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Value-at-Risk Estimation of Equity Market Risk in India

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Abstract. The value-at-risk (Va) method in market risk management is becoming a benchmark for measuring “market risk” for any financial instrument. The present study aims at examining which VaR model best describes the risk arising out of the Indian equity market (Bombay Stock Exchange (BSE) Sensex). Using data from 2006 to 2015, the VaR figures associated with parametric (variance–covariance, Exponentially Weighted Moving Average, Generalized Autoregressive Conditional Heteroskedasticity) and non-parametric (historical simulation and Monte Carlo simulation) methods have been calculated. The study concludes that VaR models based on the assumption of normality underestimate the risk when returns are non-normally distributed. Models that capture fat-tailed behaviour of financial returns (historical simulation) are better able to capture the risk arising out of the financial instrument.

Keywords: value-at-risk (VaR), equity market risk, variance–covariance, historical simulation, financial risk management

JEL Classification: C52, C53

1. Introduction

The research on financial risk management in India has from a long time been concentrated on mainly credit risk. The extent of risk posed by market risk instruments in Indian financial market has not been systematically and deeply studied. There is a relatively less number of studies dealing with market risk as compared to credit risk. This is largely because Indian financial market has from a long time been dominated by mainly credit products relating to retail, auto, housing, and personal finance. The commercial banks in India have traditionally focused mainly on the borrowing and lending business, which primarily generates credit risk. As the world is becoming more and more integrated in financial flows and the Indian financial market is also becoming more and more open to foreign

portfolio investments, there is a need for a systematic study to quantify the market risk from equity market and develop the best predictable statistical model which can be leveraged for forecasting purposes.

The present paper is trying to bridge this gap by studying the predictive accuracy of various VaR models for the Indian equity market (Sensex). This study can help market participants, traders, risk managers, and researchers who are interested in systematic and quantitative study on the Indian financial market. Sensex is taken as a benchmark index to represent the Indian equity market as it is considered the barometer of Indian equity market. Sensex is a composite index of the 30 most actively traded stocks in India. It is calculated using free-float methodology. Free-float methodology market capitalization is calculated by taking the current market share price and multiplying it by the number of shares available in the market for trading.

Value at risk (VaR) is a statistical concept and is itself just a number, used mainly to calculate the market risk of a financial instrument. It is the maximum loss that an institution can be confident it would lose on a financial instrument with a given level of confidence interval due to “normal market” movements within a specified period of time. Losses greater than VaR are supposed to occur with an already specified probability, which is known as the level of significance, or “Type I error” in statistics (*Figure 1*).

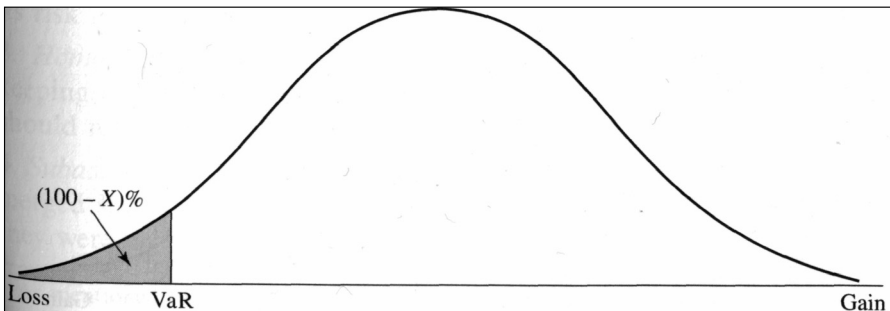


Figure 1. *VaR*

Figure 1 above shows that VaR is calculated from the left tail of the return distribution. VaR is concerned with forecasting the losses with the desired confidence level ($x\%$) from the return distribution.

The rest of the study is organized as follows. In Section 2, a brief review of highly relevant literature on VaR is provided. Section 3 describes the methodology of the present study and discusses the methods used for VaR calculation. Section 4 provides the empirical results obtained. Section 5 provides the backtesting results. Finally, Section 6 provides the summary and conclusions of the study.

2. Literature Review

The use of normal distribution of asset returns is found to be inappropriate by many empirical studies. Venkatraman (1997) recommends a mixture of various distributions as an alternative to normal distribution. The parameters of the mixture of normal distributions are examined by three methodologies: traditional maximum likelihood, the quasi-Bayesian maximum likelihood, and the Bayesian approach proposed by Zangari (1996). The performance of this method is analysed using the foreign exchange data for eight currencies over the period from 1978 to 1996. The results indicate that the mixture of normal distributions shