and 1999 unemployment rate grew moderately except occasional soaring above the tolerable level or natural rate of unemployment. Specifically, between 1980-1984 and 1985-1989 unemployment rate suddenly jumped, on average, from 4.08 per cent to 5.54 per cent, having previously stood at 2.82 per cent during 1975-1979. The sudden rise might be connected with the macroeconomic crisis witnessed across the major strata of the economy. The worst jump in unemployment rate in Nigeria began in the period between 2000 and 2004 when unemployment rate snowballed from 4.04 per cent between 1995 and 1999 to 13.50 per cent. Since then, unemployment has become a sort of burning issue in the country as it continues to rise unabated. On what could have been responsible for unemployment, Fajana (2000) noted that the persistent soaring of unemployment cannot be dissociated from hysteric nature of unemployment in Nigeria. Protracted unemployment means that unemployed persons continue to remain

[2]The 1981-1984 is the longest recession periods in Nigeria compared with the 2016/17 which lasted for only one year.

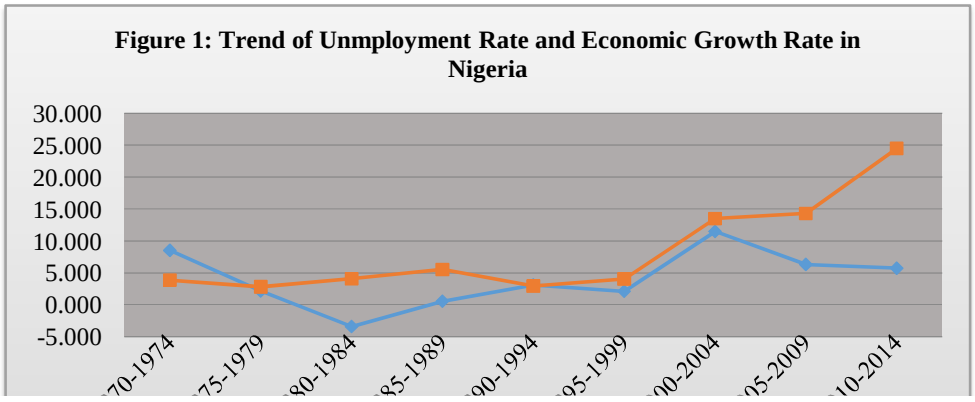
unemployed for a very long time and many graduates continuously join this army of existing unemployed. Apart from this, he stated that other factors include faulty manpower planning, increasing population, informal sector wage differential and other labour market conditions, urban-rural migration and above all economic downturn or crisis.

Linking these two macroeconomic variables together, Figure 1 shows the trend of relationship between unemployment rate and the growth rate of the economy during the period under consideration. From the figure, it can be observed that, particularly in the 70s and towards the 80s when unemployment rate was rising, economic growth depressed. However, from the 90s simultaneous rise in unemployment rate and economic growth began. It became worse since the 2000s as the appreciable increase in economic growth was accompanied with a soaring unemployment rate. It implies that the economic growth achieved during this period failed to create jobs, the phenomenon Ajakaiye, et al., (2016) described as jobless growth. This is a paradox as it contradicts Okun's law which literarily stipulated that when the economy is growing, unemployment is expected to decline by certain percentage.

Table1: Unemployment Rate and Economic Growth in Nigeria

Year	Real GDP Growth Rate (%)	Unemployment Rate (%)
1970-1974	8.539	3.880
1975-1979	2.167	2.820
1980-1984	-3.410	4.080
1985-1989	0.565	5.540
1990-1994	3.116	2.940
1995-1999	2.136	4.040
2000-2004	11.521	13.500
2005-2009	6.338	14.300
2010-2014	5.742	24.500
Total Average	4.079	8.400

Source: Computed from the data obtained from the World Development Indicators and Nigerian Bureau of Statistics



Source: Derived from the data obtained from the World Development Indicators and Nigerian Bureau of Statistics

3.0. Brief Review of Literature

There are batteries of studies carried out to test the validity of Okun's law since the law was promulgated by Arthur Okun in 1962. From these studies, two groups can be identified and these are country-specific and cross-country studies. Other issues in the literature revolve around linear versus nonlinear modelling of Okun's law. In this regards, several econometric techniques have been employed, ranging from the simple Granger-causality test to different cointegration estimation techniques,the Markov-switching method, the threshold estimation and NARDL in the case of nonlinear verification of Okun's law.

The first set of studies reviewed is the one consisting of cross-country studies. Kargi (2014) tests the validity of Okun's law in each of the 34 OECD countries using the cointegration estimation technique. He reports that Okun's law is valid in 23 out of 34 countries considered. He also reports that long-term cointegration occurred in 14 out of the 23 countries. Conclusively, the study summits that Okun's law is not valid in all the OECD countries. Huang and Yeh (2013), on the other hand, study the validity of Okun's law considering the panels of 53 countries (1980-2005) and 50 states of the United States of America (1976-2006). Using the data from the pooled mean grouped panel, they find the existence of short-run and long run relationship between unemployment and output, regardless of whether the data in the case of cross-country or states are used. Their study confirms Okun's law for both 53 countries and 50 states. Similar findings are reported by Abdul-Khaliq, Soufan and Abu-Shihab, (2014) who examine the validity of Okun's law for nine Arab countries. According to them, economic growth rises by 1 per cent when the unemployment rate declines by 0.16 per cent. However, some studies that focused on some Asian and African countries produced varying empirical findings. In his study of eight East Asian countries, Hanusch, (2012) finds that growth in East Asian countries promotes jobs with variation in the level of job creation across each country. Still focusing on Asian continent, albeit, with different countries (Pakistan, India, Bangladesh, Sri-lanka and China), Lal et al. (2010) finds no support for the Okun's law in these countries. Karim and Aomar (2016) also note that the validity of Okun's law varied across the countries in Africa and they provide plausible explanations for such variability of findings. According to themthe differences in demographic factors, the level of competition in the domestic market and the rule of law accounted for the variability of findings.

While the foregoing review is based on the cross-country studies, literature is also replete with country-specific studies. As in the case of cross-country studies, the empirical findings also vary across each country. While some countries find support for the Okun's law, others find no support. One striking observation is that even studies that focus on the same country produced mixed results. This could however be a result of differences in the main objective(s) of each of the study, methodology employed the data used and the period of analysis. Beginning from advanced economies such as the United Kingdom, Stober, (2015) who used the quarterly data that span the period from 1971 to 2013 to test the validity of Okun's law in the UK finds support for the law. However, there is a partial evidence in the support of Okun's law in US and Canada even though the coefficients of Okun's law are unstable over time.

In developing countries, Moroke, Leballo and Mello (2014) use the error correction modelling approach to investigate the existence of Okun's law in South Africa. Using the quarterly data (1999:1 to 2013:1), they find positive relationship between unemployment and economic growth which implies that Okun's law is invalid for South Africa. Similar findings are reported for Pakistan by Akram, et al., (2014). The empirical evidence is not different in the case of Nigeria (see Udude and Nnachi, 2017; Bankole and Bashiru, 2013 and Darma and Onimisi, 2017). However, study by El Andari and Bouaziz, (2015) confirmed the validity of Okun's law for the Tunisian economy.

One major feature of the above empirical studies is that the output-unemployment trade-off or relationship is modelled in a linear form. However, it has been argued that the relationship between the output and unemployment is not monotonic but can vary over time, sometimes, depending on the state of the economy. According to Holmes and Silverstone, (2006) the nonlinear Okun's law can arise for a number of plausible reasons such as change in the sectoral composition of the economy, the substitutability of factors of production, the nonlinear adjustment costs of contracts among firms, the labour force participation and the mismatch in employment. Along this line, several empirical studies have been conducted using nonlinear estimation techniques. For example, Jardin and Stephan (2012) conducted a research on the nonlinear Okun's law for 16 European countries, using the Semi-Parametric approach. They employ quarterly data covering the period of 1984 to 2009. They find that unemployment responds strongly to output in the early day of recession phases and during expansion. However, the strong response becomes weaker as the economy moves towards the middle of the recession. In Europe, Tang and Bethencourt (2017) employ the recently developed nonlinear estimation

technique known as Nonlinear Autoregressive distributed Lag method to examine the asymmetric unemployment-output trade-off in Eurozone. Their findings also confirmedthe asymmetric of Okun's law. Specifically, they find that unemployment responded to cyclical output in the short-run and that the adjustment to the long-run equilibrium is generally weak.

Silvapulle, Moosa and Silvapulle (2004), applying the data of US post War period, find support for the asymmetric Okun's law in the US. In specific terms, they find that the impact of short-run positive cyclical output on cyclical unemployment is quite different in a quantitative manner. Still on the US economy, Altissimo and Violante (2001) examine the joint dynamics of output and employment rate for the US economy using a non-linear VAR model. Introducing nonlinear through a feedback variable that endogenously augments the output lags of the VAR in recessionary phases while using different classes of threshold models, they discovered that feedback is only statistically significant on unemployment which is transmitted to the output through cross-correlation. They also show that the regime-dependent persistence feedback from recession exerts a positive effect on the long-run growth rate of the economy. In a similar version to Altissimo and Violante, but in a different approach, Chinn, Ferrara and Mignon (2013) examine the nonlinear Okun's law by considering post-recession US unemployment using the quarterly data over the period 1950:1-2007:Q4. They employ the smooth transition error-correction model,their findings which is based on the out-of-sample conditional forecasts, show that the US private sector employment, on average, revolve around 1 per cent below the level of a long-run output-employment trade-off. These findings are interpreted to mean that around 1.2 million of the trend unemployment loss cannot be attributed to the identified cyclical factors.

With respect to developing countries, Phiri (2014) employ momentum threshold autoregressive (MTAR) model to examine the nonlinear equilibrium relationship between unemployment and economic growth for the South African economies. Using the quarterly data covering the period of 2000-2013 and estimating the first-difference and gap model variations in Okun's law with the use of Hodrick-Prescott filter, Baxter-King filter and Butter-Worth digital filter for the latter model variation, the results indicated that Okun's law holds in South Africa, irrespective of the model specification and the methods of de-trending techniques used. He also finds that unemployment granger-causes economic growth.

From the foregoing review, it is evident that whether the Okun's law holds or not will depend on several factors. Two factors are prominent, the first of these

factors is the type of the economy under consideration. From the review so far and by summary, it is evident that the Okun's law is more likely to hold in advanced economies than developing economies. This discovery may be inherently hidden in the structure of the economy the differences in the efficacy of government policy and the institutional framework that allows the government policy to work effectively. The second factor is the researcher's approach to modelling unemployment-output relationship. For instance, output can be represented using different variables such as nominal GDP, real GDP, real GDP per capita and industrial production index. Employment of each of these variables in modelling unemployment-output trade-off may yield different empirical results.

4.0. Methodological Frameworks and Data Description

Three methodological frameworks are presented in this section. They include the unemployment-output nexus, the causality between unemployment and output and the Nonlinear Autoregressive Distributed Lag (NARDL) framework developed by Shin, Yu and Greenwood-Nimmo (2014).

4.1. Okun's Unemployment-Output Nexus Framework

To estimate the linear relationship between unemployment and output, Okun (1962, 1970) suggested two approaches. The first approach is through the first difference method while the second one is through the output gap method. In this study the two approaches are considered following Lee (2000) and as adopted by Jardin and Stephan (2012). The first difference method is often specified as follows:

$$U_t - U_{t-1} = \beta_0 + \beta_1(X_t - X_{t-1}) + \varepsilon_t \quad (1)$$

The gap model is also specified as:

$$U_t - U_t^* = \beta_0 + \beta_1(X_t - X_t^*) + \varepsilon_t \quad (2)$$

Where U_t denotes the unemployment rate at time *t*, $U_{t-1}$is the lag of unemployment rate in the first past period, X_t and X_{t-1} are real GDP (log form) and its past value in the first period respectively, U_t^* and X_t^* are the natural rate of unemployment rate and natural log of potential output respectively. $U_t - U_t^*$

and $X_t - X_t^*$ are employment gap and output gap respectively, β_1 is the Okun's coefficient which denotes the magnitude of change in unemployment as a result of change in the output and ε_t is the error term. One main problem is that in empirical studies, it is difficult to estimate U_t^* and X_t^*. Therefore, both U_t^* and X_t^* have to be computed through data filtering methods.

4.2. Causality between Unemployment rate and Output

We present here two forms of causality test. First is the usual Granger-causality developed by Granger in 1969 which in the VAR framework is used to test bivariate causality between two variables irrespective of the order of arrangement, however, the method which is based on levels estimation must be integrated of the order (1) before it can be fit for error correction modelling. Otherwise, no ECM estimation will be performed. Toda and Yamamoto (1995), however, noted that such test may suffer from a nuisance parameter contained in the integration of I(1). Therefore, such tests do suffer from pre-testing bias. Also, the Wald test statistic (F-test statistic) used for Granger non-causality based on the levels estimation may produce spurious results due to its lack of a standard asymptotic distribution if the process is integrated of I(1) and cointegrated (Toda and Yamamoto 1995: 226). Another problem with Granger-causality requires the pre-tests of cointegrating ranks which procedures are cumbersome to implement (Toda and Yamamoto 1995, pp. 227). Consequently, Toda and Yamamoto (1995) proposed another causality test to overcome the problem inherent in Granger-causality test. Specifically, Toda and Yamamoto proposed a modified causality test still based on VAR framework but applicable irrespective of order of variables integration or cointegrated or not cointegrated.

Granger-Causality Test Framework

$$U_t = \alpha_{1,0} + \sum_{i=1}^{p} \alpha_1 U_{t-1} + \sum_{j=1}^{p} \alpha_{1,p+j} X_{t-j} + \varepsilon_{it} \quad (3)$$

$$X_t = \alpha_{2,0} + \sum_{i=1}^{p} \alpha_2 X_{t-1} + \sum_{i=1}^{p} \alpha_{2,p+j} U_{t-j} + \varepsilon_{it} \quad (4)$$

Toda and Yamamoto Causality Framework

Following Toda and Yamamoto in 1995, the unemployment-output trade-off is presented in VAR framework in equations (5) and (6) below.

$$U_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} U_{t-i} + \sum_{j=k+1}^{d_{\max}} \alpha_{2j} U_{t-j} + \sum_{i=1}^{p} \beta_{1i} X_{t-i} + \sum_{j=k+1}^{d_{\max}} \beta_{2j} X_{t-j} + u_{it} \quad (5)$$

$$X_t = \lambda_0 + \sum_{i=1}^{k} \lambda_{1i} X_{t-1} + \sum_{j=k+1}^{d_{\max}} \lambda_{2i} X_{t-j} + \sum_{i=1}^{k} \theta_{1i} U_{t-1} + \sum_{j=k+1}^{d_{\max}} \theta_{2i} U_{t-j} + u_{2t} \quad (6)$$

4.3. Non-Linear Autoregressive Distributed Lag Framework

Following the framework of Shin, et al. (2014) and as adopted by Tang and Bethencourt (2017), the asymmetric relationship between unemployment and economic growth in the form of NARDL framework is presented in this section. NARDL is a nonlinear variant of ARDL of Pesaran et al. (2001) which accounts for the short-run and long-run decomposition into positive and negative partial sum of the regressors or independent variables. To begin with, the asymmetric long-run regression between unemployment and economic growth is specified as follows:

$$u_t = \alpha + \beta^+ x_t^+ + \beta^- x_t^- + \varepsilon_t \quad (7)$$

Where u_t and x_t are scalar of stationarity of order (1) variables and x_t can be decomposed as a *k x 1* vectors of independent variables: $x_t = x_o + x_t^+ + x_t^-$ where x_t^+ and x_t^- are partial sum of positive and negative changes in x_t:

$$x_t^+ = \sum_{j=1}^{t} \Delta x_j^+ = \sum_{j=1}^{t} \max(\Delta x_j, 0), x_t^- = \sum_{j=1}^{t} \Delta x_j^- = \sum_{j=1}^{t} \min(\Delta x_j, 0), \quad (8)$$

The associated long-run parameters are denoted as β^+ and β^-. The stationary linear combination of the partial sum components is given as:

$$y_t = \beta_0^+ u_t^+ + \beta_0^- u_t^- + \beta_1^+ x_t^+ + \beta_1^- x_t^- \quad (9)$$

According to Shin et al. (2014) if y_t is stationary, then u_t and x_t are cointegtrated asymmetrically. It is only possible to obtain standard symmetric cointegration of equation 9 when $\beta_0^+ = \beta_0^-$ and $\beta_1^+ = \beta_1^-$. Pesaran et al.'s ARDL (p.q) model given as:

$$u_t = \sum_{j=1}^{p} \phi_j u_{t-j} + \sum_{j=0}^{q} (\theta_j^+ x_{t-j}^+ + \theta_j^- x_{t-j}^-) + \varepsilon_t \quad (10)$$

Where ϕ_j is the autoregressive parameter, θ_j^+ and θ_j^- denote the asymmetric distributed-lagged parameters and ε_t is the error term which is individually and identically distributed process with zero mean and constant variance, σ_ε^2. The error correction form of the equation (10) which yields NARDL is written as:

$$\Delta u_t = \rho u_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{j=1}^{p-1} \varphi_j \Delta u_{t-j} + \sum_{j=0}^{q-1} (\eta_j^+ \Delta x_{i=j}^+ + \eta_j^- \Delta x_{i=j}^-) + \varepsilon_t$$

(11)Where ρ, θ^+ and θ^- are the long-run coefficients, η^+ and η^- are the short-run coefficients, $\beta^+ = -\frac{\theta^+}{p}$ and $\beta^- = -\frac{\theta^-}{p}$ are the asymmetric long-run parameters.

Equation (11) can be estimated in two ways. The first is through OLS. In this case, the bound testing similar to Pesaran et al. (2001) can be obtained through Wald test. Specifically, the null hypothesis of the long-run asymmetric test: $\rho = \theta^+ = \theta^- = 0$ is tested against the alternative hypothesis of $\rho \neq \theta^+ \neq \theta^- \neq 0$. If the null hypothesis is rejected based on the probability of F-test obtained from the Wald test, it implies that there exists a long-run asymmetry. The short-run and the long-run symmetries can be obtained by testing the null hypotheses that $\theta^+ = \theta^- = 0$ and $\eta^+ = \eta^- = 0 \; \forall$ I = 0,…,q). The second approach is to first estimate ARDL and then proceeds to the estimation of NARDL through EVIEWS add-in. The next is to compute the asymmetric dynamic multiplier effects of a unit change in each of the x_t^+ and x_t^- on u_t and it is given as:

$$m_h^+ = \sum_{j=0}^{h} \partial u_{t+j} \Big/ \partial x_t^+ , m_h^- = \sum_{j=0}^{h} \partial u_{t+j} \Big/ \partial x_t^- \text{, h = 0, 1, 2, …} \qquad (12)$$

Where h → ∞, $m_h^+ \to \beta^+$ and $m_h^- \to \beta^-$ and where β^+ and β^- stand for the asymmetric long-run coefficients. By definition, the dynamic multipliers denote the transition between the initial equilibrium, short-run disequilibrium after any form of shock and the new long run equilibrium.

4.4. Data Sources and Description

To test the symmetric and asymmetric Okun's law in Nigeria, we used annual data for the period of 1970 to 2014. The data include the real GDP and unemployment and they were obtained from different sources. While the real GDP was obtained the World Development Indicators (measured in local currency), unemployment rate (in percentage) was obtained from the Nigeria Bureau of Statistics. The descriptive summary of the variables are presented in Table 2

Descriptive statistics is presented in four ways: we first present the descriptive statistic of the log form of the variables. This is followed by the descriptive statistics of the first difference variables. Third we used H-P and B-P filtering methods of detrending data and their descriptive values are also presented in Table 2. From the Table, we find that mean values of unemployment rate and real GDP vary according to the different methods employed and they reduce to negative values when cyclicality of the variables is taking into consideration. Similarly, standard deviations of GDP and unemployment rate show that their values disperse moderately around their average or mean values. Apart from this, the variables, particularly real GDP, as shown by Jarque-Bera statistic test, become normally distributed as we move from log form to detrending forms. This depicts that macroeconomic variables in natural form are subject to instability except certain statistical transformation is carried out on them before they become stable and yield robust empirical results.

Table 2: Descriptive Statistics of the Variables

Variable	Log Form		First Difference		H-P Filter		B-P Filter	
	UN	**GDP**	**UN**	**GDP**	**UN**	**GDP**	**UN**	**GDP**
Min	0.47	30.24	-0.90	-0.14	-56.69	-14.05	-1.20	-7.33
Max	3.31	31.85	0.94	0.29	75.97	12.48	45.30	7.62
Mean	1.78	30.83	0.05	0.04	-1.92	-0.14	-0.85	-0.06
SD	0.84	0.45	0.36	0.07	31.42	5.98	17.23	2.99

J-B	3.00	8.32	1.43	19.82	0.54	1.19	1.05	1.43
p-value	0.22	0.02	0.49	0.00	0.76	0.55	0.59	0.49

Source: Computed by Authors using EVIEWS 9

5.0. Empirical Results

5.1. Pre-estimation Results

In this section, three pre-estimation exercises are carried out. First, the correlation test to examine whether our variables of interest have a strong or weak relationship is examined. This is followed by the unit root test which purpose is to determine whether the variables are stationary or not. And the third is causality tests with the purpose to determine which one of the variables causes the other. The findings of this empirical investigation are chronologically reported and explained as follows:

The correlation analysis of unemployment rate and real GDP is presented in Table 3. We consider the log form, first difference form and detrending forms (H-P and B-P filter methods) of these variables. As a glimpse of our results, under the log form, the two variables are highly positively correlated and very statistical significant at 1 per cent. As we move from the log form to the difference form and gap method (particularly H-P filtering method), the level of correlation reduces drastically and even turns to significant negative correlation.

Table 3: Correlation Matrix Analysis of the Variables

	Log form		**1st Diff. form**		**H-P form**		**B-P form**	
	UN	**RGDP**	**UN**	**RGDP**	**UN**	**RGDP**	**UN**	**RGDP**
UN	1.00		1.00		1.00		1.00	
GDP	0.80 (0.00)	1.00	-0.03 (0.80)	1.00	-0.45 (0.00)	1.00	0.05 (0.77)	1.00

Source: Computed by Authors using EVIEWS 9

Note: The values in parentheses are probability values

Before presenting the main results, it is expedient to examine the stationary properties of the variables under consideration. This is done to avoid the pitfall of running spurious regressions. Thus in Table 4 we present the results of unit root tests. Three methods of unit root tests are considered. First is the famous Augmented Dickey-Fuller unit root test, which is followed by Phillip-Perron and KPSS unit root tests respectively. While the ADF and P-P assume that variables are not stationary as a null hypothesis, KPSS, which is usually used to affirm the validity of ADF and P-P unit root tests, assumes that the variables are stationary at level. Table 4 shows that the results of ADF and P-P unit root tests on unemployment rate and real GDP are not stationary at level and they are only made stationary after first difference and this is also confirmed by the results of the KPSS test.

Table 4: ADF, P-P and KPSSS Unit Root Tests

Variable	ADF		P-P		KPSS	
	Level	FD	Level	FD	Level	FD
UN	-1.0048	-7.0778*	-0.9834	-7.0624*	0.6280**	0.0997
	(0.7435)	(0.0000)	(0.7511)	(0.0000)	(0.4630)	(0.3470)
RGDP	1.2517	-5.6470*	1.0199	-5.7376*	0.7006**	0.3257
	(0.9980)	(0.0000)	(0.9961)	(0.0000)	(0.4630)	(0.3470)

Source: Computed by Authors using EVIEWS 9
*Note: *, ** and *** denote 1%, 5% and 10% level of significance respectively*

They causality between real GDP and unemployment rate is examined. For comparison sake, both the Granger-causality and the Toda and Yammoto causality tests are conducted. As aforementioned, the Toda and Yamamoto causality test has an advantage over the usual Granger-causality test in that it is useful even when the variables of interest are not stationary. The two causality tests methods are predicated on the null hypothesis of no causality between real GDP and unemployment rate against the alternative hypothesis, stipulating the existence of causality. Thus, the results of the causality tests are presented in Table 5. It can be seen that there exists a bi-directional relation between real GDP and the unemployment rate, implying that unemployment rate Granger-causes real GDP and real GDP also rate Granger-causes unemployment. The results from Toda and Yamamoto causality test, however, are different from the

Granger-causality results. Specifically, Toda and Yamamoto causality results indicate that there is unidirectional causality running from real GDP to unemployment rate. In other words, real GDP is important in causing unemployment rate.

Table 5: Granger-Causality and Toda and Yamamoto Causality Tests

Variable	**Granger-Causality**	**Toda-Yamamoto Causality**
LRGDP VS LUNEMP (4 lags)	2.9638 (0.0344)	8.0106 (0.0912)
LUNEMP VS LRGDP (4 lags)	3.0431 (0.0311)	4.0025 (0.4057)

Source: Computed by Authors using EVIEWS 9
Note: The values in parentheses are probability values

5.2. Main Estimation Results

Two set of results are presented in this section. The results of linear and nonlinear bound testing approaches to cointegration are first presented in Table 6. This is followed by the results of both ARDL and NARDL. Either from ARDL or NARDL bounds testing. The results from the Table 6 shows that there is existence of a long-run relationship between unemployment and real GDP.

Table 6: Linear and Non-Linear ARDL Bounds Testing Approach to Cointegration

	Differenced Model				GAP Model (H-P Filter)				GAP Model (B-P Filter)			
	Linear		Nonlinear		Linear		Nonlinear		Linear		Nonlinear	
Test Statistic	Value	K	Value	K	Value	K	Value	K	Value	K	Value	k
F-statistic	21.261	1	12.499	2	14.541	1	6.337	2	46.465	1	29.439	2
	Critical Value Bounds											
Significance	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
10%	4.04	4.78	3.17	4.14	4.04	4.78	3.17	4.14	4.04	4.78	3.17	4.14
5%	4.94	5.73	3.79	4.85	4.94	5.73	3.79	4.85	4.94	5.73	3.79	4.85
2.5%	5.77	6.68	4.41	5.52	5.77	6.68	4.41	5.52	5.77	6.68	4.41	5.52
1%	6.84	7.84	5.15	6.36	6.84	7.84	5.15	6.36	6.84	7.84	5.15	6.36

Source: Computed by Authors using EVIEWS 9

5.2.1. Dynamic Linear ARDL Results of the Unemployment-Output Trade-off

Dynamic ARDL helps to capture the short-run and the long-run unemployment-output trade off simultaneously which the static model will fail to capture (Perman and Tavera, 2005). Table 7 presents the linear dynamic relationship between the unemployment rate and economic growth for all the models. In difference model, though unemployment rate-output coefficients are correctly signed both in the short-run and the long-run but the coefficients are not statistically significant. Specifically, the coefficients of unemployment-output trade-off are negative at about -0.358 and -0.124 for short-run and long-run respectively. This implies that for difference model, Okun's law fails to hold. This finding is in tandem with previous empirical findings in Nigeria which had adopted one method or the others (see Babalola, Saka and Adenuga, 2013; Bankole and Fatai, 2013; Udude and Nnachi, 2017). However, in the short-run, as shown in the Table, Okun's law holds with a lag in one period at 10 per cent level of significance. Considering real GDP gap method, for both H-P and B-P methods, Okun's law holds only in the long-run. To be specific, in H-P and B-P filter output gap models, the coefficients of unemployment-output trade-off stood at -3.836 and -1.378 respectively. While the coefficient of H-P filter output gap model is significant at 1 per cent of significance, the coefficient of B-P output gap is significant at 5 per cent level of significance. This implies that when real GDP increases by one per cent, unemployment rate will reduce by 3.836 and 1.378 per cent for H-P model and B-P model respectively. What can be deduced from these findings is that Okun's law can only hold in Nigeria when the cyclicality of unemployment rate and real GDP is taken into consideration. A similar observation has been put forward in the cases of South Africa and some countries in Europe (Phiri, 2014; Tang and Bethencourt, 2017)..

5.2.2. Dynamic Nonlinear ARDL Results of the Unemployment-Output Trade-off

With respect to Table 7, it can be seen that it is in the first difference model that only positive decomposition exhibits negative effect of output on the unemployment rate in the short-run and no negative decomposition effect. The positive decomposition effect only occurs with lag in one period at 5 per cent level of significance. Although the long-run positive and negative decomposition effects of output on unemployment rate are correctly signed, however, they are not statistically significant. In other words, positive and negative changes in output in the long-run have no significant effects on unemployment rate. In the case of output gap model, particularly with reference to H-P filtering method, it is found that only negative decomposition of output has negative effect on the unemployment rate at 1 per cent level of

significance in the short-run. However, in the long-run both positive and negative output decompositions have significant negative impacts on the unemployment rate. Specifically, the coefficients of positive and negative output decomposition-unemployment relations are -3.505 and -3.520 respectively. This implies that it is only in the long-run that the responsiveness of unemployment rate to cyclical movement in the output is asymmetric while it is not in the short-run. This finding is in line with the findings of Tang and Bethencourt, (2017) for some European countries such as Austria, Belgium, Estonia, Italy, Malta, Slovakia and Slovenia. Other observation from this finding is that unemployment responds more to negative cyclicality than the positive cyclicality as shown by the coefficient of negative output in relation to unemployment which is greater than that of positive output-unemployment nexus. This observation is similar to the observation of Jadin and Stephan (2012) for European countries. This means that employers will fire more workers during economic downturn than during economic expansion. Given the long-run coefficients of y^+ and y^-, -3.505 and -3.520 respectively, it can be concluded that an economic expansion (upturn) of 28.5% will reduce unemployment by 1% while the economic recession (downturn) of 28.4% will increase unemployment by 1% in Nigeria. This finding reflects the nature of the Nigerian economy in which the experience of remarkable growth may not yield commensurable level of employment. Thus, we can summit that it will require high level of economic growth for the economy to generate desirable level of employment

With regard to B-P filtering method, only negative decomposition of output has a significant negative effect on unemployment rate in the short-run. In specific terms, the estimated short-run for negative change in output was -1.689. However, no existence of long-run trade-off between real GDP and unemployment rate is found based on this method.

Table 7: Linear and Nonlinear ARDL Long-run and Short-run Dynamic of Unemployment-Output Trade-off Results

Variable	Differenced Model		H-P Filter Output Gap Model		B-P Filter Output Gap Model	
Cointegrating Form						
	Linear	**Nonlinear**	**Linear**	**Nonlinear**	**Linear**	**Nonlinear**
	Coefficient	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**	**Coefficient**
Δu_{t-1}				0.157	0.464*	0.420*
Δy_t	-0.358		-1.312		-1.203	
Δy_{t-1}	-1.392***					
Δy_+		-0.619		-0.292		-0.634
Δy_+(-1)		-2.771**				
Δy_-		-0.501		-3.010*		-0.675
Δy_-(-1)						-1.689**
Ect(-1)	-0.949*	-0.908*	-0.742*	-0.855*	-1.952*	-1.954*
Long-run Coefficients						
Constant	0.063	0.076	-1.726	0.276***	-1.394	-4.446
y_t	-0.124		-3.836*		-1.378**	
y_+		-0.528		-3.505*		-0.325
y_-		-0.552		-3.520*		-0.339
WT_{ST}		2.561***		0.670		3.494**
WT_{LR}		0.949		6.090*		3.243***
R^2	0.1326 (13.26%)	0.2159 (21.59%)	0.3943 (39.43%)	0.4371 (43.71%)	0.4456 (44.56%)	0.4925 (49.25%)
Adj R^2	0.0388 (3.88%)	0.1039 (10.39%)	0.3488 (34.88%)	0.3611 (36.11%)	0.3840 (38.40%)	0.4003 (40.03%)
F-test (p_value)	1.414 (0.2484)	1.928 (0.1146)	8.679 (0.0001)	5.747 (0.0005)	7.234 (0.0002)	5.338 (0.0006)
DW	1.773	2.003	1.745	1.605	2.057	1.758

Source: Computed by Authors using EVIEWS 9

*Note: *, ** and *** denote 1%, 5% and 10% level of significance respectively*

WT_{ST} denotes Wald test for short-run asymmetric

WT_{LR} denotes Wald test for long-run asymmetric

DW is the Durbin-Watson Test

5.3. Post-estimation Test

5.3.1. Diagnostic Check Tests

The results of diagnostic tests for linear and nonlinear models with different methods are shown in Table 8. Jacke-Bera test for normality can be rejected for difference linear ARDL model. However for others such as Bruesch-Godfrey serial autocorrelation test, the ARCH heterosecdasticity test and the Ramsey linearity test, the null hypothesis for each of the test could not be rejected. For difference nonlinear ARDL model, the results show that model passed all the tests for null hypothesis of each of the test cannot be rejected. In the linear and nonlinear ARDL gap model, either H-P or B-P filter method is used, all the tests were passed as shown in the table. This shows that our results are valid and robust and has a good fit to be used for forecasting and policy making.

Table 8: Diagnostic Tests

Test	D-M		H-P Filter Model		B-P Filter Model	
	Linear	Nonlinear	Linear	Nonlinear	Linear	Nonlinear
	Value(p-value)	Value(p-value)	Value(p-value)	Value(p-value)	Value(p-value)	Value(p-value)
Jarque-Bera	7.156(0.028)	4.262(0.119)	9.175(0.010)	5.401(0.067)	2.081(0.353)	2.627(0.269)
B-G SCLM test	0.963(0.392)	0.331(0.721)	2.064(0.141)	3.304(0.077)	0.183(0.834)	0.501(0.611)
HT ARCH	0.005(0.946)	0.005(0.945)	0.703(0.4065)	0.699(0.408)	0.0006(0.981)	0.006 (0.937)
Ramsey Reset Test	1.699(0.098)	1.674(0.103)	1.557(0.2196)	2.239(0.659)	0.073(0.789)	0.866(0.359)

Source: Computed by Authors using EVIEWS 9

Note: The values in parentheses are probability values

5.4. Dynamic Multipliers

Figures 2 presents the dynamic multiplier for the Nigerian economy based on different models consideration. Specifically, figure 2.1 denotes the response of unemployment rate to output shock generated based on first difference model. Figure 2.2 and 2.3 depict the responses of unemployment rate to output shock

based on output gap model generated from Hodrick-Prescott and Band-Pass data filtering techniques respectively. All the figures combine the dynamic short-run and long-run asymmetric shocks. The figures show that unemployment-output relationship is asymmetric with different response to both negative and positive output shocks. For instance, in figure 2.1, it can be observed that unemployment rate, a symbol of manifestation of occurrence in the labour market, responds sharply to output shocks in the short-run. However, the effect dissipates quickly as shown in the figure. This implies that the speed of adjustment towards long-run equilibrium following the output shocks is fast and takes a very short time. In fact, a cursory look at the figure shows that the disequilibrium caused by output shocks can be corrected within third to fourth quarters. Similar trend can also be observed in the Figure 2.2 generated based on H-P output gap model in which unemployment rate immediately responds to output shock before it eventually dissipates within a short time. This scenario may be connected with the nature of the Nigerian economic environment. In Nigeria, despite the protracted and soaring unemployment rate coupled with jobless growth over the years, majority of the unemployed people, particularly graduates, take menial jobs in order to survive. A situation described in the economic literature as underemployment. Little wonder, unemployment figures are dominated by underemployment figures. For instance, unemployment rate stood at 12.1% in Q1 2016 while underemployment stood at 19.9% in Q1 2016 (NBS, 2016). However, in figure 2.3 based on the B-P output gap method, the speed of adjustment back to the equilibrium appears to be indeterminate as the unemployment rate responds to different output shocks with in the periods under consideration. Thus, the dissipation of response of unemployment rate to positive and negative output shocks takes a very long time when compared with other two previous methods.

Figure 2: Dynamic Multipliers of Response of Unemployment Rate to Output in Nigeria

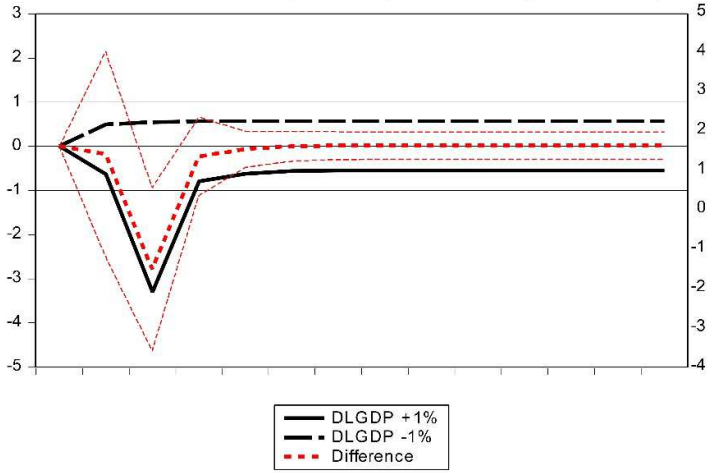


Figure 2.1: Dynamic Multiplier for first difference model

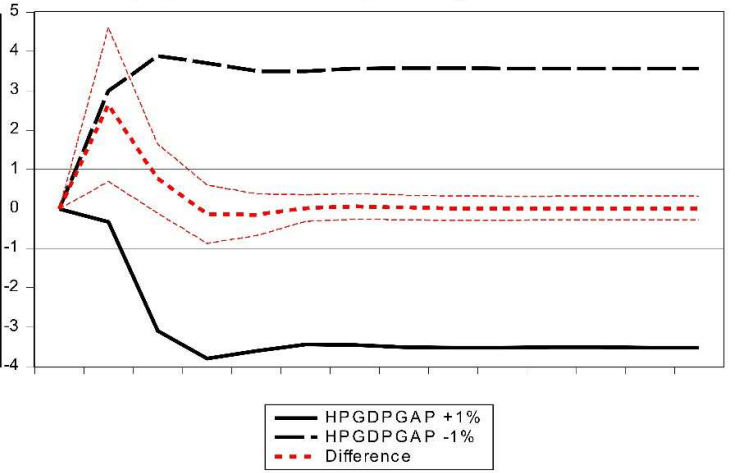


Figure 2.2: Dynamic Multiplier for Output Gap Model (HodrickPrescott)

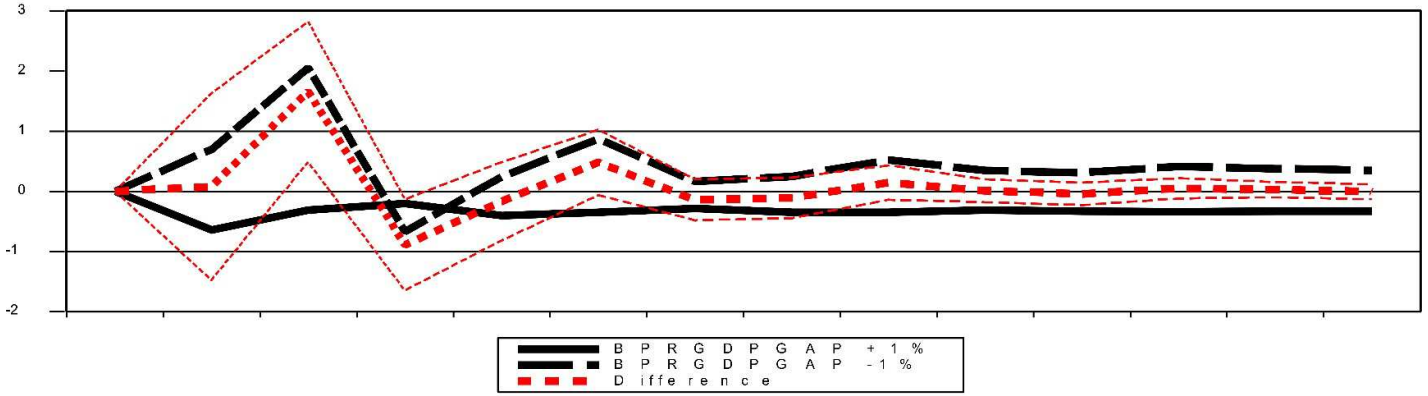


Figure 2.3: Dynamic Multiplier for Output Gap Model (Band-Pass)

6.0. Conclusion and Policy Recommendation

This study is carried out specifically to investigate the symmetric and asymmetric relationships between unemployment and economic growth based on different methods as suggested by Arthur Okun using Nigeria data spanning the period from 1970 to 2014. Preliminary econometric tests are carried out and among which are unit root tests and causality so as to know the statistical properties, characteristic or behaviour of our data and to avoid spurious regression that often leads to imprecise estimation. The results of the analysis suggest that the correlation coefficients pose no danger of multicollinearity. In addition, the variables contain unit root and they are only made stationary after first difference. With regards to causality tests, mixed results were obtained. While the findings based on Granger-causality test showed that there is a bidirectional relationship between unemployment and economic growth, Toda and Yamamoto causality test result suggests that there is only unidirectional relation between unemployment and economic growth with the direction of causality running from economic growth to unemployment.

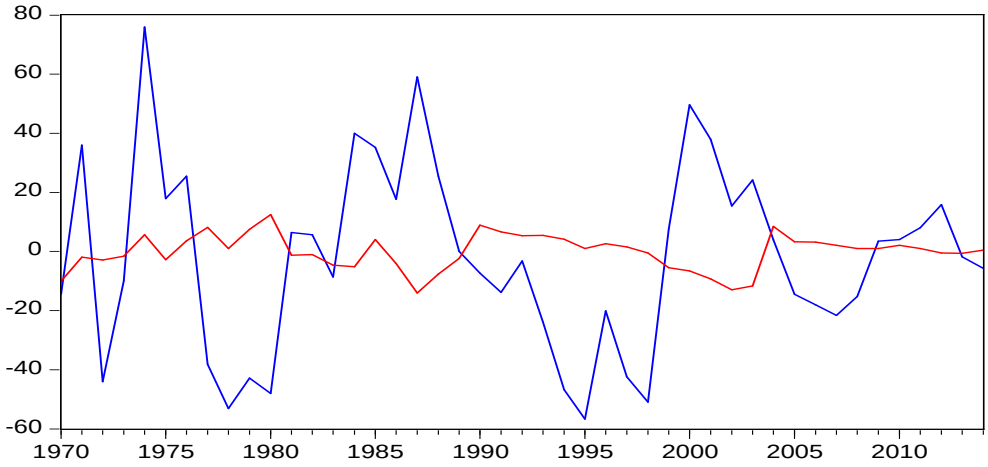
The main results from the study are more revealing and differ from linear to non-linear model specifications and the results also vary according to the different methods of calibrating unemployment and output (first difference or gap methods). Considering the first difference method under linear model specification, the results show that Okun's law does not hold in Nigeria as previously documented by other studies on Nigeria. However, when the output gap either based on H-P or B-P data filtering methods, Okun's law is confirmed in the long-run in Nigeria. The results are interpreted to mean that unemployment responds more to output cyclicality than to just a mere movement of output. The findings from the nonlinear model specification of the first difference model show that Okun's law is invalid in the long-run except in the short-run with positive change lagged in one period. In output gap methods, based on H-P data filtering method, unemployment responds to both long-run positive and negative changes in output with the response to negative change more than positive change with a slight margin. A simple interpretation of this is that employers are more likely to lay-off workers during negative economic growth (recession) than during the positive economic growth (expansion). In the case of B-P, absence of long-run unemployment-output trade-off is found except in the short-run with negative change lagged one period. This implies that negative economic growth is deleterious to job growth. In all, the study documents the existence of both symmetric and asymmetric cointegration between unemployment and economic growth as shown by linear and nonlinear ARDL bound testing approaches to cointegration.

In order to ensure the reliability of our estimated models, some post estimation tests are considered such as normality test, LM serial correlation test, ARCH LM heteroscedasticity test and RESET model specification test. To a large extent, our models passed all the aforementioned tests except in some occasions where some of the models suffer from normality problem. This, however, does not cast doubt on the reliability of the models as the most reliable model, nonlinear model based on H-P data filtering, passes all the tests.

From these findings, the following policy recommendations are proposed. Since it is found that unemployment is more responsive to negative change in output, it is imperative for the policymakers to design appropriate fiscal and monetary policies to manage both demand-side and supply-side of the economy to shorten the period of economic recession to avoid unemployment in large measure. Besides, government should ensure that safety net and retraining programmes are put in place to reduce the impact of income loss and skill obsolescence when workers lose their jobs.

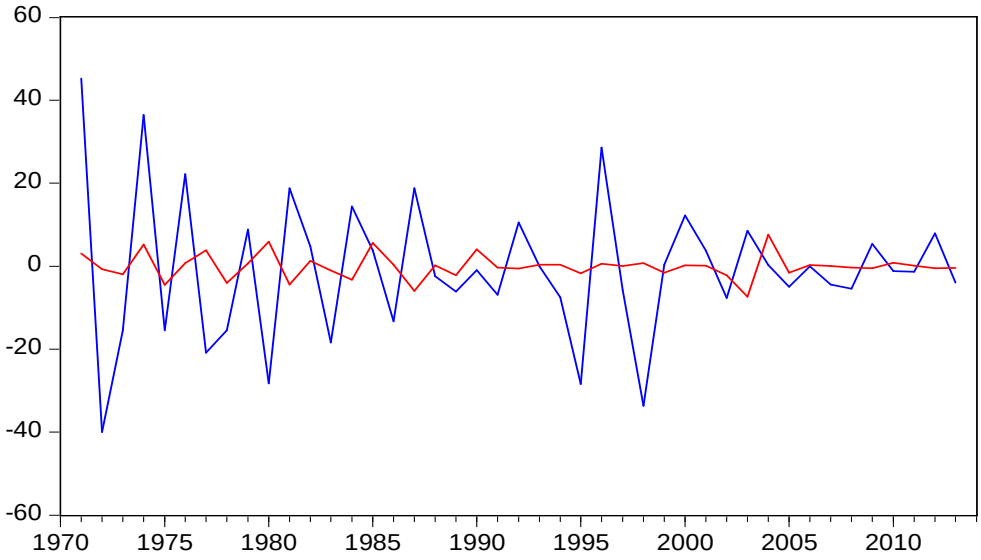
Appendices

Trend of Unemployment Gap and Output Gap Based on H-P Data Filtering Method



Key: Blue Line-Unemployment Gap; Redline-Output Gap

Trend of Unmeployment Gap and Output Gap Based on B-P Data Filetring Method



Key: Blueline- Unemployment Gap; Redline- Output Gap

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'LITTLE THINGS' THAT MATTER TO BANK CUSTOMER LOYALTY IN WEST AFRICA: EMPIRICAL EVIDENCE FROM NIGERIA

Success Osamede Abusomwan[1]

ABSTRACT

Customer sophistication and express feelings of dissatisfaction has characterized banking customers in West Africa. This may have caused increase in bank customers' attrition rate and undermined the deposit mobilizing potentials of banks in the region, increasing cost of banking, reducing banking penetration and contracting profitability of the industry. Despite empirical works in developed economies on the roles psychological and sociological factors play in customer loyalty and ultimately organizational profitability, it does not seem like required research attention has been given especially in the West Africa regional banking sector. These factors which include service quality and customer centricity have been referred to in this study as seemingly 'little things' that matter to customer loyalty in West Africa. The objective therefore was to find out if service quality and customer centricity matter to customer loyalty in West Africa. Employing multinomial regression method in an empirical study of 2120 customers across the geo-political zones in Nigeria, it was found that service quality and customer centricity were the main determinants of customer loyalty in Nigeria. Other important predictors of customer loyalty include macroeconomic stability, technology and convenience, cost of services and bank's brand/image. Demographic characteristics of respondents did not have significant impact on their loyalty. Bank management and policy makers in the banking sector of West Africa should therefore endeavor to make policies that will sustain service quality and implement customer centricity to engender increasing customer loyalty and resultant increase in profitability of individual banks and the growth of the banking industry of West Africa at large.

Keywords: Customer Loyalty, Profitability, Banking, Nigeria
JEL Classification: G210, L210, D120

[1]Department of Economics, University of Benin, Benin City, Edo State, Nigeria
*Corresponding author: osamede.abusomwan@uniben.edu;+2348183352938

1. Introduction

The banking industry is an integral part of the financial system. This is evident from the roles they play and their contributions to financial system stability (Osazee, 2007). Banks backup the sources of liquidity to all other financial and non-financial institutions and are the transmission belt for monetary policy (Corrigan, 1983), which had been a potent tool used in gearing the overall economy to achieving broad macroeconomic objectives such as GDP growth, price stability, potential output and external balance. Despite the role the banking industry plays, Africa's banking environment has been described as relatively shallow, less penetrated and less competitive compared to those in other developing and high income regions (Nyantakyi and Sy, 2015). In Nigeria, consumer sophistication has been found as one of the factors affecting the banking industry negatively (Soludo, 2010 and KPMG, 2016).

Consumer sophistication is reflected by the levels of bank customer satisfaction and loyalty. The growing technological advancements, globalization, preferences for partnerships and interaction, rise in e-commerce and the desperate desires for solutions have changed the behavior and expectations of the bank customers. These make them increasingly used to immediacy and impatient. This has tilted the sellers' power towards the power of the buyers of banking services (KPMG, 2013).

There have been express feelings of discomfort of bank customers across the globe. This is evident in the increasing number of complaints about inadequate advice, disproportionate high interest rates and inexperienced workforce (McKinsey and Co, 2012). In 2016, in West Africa, 20%, 7%, 11%, 8% and 12% of customers are ready to suffer bank attrition in Cameroun, Cote d'Ivoire, Ghana, Nigeria and Senegal respectively (KPMG, 2016). In Nigeria, the number of bank customers' complaint increased from 747 in the first half of 2015 to 1,010 in the second half. This represents 98% of the total complaints received against financial institutions in 2015 (CBN, 2015). This is further evidenced by the decline in Customer Satisfaction Index (CSI) for customer care of the Nigerian and Ghanaian banking industry from 89.20% and 68.8% in 2013 to 73.82% and 66.43% respectively in 2016 behind Zimbabwe (79.14%), Tanzania (76.53%), Botswana (75.77%), Uganda (74.87%) and Kenya (73.97%) (KPMG, 2016). The decline in these indices correlates with the declining financial performance of the banking industry in West Africa.

The declining performance of the West Africa banking sector, may be as a result of the declining customer satisfaction and loyalty (Ogbadu and Usman, 2012; Ibok and Akpan, 2013, Adiele and Miebaka and Ezirim, 2015). Issues of loyalty

are psychological and sociological in nature, which often are trivialized (somewhat seen as insignificant in determining banking growth and profitability) in corporate financial analysis. Factors that determine customer loyalty may have indirect impact on the industry's profitability and growth. It is therefore necessary to find an answer to the question 'what are the seemingly insignificant things that matter to bank customer loyalty in West Africa'. Few researches have been done in this regard in the banking industry in West Africa to the best of the researcher's knowledge. No known research of the banking industry has simultaneously examined the determinants of loyalty in a scope across geo-political, ethnic and religious divide in West Africa. Given the regional spread of Nigerian banks across West Africa (banks like UBA, ZENITH, ECOBANK, FBN and DIAMOND (KPMG, 2016)) and the relative population of Nigeria in West Africa, this study is aimed at examining the factors responsible for customer loyalty across geopolitical, ethnic, and religious lines in West Africa using customers of these banks in Nigeria as a case study.

2. Banking Sector and Customer Loyalty in West Africa region

Nigeria, Ghana and the West Africa Economic and Monetary Union (WAEMU) dominate the West Africa Banking sector (Aithward, Bodo and Zindogo, 2013). Senegal banking sector is prominent in the WAEMU. Table 1 below shows the main features of the banking industry of the main country-players in West Africa. They include Cameroun, Cote-d'voire, Ghana, Nigeria and Senegal (KPMG, 2016).

Nigeria banks have significant regional presence in West Africa. Regional and international banks dominate the banking sectors of Coted'ivoire, Ghana and Senegal of which Nigeria banks also play a major role. From table 1, increase in customer sophistication and its consequent increase in banking competition is a prominent development in the banking sector across countries in West Africa. This is reflected in the seeming association between customer loyalty and banking sector development in the region. Nigeria with the highest customer loyalty index of 77% has the largest banking sector in the region in spite of her macroeconomic challenges. Coted'voire with the least loyalty index (47%) has the largest number of foreign dominance of the banking sector and the least banking penetration (less than 1 of 10 adults has bank accounts). It also seems from table 1 that service quality is the main determinant of customer loyalty in West Africa banking sector. All the countries selected reveal that customer attrition in banks could be largely attributable to service quality. Whereas 36.3%, 34.7% and 24% of respondents attributed the primary reason for maintaining a bank account to excellent customer service, 12.2%, 19.4% and 22% of

respondents chose financial stability as their main reason in Ghana, Nigeria and Senegal respectively.

From Figure 1, excellent customer service is a major reason for opening bank account in three of the countries selected (Ghana, Nigeria and Senegal). Bank customers in Cameroun and Cote d'Ivoire prefer financial stability to excellent customer service in the determination of account opening.

Table 2 shows the Customer Satisfaction Index (CSI) ratings of bank customers in West Africa with respect to customer care, product and services and executional excellence. It also shows the relative importance of these measures to customers. Again, Nigeria had the highest ratings for customer care, executional excellence and nature of products and services in West Africa region with CSIs of 73.82%, 74.90% and 66.95% respectively. Cote d'Ivoire had the least ratings of 65.53% and 64.89% for customer care and executional excellence but the second least rating (61.74%) for nature of products and services respectively. With 91.4% and 88.9% respectively, Cote d'Ivoire recorded the highest importance of customer care and nature of products and services and second highest for executional excellence (91.6%). It therefore seems that their low banking sector performance relative to other countries in West Africa could be as a result of low customer care, executional excellence and nature of banking products and services.

Compared to other regions in Africa, West Africa still lags behind in terms of banking competition and innovations, financial depth and access to financial institutions. Table 3 shows regional representation of banking competition, banking innovation, financial depth and access to financial institutions in Africa.

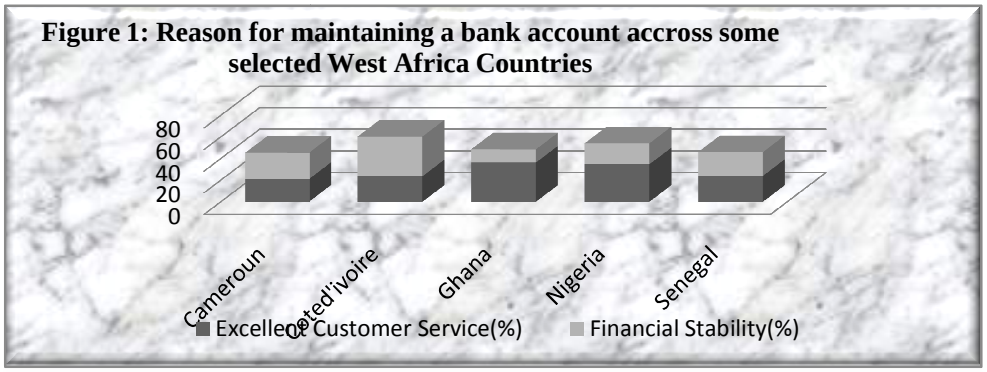
Only 0.9% of adults in West Africa use electronic payments. This is abysmal compared to Sub-Saharan Africa (SSA), Africa and Southern Africa with 3.7%, 3.4% and 8% respectively. Banking competition isrelatively low in West Africa. With Learner's index of 0.16, it is below all the other regions and even less than half of Africa average. Given these low indices which may be attributed to lower customer loyalty an empirical study of the factors responsible for customer loyalty in West Africa banking sector is inevitable. The scope of this study and its attendant financial implications limits the investigation to Nigeria bank customers. The choice of Nigeria banks is justified by their dominance and regional presence in West Africa.

Table1: Recent developments and customer loyalty in the banking sector of some selected West Africa countries

Country	Recent Banking Sector developments	Customer Loyalty
Cameroun	Establishment of Bank of SMEs and Agricultural banks. Recapitalization of troubled banks in 2013. 13 dominant commercial banks.	One in 5 customers would consider changing bank. Customer loyalty mostly depend on cost of services, service quality and internet and mobile banking offerings. 58% of bank customers would recommended their banks.
Coted'voire	Dominated by foreign banks. About 70% of banks are regional or international banks. Less than 1 out of every 10 adults has bank accounts.	Less than one of ten customers would consider changing banks. Customer loyalty depends on cost of services and service quality. 47% of bank customers would recommended their banks.
Ghana	Increase in customer sophistication. Increasing regulatory interventions. Increase in foreign participation. Increasing competition. Consolidation of some banks.	11% of customers intend to change their banks. Service quality is the main reason for leaving/remaining in banks. 55% of customers would recommend their banks.
Nigeria	Disturbing macro-economic environment. Decrease in FOREX, banking transactions and profitability. Liquidity challenges. Increased sophistication of bank customers.	Relatively high level of customer loyalty (77%). Service quality is paramount to customer loyalty. 8% of customers intend to change their banks.
Senegal	4 banks contribute 75% of total banking market share. Low penetration of banks. Low banking electronic	12% of customers will change banks in the near future. Customer loyalty/attrition largely depends on service quality. 53% of customers will recommend their

	infrastructures. Growing banking sector.	banks.

Source: Author from KPMG, 2016



Source: Author, from KPMG, 2016.

Country	Customer Care		Executional Excellence		Products and Services	
	CSI (%)	Importance (%)	CSI (%)	Importance (%)	CSI (%)	Importance (%)
Cameroun	66.84	84.1	66.75	84.8	62.07	81.3
Coted'ivoire	65.53	91.4	64.89	91.6	61.74	88.9
Ghana	66.43	87	67.23	96.6	62.02	81.3
Nigeria	73.82	90.3	74.9	91	66.95	81.2
Senegal	66.85	80.1	66.59	78.8	60.74	72.2
West Africa	67.89	86.58	68.07	88.56	62.7	80.98

Note: CSI is Customer Satisfaction Index

Source: Author, from KPMG, 2016.

Table 3: Financial depth, access to financial institutions, banking innovations and competition in Africa regions

	SSA	North Africa	East Africa	West Africa	Southern Africa	Africa
Financial Depth (Ratio of Domestic credit to private sector)	24.4	48.1	21	20.3	43.1	36.3
Access to Financial Institutions (Share of population with bank account (%))	20.9	28.5	21.1	13.7	36.7	24.7
Banking Innovations (% of adults using electronic payments)	3.7	3.1	2.4	0.9	8	3.4
Banking Competition	0.26	0.35	0.34	0.16	0.33	0.3

(Learner's index)

Source: Author, from Nyantakyi & Sy (2015)

3. Review of related Literature

A customer has been described variously as; the life-blood of any business (Ogbadu and Usman, 2012); the common denominator between a bank's product or service and corporate profitability (Emerson, 2007); a conduit between the employee and any profit potential that a bank may realize (Marsh, Sparrow and Hird, 2010). Customers do not only generate revenue for an organization, what they say and how they feel influence future revenues. How satisfied customers are could affect their purchase decisions which invariably affect profitability of organizations (Heskett, Jones, Loveman, Sasser and Schlesinger 1994).

Customer satisfaction is defined as the collection of outcomes of perception, evaluation and psychological reactions to the consumption experience with a product or service (Ibok and Akpan, 2013). A satisfied customer may not be loyal. Merely feeling of product and service satisfaction may not lead to an ecstasy that will make the customer not choose a competitor despite the experience. A loyal customer therefore, is ecstatic, rarely uses other organizations that sell the same product or service and will use positive words of mouth to market the products and services to prospective customers who could be very close family members, acquaintances and friends (Emerson, 2007). Farris, Bendle, Pfeifer and Reibstein (2010) stated that loyalty intensions are a function of perceived value early in the life cycle of the customer.

Empirical Literature

Macroeconomic stability was found to significantly affect customer loyalty (Roberts, 2011). Customer loyalty decreased after an economic recession, in a study of the impact of economic recession on customer loyalty to banks using Chi-square test, Pearson correlation and ANOVA from questionnaires administered to 300 respondents in the UK. She did not find any relationship between demographic factors and loyalty. Loyalty was also found to be affected by economic and company related issues.

Nguyem, Leclere and LeBlanc (2013) administered 1,296 questionnaires to about 300 members each from 21 credit unions in the province of New Brunswick in Canada. Using Maximum-likelihood estimation procedure, they found that customer trust plays a mediating role between corporate image and customers' loyalty.

Ellisavet, Lazaros and Dimitros (2013) in a survey of 304 banks of the Greek banking sector using exploratory factor analysis, confirmatory factor analysis, SEM and Pearson's correlation co-efficient found a positive relationship between tangibles and satisfaction. Convenience was not found to affect customer loyalty.

Brandirali and Ghigliano (2014)in a studyof more than 32,500 retail bank customers in forty three countries worldwide found that financial institution's stability was the primary driver of trusts for attracting and retaining customers. 60% of respondents reported that financial stability is their main consideration in choosing financial institutions. Customer experience represented 56% while 26% of the respondents stated that fees and rates are their main considerations. Convenience of banking with respect to accessibility and branch locations was also identified by Brandirali and Ghigliano (2014) as one of the main drivers of banking patronage in European banks.

Stan (2015) in data obtained by administering questionnaires to 3,049 individual customer household of major American retailers and using the Partial least squares method of analysis found that women are more loyal than men hence sex is an important predictor of customer loyalty.

In a survey of 1,079 respondents of 18 years and older in Netherland, Pauline, Esterik-Plasmeijer and Fred (2016) found that loyalty is determined by financial stability, competence of employees, transparency and value congruence.
Johnson, Herrmann and Huber, (2006) found that product, place, promotion, process, people and not prices affect satisfaction.

Ouma, Ndirangu, Manyaka, Gongera, Evans, Maringa, Nguthuri, Nyokabi, Njenga, Kagumba, Julius and Maswani (2013) in a descriptive research design, adopting systematic random sampling technique in survey and analyzing using Chi-Square and Spearman bivariate correlation found that customer loyalty is not affected significantly by bank stability, reliability, corporate social responsibility and demographic variables. They however found a link between service quality and customer loyalty in Thika branch of Equity bank in Kenya.

Sampling 200 customers from different banks in Pakistan and employing Chi square method of analysis, Afzal and Pakistan (2013), found a significant relationship between age, gender, academic qualification, marital status, customer categories (businessman, salaried worker and students) and customer loyalty. However, Roberts (2011) and Ouma et al (2013) in a descriptive analysis

carried out in Kenya did not find any form of relationship between demographic characteristics and customer loyalty.

Sabir, Ghafoor and Akhtar (2014) in their study of factors affecting customer satisfaction in the banking sector, found that service quality leads to satisfaction and 54% change in loyalty. The study involved 72 respondents in Sahiwal and Arifwala cities in Pakistan. Employing correlation and regression analysis, they found that staff quality, friendliness and competence positively enhance loyalty. Employing Structural Equations Modeling, Chung, Yu, Choi and Shin (2015) in a web-based survey conducted through e-mail and social networks in Liaoning, Beijing, Shanghai & Shandong province of East China from 276 responses found a positive relationship between Corporate Social Responsibility (CSR), customer satisfaction and loyalty. They also found that corporate image had a moderating effect in the relationship. They found customer satisfaction as mediating factor for service quality and that CSR is the most influential factor of customer satisfaction in India banking industry. Njiru (2014) in a descriptive, regression and correlation analysis of 100 responses of customers from a survey of three of the forty four banks in Kenya, found that customers derived prestige from socially responsible banks and shared in the increased share value created for the investor and the economic, social and environmental benefits enjoyed by the communities as a result of the CSR. The positive relationship between CSR and customer loyalty was also confirmed empirically from the study of customer behavior in a Swedish chocolate market using a web-based survey stemming from a cross sectional design. Ali, Rehman, Yilmaz, Nazir and Ali (2010) using SEM and AMOS7 in cellular industry in Pakistan and 250 respondents confirmed that CSR positively affects customers' loyalty.

Osman et al (2015) in a study in Malaysia banking industry survey of 512 customers, employing SEM and partial Least Squares found a positive relationship between physical environment and loyalty. Edvardsson et al (2000)and Osman et al (2015) also found a positive relationship between brand, corporate identity and loyalty through trust.

Kombo (2015) administered questionnaires to 403 respondents in the banking industry in Kenya to test the factors responsible for customers' satisfaction and dissatisfaction in Kenya banking industry. Applying descriptive statistics, he observed that bank charges are the most important factor of customers' dissatisfaction. He also found that bank concentration is important for satisfaction and loyalty. Edvardsson et al (2000) found that online banking, ATM and mobile banking positively influence customer satisfaction and specifically explains 68% of satisfaction.

Muazu, Nik-Kamariah, Abubakar, Abdalla, Abdulkadir and Faruq (2013) using SEM (AMOS 16) and Confirmatory Factor Analysis (CFA) in a survey of 209 Nigerian students studying at the University of Utara, Malaysia, found that responsiveness is a significant predictor of customer satisfaction and assurance a significant predictor of loyalty of Islamic bank customers in Nigeria. They also observed that queuing time negatively influences satisfaction.

Fees and rates of services are drivers of customer's choice and retention. Ibok and Akpan (2013) in a sample of 45 MBA students of the University of Uyo in Akwa Ibom state of Nigeria, using multiple regression analysis found that competitive pricing has a positive impact on loyalty. They also found that bank security and confidentiality positively influence customer satisfaction and retention.

Adiele, Grend and Chiedu (2015) studied 14 banks in the South South geopolitical zone in Nigeria. In a survey of 42 managers and customers using spearman rank correlation coefficient and Pearson's partial correlation found that design of workplace impact positively on sales volume, profit margin and customer retention.

4. Methodology

The Research Design

Multivariate and covariance survey designs are employed in this study. The population of this study is the customers of Deposit Money Banks (DMBs) in Nigeria. A sample of customers of 10 banks is selected due to their relative position with respect to branch network, total assets, shareholders' funds and West Africa regional presence. The banks are, Access Bank, Diamond Bank, Ecobank Nigeria, First City Monument Bank, First Bank of Nigeria Plc, Fidelity Bank, Guarantee Trust Bank, Union Bank, United Bank for Africa, and Zenith Bank. These banks have a total of about 3738 branches, representing 69.90% of the total bank branches' population.

Questionnaires which have been adjudged the most suitable instrument of carrying out primary research survey (Babbie and Mouton, 2003), is the main instrument used in eliciting information from respondents in this study. It shows the psychological disposition of the respondents. Off-line administration of the questionnaires will be adopted. Though this method makes the exercise more rigorous and costly, it has the attendant benefit of being extensive, reducing biases associated with on-line responses thereby improving efficiency of the process. The Likert scale is adopted in the questionnaire design. A cover note

stating the usefulness of the responses and guaranteeing confidentiality is attached to the questionnaires (Gupta, 2013).

The Questionnaires were administered to a sample of two thousand, one hundred and twenty these banks across the six geopolitical zones in Nigeria. To determine the reliability and extensiveness of the findings as contribution to knowledge Cronbach's Alpha test was conducted (Yee, Yeung & Cheng, 2008; Christina and Gursoy, 2009 and Babbie and Mouton, 2012).

For the purpose of field survey, the researcher employed the services of three research assistants each from the six geo-political zones. These were eighteen of the brightest students of Monetary Economics class of the department of Economics and Statistics, University of Benin. The Researcher who is their lecturer selected them and asked them to administer the questionnaires in chosen banks around their respective localities during the second semester holiday (August-September 2017). Three days training by the researcher on how to administer the questionnaires prior to their departures were given to them.

The field survey covered a period of three months (August – September, 2017). After retrieval, the questionnaires were coded and analyzed by the researcher using the STATA statistical software.

Data and Variable Measurement

Index of Customer Loyalty

The index of Customer Loyalty was computed following the theoretical definitions of customer loyalty. Two questions in the administered questionnaire that measure the level of customer loyalty are; (1) My experience measures up with my expectation from my bank, (2) I will continually repeat transactions and recommend my bank to other people. The expected response is binary (0 for disagree and 1 for agree). If a customer's response is disagree for the first question, it will obviously disagree for the second response and get a score of zero in aggregate for the two responses. The customer is classified as dissatisfied. If a customer agrees to the first question and disagrees to the second an aggregate score of 1 is gotten and the customer is classified as just satisfied. A customer who agrees to both questions scores 2 in aggregate and is classified as loyal. This is in line with loyalty theory (Heskett et al, 1994). When a customer's experience does not measure up with expectation from the bank, the customer is dissatisfied otherwise the customer is satisfied. When a satisfied customer continuously repeat transactions and will recommend his/her bank to other people, the customer is loyal. Therefore from the survey a total score of 0, 1 and 2 from both questions represent dissatisfied, just-satisfied and loyal customer.

Table 4 shows the explanatory variables description and measurements.

Table 4: Variables description and measurement

Variable Notation	Variable	Description	Measurement*
PERF	Financial Performance	The customer's bank ability to continue to grow in revenue and maintain stability	The continued growth and stability of my bank is guaranteed
BRAND	Brand/Image of customer's bank	Reputation, trust and integrity of the customer's bank in public's view	My bank is reputable publicly, trustworthy and honest in dealing with customers
MACRO	Macroeconomic Stability	Stability of general prices of goods and services	The general prices of goods and services and the growth of output in the economy is currently very stable
TECH	Technology &Convenience	The adequacy and efficiency of the bank's products, ATMs and other electronic banking channels coupled with the ease of banking.	My bank processes are convenient
			There is speed and accuracy of transactions in my bank
			The electronic platforms are user friendly and fast
CUCE	Customer Centricity	The extent to which product and services are designed strictly to meet my needs	I am aware of the customer centric vision of my bank
			My bank understands my business
			My bank constantly communicates with me meet my needs
			The target of service of my bank is customer satisfaction
SERQ	Service Quality	The bank's reliability, quality of services,	This bank is always there for me
			The staff are always eager to deliver on their promise

		assurance, staff friendliness and empathy	The bank offers quality products and services My needs and feelings are understood &met The Staff accept responsibility for their errors
PRIC	Cost of Services	Pricing of the bank's products and services	My bank's charges are fair prices compared to other banks My bank charges on transactions and loans are fair
AGE	Age	Age of respondents	18-25yrs, 26-35yrs, 36-45yrs, 46-55yrs, 56yrs & above
SEX	Sex	Sex of respondents	Male Female

Note: * Each question except for Sex is on a likert scale of 1(strongly disagree) to 5(strongly agree). Th average score is a measure of the variables

Source: Author

The Model

The Conditional Multinomial (Mixed) Logit Model

The Multinomial Logit (MNL) technique is employed in the analysis of the determinants of customer loyalty. MNL is a generalization of the binary logit for *K* category (Cameron and Trivedi, 2005). When regressors do not vary across alternative, the best model is the ML model and when regressors vary across alternatives the model suitable for analysis is the Conditional Logit (*CL*) model. However, a situation could arise as in this study where some regressors are invariant across alternatives while others are not. A suitable and richer model to address this is the so called Mixed Logit Model.

Given *m* alternatives, dependent variable *y* can be defined to take value *j*. If the j^{th} alternative is chosen, then, $j = 1,\ldots,m$. For regression, let *i* be the i^{th} individual and the regressors x_i specifying a model for the probability that individual *i* chooses the j^{th} alternative,

$$p_{ij} = p_r(y_i = j) = F_j(x_i, \beta), \qquad 1$$

Where, p_{ij} is the probability that individual *i* choses the j^{th} alternative. $x_{i's}$are the regressors and $\beta_{'s}$ are parameters.

The MNL model specifies,

$$p_{ij} = \frac{\ell^{x'_i \beta_j}}{\sum_{l=1}^{m} \ell^{x'_i \beta_l}}, \; j = 1,...,m. \qquad 2$$

Since, $\sum_{j=1}^{m} p_{ij} = 1,$ the restriction for model identification is given as $\beta_i = 0$.

The *CL* model specifies,

$$p_{ij} = \frac{\ell^{x'_{ij} \beta}}{\sum_{l=1}^{m} \ell^{x'_{il} \beta}}, \; j = 1,...,m. \qquad 3$$

The probability of individual *i* for the jth alternative is between 0 and 1 and also sum over *j* to one since $exp(x'_{il}\beta) > 0$ (Cameron & Trivedi, 2005).

A Mixed Logit model is derived by combining the two models above,

$$p_{ij} = \frac{\ell^{x'_{ij} \beta + w_i y_j}}{\sum_{l=1}^{m} \ell^{x'_{il} \beta + w'_i y_l}}, \; j = 1,...,m. \qquad 4$$

Where x_{ij} vary across alternatives and w_i do not vary across alternatives. β andy are parameters of the regressors that vary and do not vary over alternatives respectively. The mixed and the MNL models can be re-expressed as a CL model (Cameron and Trivedi, 2005).

From the model above, we can compute the marginal effects on the probabilities chosen of a change in the regressor for any respondent.

In adapting the MNL model for this study, let *i* be the i^{th} customer of bank *k*, who has *j* alternative perception about his/her level of satisfaction. The dependent variable *y* is defined to take value j_n where, $n = 1, \ldots, N$. In this study, $N = 3$. This is because there are three possible alternative perceptions about the level of customer satisfaction. They are

j_1 for dissatisfied customers,

j_2 for just satisfied customers and

$j_3$for loyal customers

The probability of customer *i* choosing alternative j_n depends on the regressors x_i which are the factors that influence the loyalty of customer *i*. They are, service quality (X_1), financial performance of customer's bank (X_2), cost of services (X_3), Technology and Convenience (X_4), Bank's brand/image (X_5), Macroeconomic stability (X_6), Customer centricity (X_7), Sex of customer (X_8), Age of customer (X_9) This is expressed as;

$$p_{ij} = p_r(y_i = j) = F_j(x_i, \beta), \qquad 6$$

Where, p_{ij} is the probability that customer *i* choose the $j_n$alternative.
Given x_i, $i = 1,\ldots,I$. where*I* is the total number of regressors in the model.
The conditional logit model of customer i for the j alternative is given as;

$$p_{ij} = \frac{\ell^{x'_{ij}\beta + w_i y_j}}{\sum_{l=1}^{m} \ell^{x'_{il}\beta + w'_i y_l}}, j = 1,\ldots,N. \qquad 7$$

It is expected that,

$$\frac{\delta p_{iL}}{\delta X_i} > 0, \text{ for } X_1, X_2, X_4, X_5, X_6, X_7, \frac{\delta p_{iL}}{\delta X_i} < 0, \text{ for } X_3, \text{ and } \frac{\delta p_{iL}}{\delta x_i} >, \text{ or } < 0 \text{ for } X_8, X_9$$

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5. Presentation and Analysis of Results

Of the 2120 questionnaires administered to bank customers 1709 were returned. This amounts to 80.61 % response rate.

The result of the multinomial regression model of customer loyalty developed for this study is presented on table 5. This is to test the research hypothesis, 'customer loyalty in the Nigerian banking industry is not significantly affected by customer centricity, macroeconomic stability, service quality, corporate financial performance, cost of services, technology and convenience and sex and age of customers'. Customer dissatisfaction is taken as the base outcome of the model. With a Crombach Alfa of 0.79, the reliability of the instrument used in this study is without question since it exceeds the threshold of 0.7 (Christiana & Gursoy, 2009).

Table 5: Determinants of Customer Loyalty

Variables	*Coef.*	*Odds Ratio*	*Prob.*	*Preliminary Analysis*	*Values*
Constant (C)	-12.733	0.000	0.000***	Number of Obs	1709.00
Service Quality (X1)	1.996	7.360	0.000***		
Bank's Financial Performance (X2)	0.314	1.369	0.016**	Wald Chi2	304.970
Cost of Services (X3)	-0.433	0.649	0.001***	Prob.	0.000
Technology and Convenience (X4)	0.253	1.288	0.217		
Bank's brand/image (X5)	0.455	1.576	0.001***	Pseudo R2	0.257
Macroeconomic stability (X6)	0.365	1.441	0.001***		
Customer centricity (X7)	0.642	1.900	0.000***	Log Pseudo-Likelihood	-1087.152
Customer sex (X8)	0.132	1.141	0.435		
Customer age (X9)	-0.007	0.993	0.613	Crombach Alfa Coeff	0.79

Note: Customer dissatisfaction is the base outcome and *,,*** represent 10%, 5% and 1% significance levels**

Source: Author's computation

With Pseudo R-squared value of 0.257, (which represents coefficient of determination), the model explains 25.7% of variations in customer loyalty. This is good for a survey analysis. The Wald Chi-squared value of 304.97 and its corresponding zero probability implies that taken together, the variables chosen significantly determine customer loyalty in Nigeria.

From table 5, service quality significantly predicts customer loyalty at the 1% level of significance. With a coefficient of 1.996 and odds ratio of 7.360, it can be inferred that it is 7 times more likely for a unit increase in service quality to result in customer loyalty compared to dissatisfaction of bank customers in Nigeria. Alternatively, it could be said that increasing the quality of service in Nigeria banks is more likely to produce loyal customers than dis-satisfied customers. This is supported by the works of Badara et al (2013), Ouma et al (2013) and Sabir, Ghafour and Akhtar (2014).

Banks' corporate financial performance is also a factor to reckon with in determining customer loyalty in Nigeria. Table 5 reveals the coefficient and probability of the variable to be 0.314 and 0.016 respectively. This implies that the variable is significant at the 5% level. The odds ratio of 1.369 reveals that if the financial performance of a bank increases by a unit, there will be a 36.9% increase in the probability of having loyal customers versus dissatisfied customers in Nigeria banks. This is in line with the studies of Pauline et al, 2016 and Brandirali and Ghigliano, 2014.

Customers' perception about the cost of services in the banking industry seems to determine their loyalty. With a coefficient, odds ratio and probability of -0.433, 0.649 and 0.001 respectively, as cost of services increases by a unit, the odds of realizing customer loyalty compared to customer dis-satisfaction decreases by 35.1%. This proves the existence of a significant inverse relationship between cost of services and customer loyalty in Nigeria in conformity to the findings of Ibok and Akpan (2013).

From table 5, although the level of technology of banks does not seem to be significant in explaining customer loyalty which conforms to the work of Ellisavet, Lazaros and Dimitros (2013), an odds ratio of 1.80 suggests that it is more likely for banks with improved and efficient technology to have loyal customers compared to dis-satisfied customers than others.

An improvement in the brand and image of banks in Nigeria makes customers more loyal in comparison to customer dissatisfaction by 57.6% at 1% level of significance. This is evident in the odds ratio (1.576) presented in table 5. This is in line with the findings of Osma et al (2015) and Chung, Yu, Choi and Shin (2015).
An increase in the stability of an economy guarantees the probability of realizing an increase in customer loyalty compared to customer dis-satisfaction at 1% level by 44.1% in conformity with the findings of Roberts (2011). Stability of prices could allow customers plan their expenditures in a way that will ensure stability in their bank patronage and hence loyalty.

Customer centricity has been found to have a positive impact on customer loyalty. From table 5, Customer centricity is one of the most significant influencers of customer loyalty. This is evident in its significance level of 1%. With odds ratio of 1.9, an increase in customer centricity increases the probability of realizing loyal customers compared to dis-satisfied customers by 90%. This conforms to the findings of Emerson (2007) and Ballard (2008).

Demographic characteristics such as sex and age of customers do not significantly determine customer loyalty in Nigeria.

From the analysis above, we accept the alternative hypothesis that customer loyalty in the Nigerian banking industry significantly depend on customer centricity, macroeconomic stability, service quality, corporate financial performance, cost of services, technology and convenience and bank brand.

6. Policy Implications of Results and Conclusion

Policy Implications of Result

Service quality and customer centricity stood out of all the variables found to determine customer loyalty. The implication of this is consistent implementation of policies aimed at ensuring sustained quality service and customer centricity of banks will invariably enhance customer loyalty. Government policies that stabilize the economy also have implications for customer loyalty. The results presented above revealed that macroeconomic stability positively enhanced customer loyalty. Prudential monetary policies formed by the apex regulatory institution in the Nigeria financial system would ensure the retention of bank customers in Nigeria and may reverse the attrition currently witnessed in the sector. The study also reveals that policies on sustainable profitability drive also indirectly enhance loyalty in the Nigerian banking Industry. This is revealed by customer's perception that the levels of financial performance of their banks also determine their loyalty. Policies aimed at improving the technology of banks enhance the ease and speed of transactions leading to more customers becoming loyal. Branding and rebranding policies of banks in Nigeria may have far reaching implications for customer loyalty. Customers in the Nigeria banking industry seem to be motivated by bank brands and image. They are proud of banks with public reputation. Such policies could include increasing their integrity in the eyes of the public and appearance of their business offices and staff.

Conclusion

The growing customer sophistication across the globe is found to have serious implications for bank's financial performance and ultimately economic growth. West Africa banking sector has recorded a significant growth in customer sophistication compared to other regions of the world. This is reflected in growing bank customer complaints and attrition which has downplayed deposit mobilization, financial inclusion and penetration in the region. A cursory investigation of the factors that seemingly looks 'little' but are very important to achieving customer loyalty in the banking industry in West Africa was therefore

inevitable. This was why this study was carried out. Because of the difficulty of conducting a survey across West Africa simultaneously, Nigeria bank customers were chosen for the empirical analysis. This is due to the relative relevance of the Nigeria banking sector in West Africa, with the largest customer base, banking penetration, customer sophistication and regional presence.

Employing multinomial regression model it was found that whereas, customer centricity, macroeconomic stability, service quality, corporate financial performance, technology and convenience and bank brand significantly and positively affect customer loyalty, cost of services had an inverse impact on customer loyalty in Nigeria. Banking management policies aimed at improving customer centricity, service quality, financial performance, technology and brand should enhance customer loyalty and ultimately improve their profitability positions. Also macroeconomic stabilization policies and policies that engender growth of the domestic economy should improve customer loyalty of banks.

Bank managements should therefore consistently implement policies that will raise the levels of their banks' service quality and customer centricity in order to record influx of loyal customers. To achieve improved quality of service, bank management should consistently pay attention to tangibles (appearance of physical facilities and personnel), assurance (knowledge and courtesy of employees) and reliability (making their words and promises to customers count). They should also ensure that their employees are responsive to customer's needs and empathetic. They should not just crave for customer satisfaction but see them delighted. Delighted customers with positive words of mouth would advance the growth of their banks. It should also be noted that poor service quality could breed dissatisfied customers who from research is more likely to speak about their negative experiences than the satisfied customers. In an era of growing information technology, these reactions could reverberate across the internet spectrum and result in devastating effects on bank's growth and profitability. To this end, internal and external mechanisms to ensure that stated customer charters are strictly complied with in all the service touch points should be in place. Employees of banks should be made to periodically undergo trainings on the relevance of service quality and customer centricity to customer loyalty and organizational sustainability. They should also be made to understand their bank's customer care values and charters.

Although this study was carried out across Nigeria, it did not focus on cultural, geopolitical and religious considerations with respect to customer loyalty. These could be further 'little things that matter to customer loyalty in West Africa' and therefore should be considerations for future research. A replication of research

of this nature in other West Africa countries could also have far reaching implications for policy making in the regional banking industry and for the body of literature in behavioral economics and marketing research.

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SOURCES OF PRODUCTIVITY CHANGE IN THE NIGERIAN BANKING INDUSTRY

Hilda E. OLELE, [1] Douglason G. OMOTOR[1,2] and Christopher O.ORUBU[1]

Abstract

This paper examines total factor productivity growth in the Nigerian banking industry within the period 1993-2013, an era that witnessed varying degrees of policy reforms in the industry. Data envelopment analysis (DEA) was employed in identifying the technical efficiency frontier and thereafter, Data Envelopment Analysis-based Malmquist total factor productivity change index was computed, decomposing productivity into technological change, or change in best practice and efficiency change components both of which account for dynamic shifts in the efficiency frontier. The findings from this study showed that the Nigerian banking industry generally operate with high efficiency which is indicative of an optimal input mix in production within the period of study. Overall, the period recorded impressive productivity growth mainly attributable to technological progress with modest contributions from other components of productivity growth.

Keywords: Productivity, Banks, Change, Data Envelopment Analysis
JEL Classification: C10, E23, E44, G21, O33.

1. Introduction

In recent times, there has been renewed interest in almost all economies in creating a more market-oriented, competitive and productive financial sector through the integration of the services provided by banking and non-banking institutions in the financial system. At the same time, advances in technological innovations have led to the transformation of the mode of operation and available products in the industry. It is argued that if banks are becoming more productive, then it is logical for one to expect better performance, reduced prices, and enhanced service quality for consumers, as well as greater safety and soundness, particularly if productivity expansion is directed towards strengthening capital buffers that can absorb risks. So far, assessing efficiency from the perspective of total factor productivity growth has not been a major focus in the efficiency literature in the Nigerian banking sector. Rather, the empirical literature on banking sector efficiency in Nigeria

[1]Department of Economics, Delta State University, Abraka- Nigeria
[2]West African Institute for Financial and Economic Management (WAIFEM), Lagos, Nigeria
*Corresponding author: olelehilda@gmail.com

has generally concentrated more on the effect of liberalization on interest rate spread, transaction and search costs and how this has impacted on banking sector efficiency (Onwioduokit and Adamu, 2005; Adeoye and Adewuyi, 2005).

Total factor productivity, according to Comin (2008), is the portion of output that is unexplained by the amount of inputs employed in production and as such, determined by the efficiency and intensity of inputs utilized in the production process. Implicitly measured as a residual, this very important component of output growth was not given the required focus in Nigeria before the 1990s as was done in developed nations, owing mostly to heavy state interventions, licensing policies and domination of public sector undertaking in major economic activities. The adoption of the reform process of deregulation and liberalization of the Nigerian economy in the mid-1980s however, led to the development of a free market-oriented economy by encouraging increased competition and restructuring in order to adapt to a world market order (Ghosh, 2005).

According to economic theory, a relapse in entry and exit barriers within an industry creates opportunities for new financial instruments, structures and institutions. Such innovations create new markets and regions which promote competition in the industry. Consequently, inefficient firms either exit the industry or take appropriate measures directed towards improving their efficiency and productivity.

In a bid to keep track of the rapidly changing market environment, an assessment of the efficiency and productivity concerns is deemed necessary in order to inform policy makers, regulators, investors and practitioners of the possible sources of efficiency and productivity growth in the Nigerian banking industry. Such assessment should provide a framework for the design of policy measures that would ensure efficient bank supervision and responses to regulatory changes and optimal investment decisions, culminating in productivity improvements. The pivotally strategic role the banking sector plays in all economies and particularly in emerging economies like Nigeria provides another motivation for this study.

The data envelopment analysis (DEA) approach was employed in this analysis and thereafter Malmquist total factor productivity change index was computed and decomposed into its four components, namely: technical efficiency, technological change, pure technical efficiency and scale efficiency change. This decomposition is important because it provides a basis for assessing whether

productivity is deteriorating, improving or stagnating and also to determine the overall sources of productivity change in the Nigerian banking industry.

Following this introductory section, the remaining part of the paper is structured as follows: Section 2 reviews the main literature on the analysis of efficiency and productivity changes and Section 3 briefly discusses the data and outlines the approaches to the measurement and estimation of productivity growth. Section 4 illustrates the results while Section 5 concludes the paper.

2. Literature of Relevant Review

The literature on bank efficiency and productivity in developed economies is replete. One of the first studies that examined productivity change in the banking industry was provided by Berg, Forsund and Jansen (1992). Using Norwegian banking industry data from 364 banks within the period 1980-1989, Malmquist indices were computed to measure productivity growth. The finding from this study showed that productivity growth was attributable to improvements in efficiency change in Norway. An expansion of the original data space in the study by Berg, Forsund and Jansen (1992) to include Finnish data for a single year, for the purpose of cross-country comparison by Berg, Forsund, Hjalmarson and Suominen (1993), found broadly similar results, based on the Malmquist index approach. Wheelock and Wilson (1999) also used the Malmquist index to examine change in productivity for the banks in the US between 1984 and 1993. Their finding showed that on the average, productivity declined during this period as a result of reductions in efficiency. Adopting a similar approach to Wheelock and Wilson (1999), Alam (2001) investigated productivity change among US commercial banks over the 1980s and found a significant increase in productivity over the period 1983-1984; and then a fall in 1985, which was thereafter followed by growth.

Grifell-Tatjè and Lovell (1997) examined the pattern of productivity change over the period 1986–1993 in the Spanish banking industry dominated by commercial banks and the faster-growing savings banks. In a multistage approach, productivity change was examined separately within each sector and thereafter the two sectors were merged since both sectors are gradually becoming more competitive and finally examining productivity change in the industry. The merging procedure follows a methodology originally proposed by Charnes, Cooper and Rhodes (1981), in which intra-sectoral managerial inefficiency is eliminated prior to merging, thus allowing a distinction between differences in managerial efficiency within each sector from differences in the institutional efficiency of the two sectors. It makes possible the decomposition of

potential productivity change into institutional efficiency change, technical change, and the impact of scale economies. The result indicates that commercial banks have had a slightly lower rate of productivity growth, but a slightly higher rate of potential productivity growth; a phenomenon attributable to differences in both managerial efficiency and institutional efficiency, to differences in the rate of technological progress, and to the unfavorable impact of diseconomies of scale in the commercial banking sector.

Casu, Girardone and Molyneux (2004) in a study spanning 1994-2000, compared parametric and non-parametric estimates of productivity change in European banking and a further decomposition of productivity change into technological change, or change in best practice, and efficiency change. The findings from this study suggest a consistent identification of those systems that have benefited most (and least) from productivity change during the 1990s from both approaches. Also, productivity growth (where found) was mainly been brought about by improvements in technological change without obvious `catch-up' by non-best-practice banks. Interestingly, the two approaches generally did not yield markedly different results in terms of identifying the components of productivity growth in European banking during the 1990s, thus demystifying the conflicting results sometimes posted by competing methodologies for the sources of productivity for individual years.

Tripe (2003) used the data envelopment analysis to study the trends in efficiency in the New Zealand banking industry during the period 1996-2002. The result revealed improvement in the bank efficiency in New Zealand attributable to fall in interest rates, pure efficiency change and technological progress. More recently, Adjei-Frimpong, Gan, Ying and Cohen (2014) examined efficiency and productivity change during the US subprime mortgage crisis period, 2007-2011 in New Zealand using the DEA-based Malmquist productivity change index. Findings indicate that the retail banks in New Zealand generally have high efficiency and modest productivity growth mainly attributable to technological progress.

Ataullah and Le (2004) in their survey provided a comparative analysis of the evolution of the technical efficiency of retail banks in Pakistan and India over the period 1988-1998. Employing the DEA technique, they estimated technical efficiency, decomposing it into scale efficiency and pure technical efficiency. The study reported low technical efficiency in both countries driven primarily by low scale efficiency. Pasiouras (2008) examined the efficiency of the Greek banking industry including foreign bank branches over the period 2000-2004 using the data envelopment analysis. Findings indicate that banks operating at

the national level are not as efficient as those operating abroad. This study however is limited to just five years and considered both domestic and foreign banks. Sufian (2005) applied data from the Malaysian commercial banks during the post crisis period of 1998-2003 to the non-parametric Malmquist Productivity Index (MPI) method, to investigate the productivity change. The results suggest that Malaysian banking sector exhibited productivity regress during the period of study largely attributable to technological change regardless of size. Again, Sufian and Habibullah (2010) in their study from 1999-2008, examined the efficiency of the Thai banking sector and observed that inefficiency in the Thai banking sector is predominantly from scale efficiency.

Gerhardus (2013) studied bank productivity and sources of efficiency change in South Africa using data from the four largest banks and employed the Malmquist productivity index to estimate the total factor productivity and productivity change for the period 1994-2010. Findings from this study upheld that the banks on the average exhibited regress in total factor productivity and technological change, the latter signifying a lack of innovation but operated in the proximity of full technical efficiency.

Other studies that have supporting evidence of technological change-driven productivity growth are: Mukaherjee, Ray and Miller (2001) for US banks, Koutsomanoli-Filippaki, Margaritis and Staikouras (2009) for European banks, Matthews, Zhang and. Guo (2009), Matthews and Zhang (2010) for Chinese banks.

3. Methodology and Data

This study utilized the data envelopment analysis (DEA) model to estimate efficiency and productivity in the Nigerian banking industry. DEA is a linear programming-based technique for measuring the relative efficiency of a fairly homogeneous set of decision making units (Charnes et al., 1978). DEA does not stipulate a particular functional form of the underlying production relationship or require any assumption about the distribution of inefficiency neither does it take into account random error in the data. DEA constructs the frontier as a discrete piecewise linear combination of the most efficient units (actual inputs and outputs) to give a convex production possibility set enveloping all observations in the sample. DEA can be executed by assuming a constant returns to scale orientation (Charnes, Cooper and Rhodes, 1978) or variable returns to scale (Banker, Charnes and Cooper, 1984). The constant return-to-scale (CRS) means that a proportionate increase in input leads to a proportionate increase in output while variable return-to-scale (VRS) implies that a proportionate increase

in input potentially leads to a disproportionate change in output. In this study, we adopt the output–oriented approach of DEA –Malmquist Index (Coelli, 1996) to put greater weight on the expansion of output from a given amount of inputs.

Consider the situation with K number of inputs, M number of outputs and N number of banks. For the i*th* bank, x_i represents a vector of inputs and y_i represents a vector of outputs. The (K × N) input matrix X, and the (M × N) output matrix Y, represent the banking industry data for all N banks. The output oriented measure of a particular decision making unit under constant returns to scale is calculated as:

$$D_0^c(x_c, y_c)^{-1} = \max_{\emptyset, \lambda} \emptyset \qquad (1)$$

Subject to:

$$-\emptyset\, y_{ic} + Y_c\lambda \geq 0,\ x_{ic} - X_c\lambda \geq 0,\ \lambda \geq 0, \qquad (2)$$

where, θ is a scalar and is the (technical) efficiency score and λ is a vector (N x 1) of constants or weights attached to each of the efficient banks. The efficiency score lies between the range 0 and 1. An efficiency score of one (θ = 1) indicates a technically efficient bank, as it lies on the frontier while a value of θ < 1, indicates that the bank is inefficient.

Banker, Charnes and Cooper (1984) introduce the VRS DEA model by including an additional convexity constraint, N1'λ = 1, to account for VRS, which offers a measure of pure technical efficiency. Thus, the linear programming model CRS can be modified to VRS by adding a constraint N1'λ = 1 as follows:

$$D_0^c(x_c, y_c)^{-1} = \max_{\emptyset, \lambda} \emptyset$$

s.t.

$$-\emptyset\, y_{ic} + Y_c\lambda \geq 0,\ x_{ic} - X_c\lambda \geq 0, \qquad N1'\lambda = 1 \qquad \lambda \geq 0, \qquad (3)$$

Where, N1 is a (N x 1) vector of ones. The use of a VRS that decomposes overall technical efficiency into pure technical efficiency (which refers to the ability of managers to optimally utilize given resources), and scale efficiency (which refers to the exploitation of scale economies by operating at a point where the production frontier depicts constant return to scale, was suggested by Banker, Charnes and Cooper (1984).

3.1 The Malmquist Total Factor Productivity Index

The Malmquist total factor productivity concept is derived from the ideas of Malmquist (1953). It is the most commonly used non-parametric measure of productivity change developed from Caves, Christensen and Diewert (1982). It depends on the constant returns to scale and output-based orientation. According to Thanassoulis, (2001), Coelli (1996), Yao, Han and Feng (2008), a Malmquist index computed when a constant return to scale is assumed indicates that the result of the output-oriented approach would not differ from that of the input-oriented approach. The Malmquist total factor productivity index measures total factor productivity change between two data points by calculating the ratio of each data point relative to a common technology. Following after Färe, Grosskopf, Norris and Zhang (1994) construct, the output-oriented Malmquist index structure under the assumption of constant return to scale can be expressed as follows:

$$M_n = \left[\frac{d_o^s(x_n^t, y_n^t)}{d_n^t(x_n^{t+1}, y_n^{t+1})} \frac{d_n^{t+1}(x_n^t, y_n^t)}{d_n^{t+1}(x_n^{t+1}, y_n^{t+1})}\right]^{\frac{1}{2}} \quad (4)$$

In equation (4), M_n measures the productivity of the production points (x^{t+1}, y^{t+1}) relative to the production points (x^t, y^t). The Malmquist index uses period *t* technology and technology in the next period *t+1*. The two mixed periods' technical efficiency scores are used in calculating the index. A value of M_n greater than 1 indicates an increase (improvement) while a value less than 1 signifies a decrease or deterioration and if it is equal to one, it shows stagnation. The Malmquist productivity index makes use of distance functions to measure productivity change. The Malmquist total productivity change index makes possible the decomposition of total factor productivity into technical change (technological progress) and technical efficiency change (technical efficiency). Hence, we have equation (4) adapted to measure the technical efficiency change and the shift (movement) of the production frontier of a specific decision making unit as follows:

$$M_n = \frac{d_n^t(x_n^t, y_n^t)}{d_n^{t+1}(x_n^{t+1}, y_n^{t+1})} \left[\frac{d_n^{t+1}(x_n^{t+1}, y_n^{t+1})}{d_n^t(x_n^{t+1}, y_n^{t+1})} \times \frac{d_n^{t+1}(x_n^t, y_n^t)}{d_n^t(x_n^t, y_n^t)}\right]^{\frac{1}{2}} \quad (5)$$

Where, the ratio outside the square brackets measures the change in the output oriented measure of Farrell technical efficiency between period *t* to *t+1*. In other words, efficiency change is equivalent to the ratio of the Farrell technical efficiency in period *t* to the Farrell technical efficiency in period *t+1*. On the other hand, the geometric average of the two ratios in the square brackets is a

measure of technical change which captures the shift in technology between the two periods, *t* and *t+1*. Therefore, separating the two terms in equation (5) yields:

$$\frac{d_n^t(x_n^t, y_n^t)}{d_n^{t+1}(x_n^{t+1}, y_n^{t+1})} \quad = \quad \text{Technical Efficiency change}$$

and

$$\left[\frac{d_n^{t+1}(x_n^{t+1}, y_n^{t+1})}{d_n^t(x_n^{t+1}, y_n^{t+1})} \times \frac{d_n^{t+1}(x_n^t, y_n^t)}{d_n^t(x_n^t, y_n^t)}\right]^{\frac{1}{2}} = \quad \text{Technological change}$$

Thus, productivity change (M_n) is decomposed into Technological Change (TECH), which reflects shifts (improvement or deterioration) in the performance of best practice Decision Making Units (DMUs); and Technical Efficiency Change (TEFFCH), which reflects the convergence towards or divergence from the best practice on part of the remaining DMUs. Hence, productivity change is the product of technical efficiency change and technological change. The importance of this decomposition is that it provides information on the sources of the overall productivity change. Fare et al (1994) further proposed an "enhanced decomposition" which takes efficiency change component calculated relative to the constant returns to scale technology and further decomposed into a "pure technical efficiency change" (PECH) component (calculated relative to the variable returns to scale technology) and a residual "scale efficiency" (SECH) component, which measures changes in the deviation between the variable returns to scale and constant returns to scale technologies. Consequently, the decomposition taking into account the influence of variable returns to scale technology is given as:

TEFFCH = PECH x SECH
Overall,
M_n = TECH x PECH x SECH (6)

Although this decomposition has been subjected to various criticisms, there is however a consensus that the Malmquist index is correctly measured by the ratio of the constant returns to scale distance function even when the technology exhibits variable returns to scale. The implication of the values of Mn is defined in Table 1. If the value of M_n is greater (lower) than 1, this indicates a growth (fall). On the other hand, any value equal to 1, indicates stagnation (no change) in the relevant index.

Table 1: Status of productivity index

Malmquist productivity index	Productivity status
$M_n > 1$	Increase or growth in productivity
$M_n < 1$	Deterioration or productivity loss
$M_n = 1$	No change or stagnation in productivity

Source: Literature review

3.2 Data

Data were obtained on ten banks in the Nigerian banking industry which includes Access, Afribank, Diamond, Finbank, Fidelity, First Bank of Nigeria, Guaranty Trust Bank, Union Bank, United Bank for Africa and Wema Bank. These banks were chosen based on consistency and continuity in name after the 2004 consolidation exercise which resulted in many of the banks changing their operational name after merger and/or acquisition. This study made use of panel data obtained mainly from various issues of the Nigerian Stock Exchange Factbooks from 1993 – 2013; a period that witnessed diverse policy reforms in the banking industry.

3.3 Variable definition and selection

The appropriate definition of what constitutes bank output remains a relevant research issue in efficiency analysis in the banking industry. There are various approaches to variable selection in the literature. However, the selection of variables used in this study follows a variant of the intermediation approach, which was originally developed by Sealey and Lindley (1977). Thisapproachconsiders banks as mobilizers of surplus funds, which are then transformed, into loans and other assets. In other words, depository financial institutions are viewed as producers of services related directly to their role as intermediaries in the financial markets (Clerk, 1988). In this approach, funds borrowed from the financial markets and deposits collected from the banking public are the inputs while the output variables are measured by the volume of loans and investments outstanding. Nyong (2005) added labour employed as one of the inputs while Clerk (1988) recognizes both capital and labour as inputs. Proponents of this approach define the banks various naira volumes of earning assets including securities investments" as measure of output. Other

outputs specified under this approach are interbank loans, loans and advances for customers (Mester, 1987; Molyneurx, Altunbas, and Gardener, 1996,). Costs are defined to include both interest expense and total costs of production. This approach is complementary to the production approach. Mester, however, notes that the availability of data is a major determinant of the choice between intermediation and production approach.

Table 2 provides a summary of the variables used in this study. Total deposits, total share capital and labour are categorized as inputs while loans & advances, investment securities and properties & equipments constitute the output variables. The descriptive statistics of the variables is contained in table 3. The data were analyzed using the DEAP 2.1 computer program written by Tim Coelli of the Centre for Efficiency and Productivity Analysis, Unive Table 2 provides a summary of the variables used in this study. Total deposits, total share capital and labour are categorized as inputs while loans & advances, investment securities and properties & equipments constitute the output variables.

Table 2: Definition of input and output variables

Symbol	Category	Definition
Y1	Output	Loans & advances (millions of naira)
Y2	Output	Investment securities (millions of naira)
Y3	Output	Properties and equipments (capital) in millions of naira
X1	Input	Total deposit (millions of naira)
X2	Input	Total share capital (millions of naira)
X3	Input	Labour (total number of employee)

Source: Authors' definition, based on literature review

4. Analysis of Results

The descriptive statistics of the variables are contained in Table 3. The data were analyzed using the DEAP 2.1 computer program written by Tim Coelli of the Centre for Efficiency and Productivity Analysis, University of Queensland, Australia. The results from the DEAP 2.1 computer program which summarizes productivity change and components of the Malmquist (output-oriented) total factor productivity change index are presented in table 4 and Figure1. When an index value is greater than one (>1), it indicates progress/increase/growth in productivity while a value less than one (‧1) signifies deterioration or loss in

productivity and an index equal to one (1) shows stagnation or no change in productivity.

Table 3: Descriptive statistics of variables

Variable	Minimum	Maximum	Mean	Standard deviation
Y1	99593	1814177000	1814177000	267753306
Y2	1856	873521000	55788682	124234648
Y3	2000	73042000	12634694	18003711
X1	493085	2929081000	262522308.5	435770748
X2	50000	8500000000	20243074	78300931
X3	141	30223	3622.757	3780

Source: Authors computation, 2017.

Productivity change was decomposed into technological change (TECH), and technical efficiency change (EFFCH) and a further decomposition of technical efficiency change into pure efficiency change (PECH) and scale efficiency change (SECH). An increase in TECH is seen as a shift in the best practice frontier while an improvement in EFFCH is interpreted as the "catch up" term. The significance of this decomposition is that it provides information on the overall sources of productivity change in the Nigerian banking industry.

Table 4: Malmquist Productivity Index Summary
(Nigerian banking industry, 1993-2013)

Period	**EFFCH**	**PECH**	**SECH**	**TECH**	**TFPCH**
1994	0.944	1.008	0.937	1.046	0.987
1995	1.100	1.020	1.079	1.077	1.184
1996	0.877	0.995	0.882	1.317	1.156
1997	0.982	0.974	1.008	1.061	1.043
1998	1.040	1.020	1.019	0.890	0.926
1999	1.014	1.011	1.003	1.110	1.125
2000	0.827	0.979	0.845	0.981	0.811
2001	1.272	1.022	1.245	1.264	1.609
2002	0.874	0.986	0.887	0.992	0.868
2003	0.989	1.014	0.975	1.018	1.007

2004	1.072	0.994	1.079	1.172	1.257
2005	0.948	0.992	0.956	0.932	0.884
2006	1.170	1.010	1.159	1.114	1.304
2007	0.808	0.953	0.847	1.647	1.330
2008	1.038	0.955	1.086	1.023	1.061
2009	1.173	1.075	1.091	0.977	1.146
2010	1.028	1.005	1.023	0.983	1.010
2011	0.938	0.989	0.948	1.217	1.141
2012	1.025	0.976	1.050	1.094	1.122
2013	1.043	1.058	0.986	0.850	0.887
Mean	**1.002**	**1.001**	**1.000**	**1.076**	**1.078**

Source: Author's Computations, 2017

Note: t-1 in year 1 and t+1 in the final year are not defined. Also, all Malmquist indices are geometric means.

From the results in Table 4, the Nigerian banking sector recorded nine periods of regress in technical efficiency change ranging from -19.2 to -1.1 percent. Apart from 1996-97 and 2002-03 periods that experienced concurrent phases of deterioration, all other deterioration phases were followed by at least one period of improvement in technical efficiency change. There was no record of prolonged regress in technical efficiency change in the industry. Conversely, technical efficiency showed varied degrees of progress ranging from 1.4 to 27.2 percent for eleven periods representing 55 percent of the period (Table 5) since t-1 in the first year and t+1 in the final year are not defined. On the whole, the period recorded a modest improvement of 0.2 percent.

Table 5: Frequency distribution of Malmquist productivity change indices

Index	**Frequency**									
	EFFCH	**%**	**PECH**	**%**	**SECH**	**%**	**TECH**	**%**	**TFPCH**	**%**
0.801-0.900	4	20	-		4	20	2	10	4	20
0.901-1.000	5	25	10	50	5	25	5	25	2	10
1.001-1.100	8	40	10	50	9	45	6	30	4	20
1.101-1.200	2	10	-		1	5	3	15	6	30
1.201-1.300	1	5	-		1	5	2	10	1	5
1.301-1.400	-		-		-		1	5	2	10
1.401-1.500	-		-		-		-		-	
1.501-1.600	-		-		-		-		-	
1.601-1.700	-		-		-		1	5	1	5
Total	**20**		**20**		**20**		**20**		**20**	

Source: Authors computation, 2017

Pure efficiency change recorded four double incidences and two single incidences of regress over the sample period bringing the total incidences of regress to ten while improvement in pure efficiency change recorded three double incidences and four single incidences making it a total of ten. Between 2004 and 2008, there was only one period of improvement (2006) in pure efficiency change. This may arguably be due to adjustment effects of the consolidation exercise embarked upon in the Nigerian banking sector. This could also be attributable to the adverse effect of the mergers and acquisition which allowed management to "get away" with slackened productivity at the take-off of the reform. The sector ended with pure efficiency change almost stagnating.

Scale efficiency change component recorded nine periods of regress with the highest peak regress in 2000 (-0.155) and lowest in 2013 (-0.014) while improvement was recorded for eleven period. The period between 1997-1999 and 2008-2010 recorded a three-year continuous improvement in scale efficiency. In the former period, the average number of banks in the Nigerian banking industry stood at 57 and average bank branches were 2,259 while the latter period witnessed an explosion in the number of banks as well as bank branches (90 and 3000+ respectively) in Nigeria. This could be the reason why four periods of regress was recorded for both efficiency change and scale efficiency change. The improvement noticed in the latter period (2008-2010), is evidently a result of the massive mergers and acquisitions that took place in the banking sector which accounted for increasing efficiency and economics of scale. Overall, the banking industry posted stagnating scale efficiency change.

Technological change recorded seven periods of regress with the highest deterioration in 2013 (-0.15) and the lowest in 2002 (-0.8). The period between 2009 and 2010 recorded double incidence of regress in technological change and this may be connected with the global financial crisis which was not conducive to expanding investment in technology, but rather the introduction of new and additional banking services. This finding agrees with the results of the study by Gerhardus (2013) on the four largest banks in South Africa. Technological change however, recorded very impressive improvement over the sample period with a peak in 2007 (64.7 percent) and the least progress in 2003 (1.8 percent). The result showed that technological change closed with 7.6 percent progress within the period of analysis.

Total factor productivity change over the study period showed a very impressive trend with only six periods of regress. The highest deterioration occurred in 2000 (-0.189) and the lowest in 1994 (-0.013). The year 2001 recorded the highest

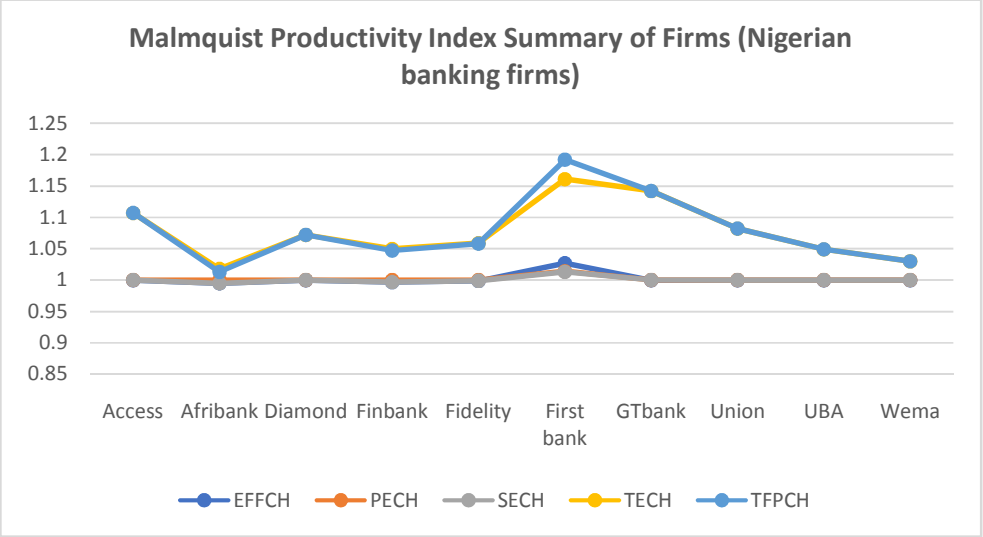
improvement in total factor productivity (60.9 percent) which may be linked to the introduction of universal banking in Nigeria while the lowest occurred in 2003 (0.7 percent). The period 2006-2012 recorded continuous improvements in total factor productivity. Overall, the period showed a 7.8 percent improvement in total factor productivity.

On the whole, the results seem to support the existence of a positive productivity growth (7.8 percent) in the Nigerian banking industry. In other words, productivity increased at an average of 7.8 percent annually in the industry during the period, 1993 – 2013. Improvement in productivity was observed to have resulted largely from a positive technological change (7.6 percent). Studies that obtained similar results are: Casu, Girardone, and Molyneux (2004) study on European banks; Koutsomanoli-Filippaki, Margaritis, Staikouras (2009), on Central and Eastern European banks; Matthews, Zhang, and Guo (2009); Matthews and Zhang (2010) on Chinese banks; and Adgei-Frimpong, Gan, Ying and Cohen (2014).

This substantial shift in the best practice frontier in the Nigerian banking industry may not be unconnected with the policy reforms which resulted in diverse kinds of restructuring. The industry exhibited a modest tendency to exploit some marginal catch up effect as shown by EFFCH value of 0.2 percent. Interestingly, the marginal catch up effect observed was as a result of the modest contribution from pure technical efficiency change which recorded 50 percent productivity losses (gains) as the case may be within the period of analysis (see Table 5) while scale efficiency was unable to offset the productivity losses recorded in 45 percent of the period with the productivity increase from the remaining 55 percent, leading to a stagnation.

The summary of firm's means presented in Fig, 1 and Table 6 show that all the banks exhibited progress in technological change and total factor productivity change to the tune of 7.6 and 7.8 respectively within the period of study. Progress in total factor productivity change ranges between 1.3 and 19.2 percent while Firstbank is adjudged the highest in best practice with 16.1 percent and Afribank the least in best practice (1.8 percent).

Fig. 1: Malmquist Productivity Index Summary of Firms (Nigerian banking firms)



Source: Authors computation, 2017

Table 6: Malmquist Productivity Index Summary of Firms (Nigerian banking firms)

Firms	**EFFCH**	**PECH**	**SECH**	**TECH**	**TFPCH**
Access	1.000	1.000	1.000	1.107	1.107
Afribank	0.995	1.000	0.995	1.018	1.013
Diamond	1.000	1.000	1.000	1.072	1.072
Finbank	0.997	1.000	0.997	1.050	1.047
Fidelity	0.999	1.000	0.999	1.059	1.058
First bank	1.027	1.014	1.013	1.161	1.192
GTbank	1.000	1.000	1.000	1.142	1.142
Union	1.000	1.000	1.000	1.082	1.082
UBA	1.000	1.000	1.000	1.049	1.049
Wema	1.000	1.000	1.000	1.030	1.030
MEAN	**1.002**	**1.001**	**1.000**	**1.076**	**1.078**

Source: Authors computation, 2017

Almost all the banks operated at stagnating levels of pure efficiency change without any record of deteriorating growth rates. Afribank, Finbank and Fidelity bank were the only banks that recorded regresses in both technical efficiency change and scale efficiency change at some point in time. The observed regress in scale efficiency change could be an indication that inefficiency in the banking industry is more of a scale issue rather than management error or omission. Overall, the banks recorded modest growth rates in technical efficiency change and pure efficiency change.

5.0 Conclusion

This paper examined the sources of productivity change in the Nigerian banking industry during the period 1993-2013. The findings show that Nigerian banks have achieved high productivity gains driven primarily by best practice institutions (technological change) with marginal catch up effect from the remaining institutions (technical efficiency change). This is an indication that only best practice banking firms have successfully reaped the benefits of the opportunities provided by various interactive change factors in the Nigerian banking sector.

Recommendations

In the light of the foregoing, the paper therefore recommends the sustenance of all change factors driving productivity increases in the banking sector. Notable among these factors is the translation of the banking sector from analogue banking practices to automated banking processes during this period which no doubt, has encouraged massive technological investments which may have resulted in the technological change driven growth in the Nigerian banking sector. Another change factor that may have resulted in the observed trend could be the enactment and subsequent implementation of the consolidation policy. The exact effect of this policy within this period however, will be the focus in future research.

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COINTEGRATION AND GRANGER-CAUSALITY BETWEEN EXPORTS AND ECONOMIC GROWTH:FURTHER EVIDENCE FROM NIGERIA

Victor Ukpolo[1*]

Abstract

The paper examines the causality between exports and economic growth using Johansen cointegration and Granger-causality tests for Nigeria. The export-led growth (ELG) hypothesis stipulates that economies with increased exports would tend to be rewarded with increased economic growth. As such, countries, especially developing countries, should embark on economic policies that would tend to promote exports. The period of analysis adopted for this study ranges from 1981 to 2016, using annual data obtained from World Bank's World Development Indicators. Our Johansen cointegration results suggest that there is a long run relationship among the variables (real GDP, real exports and real imports). However, there is no evidence to support the existence of Granger-causal relationship going from exports to economic growth. The only Granger-causal relationship that is found to exist goes from GDP to exports.

Key Words: Exports, economic growth, Granger causality

GEL Classification: O47, F140

I. Introduction

Economists have been vigorously engaged, for time now, in an on-going debate on the causal relationship between exports and economic growth. Recently, the focus of the debate has been on investigating the exports and economic growth nexus in developing economies. The premise is that, by embarking on export-led growth (ELG) policies, developing economies would eventually enjoy increased economic growth, directly via increased aggregate output and indirectly, via improved efficiency in production of exported goods and services due to specialization. As developing economies focus on exports where they can attain a comparative advantage in the international market, greater employment opportunities, increased income and prosperity would be the eventual result for their citizenry.

The literature is vast on the test of this hypotheses, particularly as it pertains to developing economies (Ukpolo, 1994; Ekpo, and Egwaikhide, 1994; Koh and

[1]Southern University at New Orleans

*Corresponding author: vukpolo@gmail.com

Moh, 2013; Mah, 2015; Tang, 2006; Panas and Vamvoukas, 2002; Atukeren, 94; Biswal and Dhawan, 1998; Burney, 1996; Dutt and Ghosh, 1993; Abual-Foul, 2004; Awokuse, 2005; Ahmed 1996, 2001; Omotor, 2008; Elbeydi, Hamuda and Gazda, 2010; Mangir, 2012). The results have been mixed. On one hand, some authors found strong positive causal relationship between exports and economic growth ranging from support for unidirectional impact going from export to growth; to support from growth to export and to support for bidirectional impact. On the other hand, other authors found no evidence to support the notion that export expansion causes economic growth. Ahmed (1996, 2001), drawing evidence from developed and developing economies, asserted that the issue as to whether exports have significantly impact to economic growth remains weak.

Earlier studies (e.g., Sheeley, 1990) were based on cross-sectional data for 36 countries for the period 1960-70. However, broad generalizations using cross-sectional data is not suitable to determine causal impact over time. As such, it is not acceptable to infer any causal relationship between exports and economic growth with the use of cross-sectional data. A great number of studies also exist in the literature that adopted the use of times series data at their levels, which implies stationarity of the macroeconomic variables and thus integration of the order zero, I(0). But, it has shown that many macroeconomic time series are non-stationary in their levels, but stationary after first differences, thus integrated of the order one, I(1). (Nelson and Plosser, 1982). Empirical studies based on non-stationary macroeconomic data would lead to spurious results (Granger and Newbold, 1974).

In recent years, many existing empirical studies on developing economies have increasingly been relying on the use of Johansen Conitgeration and Granger causality methodology in testing the ELG hypothesis to avoid the pitfall of using non-stationary data. In the case of Nigeria, there are few recent empirical studies on ELG hypothesis. Nonetheless, the results remain mixed. Alimi and Muse (2013); Olubiyi (2014); Adegboyega, 2017and Lawan (2017) empirical findings appears to support the ELG hypothesis for the Nigerian Economy. On the contrary, however, other authors (Uwakaeme, 2015 and Chimobi, (2010) refute the ELG hypothesis suggesting that positive linkage that might exist between exports and growth is not statistically significant, thus not impressive.

This paper seeks to add to the existing literature by investigating the ELG hypothesis using Nigeria annual data from 1981 to 2016. Our objective is twofold: 1) we will examine whether a long run relationship exists between export and growth or not by using the Johansen Cointegration technique, and

2) we will conduct Granger causality test to determine whether or not causality exist, and if so, which direction. If there is evidence to support exports to GDP causal relationship, ELG policies would be justified for Nigeria. The ELG two variable model will be expanded in this study to include imports. As noted, (Tang, 2006; Agarwal, 2015), since economic growth depends on many other relevant macroeconomic variables, the absence of important variable in the model could to lead misleading conclusions. As a result, this paper will include imports in the model in the process of ascertaining the causal relationship between exports and economic growth for Nigeria. The rest of the paper is organized as follow: Section II gives a brief analysis of the Nigerian economic performance within the last decade. Section III examines the methodology and data used for the study. Section IV discusses the empirical findings and in Section V, conclusion and recommendations are discussed.

II. Nigerian Economic Performance

Nigeria continues to be viewed as the dominant economy in Africa with a GDP of $584.27 billion in 2017. However, with population registering over 190 million in 2017, Nigeria's GDP per capita is ranked 16th among all African countries. Over 30% of Nigerians are living below poverty level. Nigeria exported over US$40.7 billion worth of goods and services in 2017, representing a 54.5% drop from 2013 but a 23.8% increase from 2016 to 2017. Nigeria is also the largest oil producing and oil exporting nation in Africa. In 2016, the oil industry dominated the export market in Nigeria, as it accounted for over 95% of its total exports. According to CIA's World Factbook, January, 2018, Nigeria produces only 2.5% of world's total oil behind the global leaders - Russia, Saudi Arabia and the United States with 13.08%, 12.97% and 11.01%, respectively. Other Nigerian exports include some of the following: Cocoa, Rubber, Fertilizers, Tobacco, etc. each of which accounts for less than 1% of total exports.

Nigeria obtains a significant amount of its foreign reserves from the sale of oil products in the world market. In general, Nigeria's foreign reserves acquisition relies heavily on oil market conditions. The 2016 recession experienced in Nigeria was mainly due to the severe drop in crude oil prices from a high of $88.47 per barrel to a low of $37.02. Again, with the help of oil, Nigeria exiting the recession is said to be driven by the increase price of crude oil which climbed back to about $73 as of July, 2018. This heavy reliant on oil as the major engine driving the Nigerian economy has been shown to lend itself to excessive rent-seeking behavior, that is detrimental to its economic growth and development. (Abubakar, Ahmad, Sani and Jinjiri, 2016).

III. Methodology and Data

The ELG hypothesis is tested with the use of the Johansen cointegration techniques to explore whether or not there is a long-run relationship between exports and economic growth. In light of the discussion above, a multivariate cointegration model is specified as follows:

$$RGDPt = \alpha RXt + \beta RIt + \varepsilon t \quad (1)$$

Where RGDP represents level of real Gross Domestic Product, serving as a proxy for real economic growth, RX denotes the level of real exports and RI represents real imports, ε is the error term. As mentioned above, before we proceed with the test, the stationarity of the series at their level must be ascertained. It has been demonstrated, in the literature, that the use of nonstationary series in an OLS model would lead to spurious results. We will use the augmented Dickey Fuller unit test (with constant only, and with constant and trend) to allow us to determine whether a unit root is present in each of the series.

Where it can be shown that unit root cannot be rejected in all the variable series at their levels but rejected after first differencing, then, we will proceed to test for the long run relationship of the variables using Johansen cointegration test. In addition, we will use the Granger causality test to determine the existence, if any, of causality between exports and economic growth for Nigeria. If we find the existence of a unidirectional causality that would mean either growth Granger-causes exports or exports Granger-cause growth. However, the existence of bidirectional causality suggests the impact is moving in both directions while no directional causality would suggest no impact going from exports to growth nor from growth to exports. This paper uses annual data series of the gross domestic product, exports and imports for Nigeria for the period of 1981-2016 obtained from the World Bank's *World Development Indicators*.

IV. Empirical Analysis

A. Unit Root Results

The augmented Dickey-Fuller unit root test is conducted to ascertain the stationarity of the variables and results are displayed in Table 1:

Table 1: Augmented Dickey Fuller Unit Root Test Results

Variables	ADF Constant	Level of Significance	Order of Integration	Probability	ADF Constant & Trend	Probability	Level of Significance	Order of Integration
Real GDP	-3.582058	5%	I(1)	0.0115	-4.42029	0.0066	1%	I(1)
Real Export	-5.099075	1%	I(1)	0.0002	-5.824335	0.0002	1%	I(1)

Real Import	-5.949366	1%	I(1)	0	-5.86519	0.0002	1%	I(1)

The first-differenced series results reject the null hypothesis of the presence of a unit root in each of the series in the paper. It indicates, therefore, that all variable series are stationary and integrated of the same order I (1). This satisfies the precondition of the use Johansen cointegration test procedure to determine whether or not a long run relationship exist among the variables in Equation 1.

B. Johansen Cointegration Test Results

Tabe 2: Johansen cointegration Test Results

Sample: 1981-2016
Included observations: 34 after adjustments
Series: RGDP, RX, RI
Lags interval: 1 to 1

Hypothesized No of CE(s)	Trace Statistics	Critical Value	Probability	Max-Eigen Statistic	Critical Value	Probability
None*	34.17736	29.79707	0.0147	24.149	21.13162	0.0182
At most 1**	10.02836	15.49471	0.2786	9.872301	14.2646	0.2204
At most 2	0.15606	3.841466	0.6928	0.15606	3.841466	0.6928

* denotes rejection of the hypothesis no cointegration in the model at the 5% level.
** the Trace and Max-eigenvalue tests indicates the existence of at most 1 cointegrating equation at the 5% level.

The null hypothesis of no cointegrating equation is rejected at the 5% level, indicating that there is the existence of at most one cointegrating equation in the series tested. The implication, therefore, is that there is a long run relationship between real GDP, real exports and real imports. But, we still need to test for the causality between exports and economic growth. Of recent, one of the most popular techniques adopted, in the literature, to test for causality is the Granger causality method. It is important to note here, however, that Granger causality does not suggest causal impact in the traditional sense, but

rather it attempts to measure past information contained in one variable and how that information is impactful in predicting or Granger-causes another variable.

C. Granger Causality Test results

Granger causality test is conducted to determine whether causality does exist and if so, in what direction. The test attempts to determine the influence a series would have in the prediction of another series (see, Granger, 1969). Table 3 presents the results of the test.

Tabe 3: Pairwise Granger Causality Tests

Sample: 1981-2016

Lags: 2

Null Hypothesis	Observations	F-Statistic	Probability
Real Export does not Granger Cause Real Gross Domestic product	34	0.04442	0.9566
Real Gross Domestic Product does not Granger Cause Real Export	34	16.0084	0.00002
Real Export does not Granger Cause Real Import	34	0.34112	0.7138
Real Import does not Granger Cause Real Export	34	6.40588	0.005
Real Gross Domestic Product does not Granger Cause Real Import	34	1.97619	0.1568
Real Import does not Granger Cause Real Gross Domestic Product	34	3.36628	0.0485

As far as the ELG hypothesis test for Nigeria is concerned, Table 3 above suggests that we cannot reject the null hypothesis that real export does not Granger cause real RGDP. However, based on our findings, we can reject the null hypothesis that real GDP does not Granger cause real exports. This suggest that there is only one-directional causal relationship going from real GDP to real export, thus rejecting the ELG hypothesis for Nigeria.

V. Conclusion and Recommendations

This paper examined the ELG hypothesis for Nigeria with the use of Johansen cointegration technique and the Granger causality test for the period 1981 to 2016. The evidence suggests that while a long run relationship exist among the variables (real exports, real imports and real GDP), there is no Granger causality

going from exports to economic growth. Rather, the evidence supports the existence of only one-way causality from real GDP to real exports. In the case of Nigeria, the implication is that the adoption of ELG policies solely with the aim to boost economic growth would not be effective. Our results, instead, suggest that Nigerian policy-makers need to look inwards to boost real GDP, which will eventually trigger an increase in real exports. There are so many factors that one could argue impede the sustainable growth of the Nigerian economy, including the lack of adequate infrastructure, shortage of electricity supply, lack of strong democratic institutions, inadequate governmental initiatives to support small business entrepreneurs, etc. Policies aimed at improving some of these impediments would be helpful in boosting the entire economy as several sectors of the economy would be positively impacted. More Nigerians would stand to benefit from such growth process. The dominance of oil in the Nigerian export environment would be reduced, making the economy less vulnerable to the world oil market conditions. This strategy would lead to a sustainable growth and diversification of the Nigerian economy in the long run.

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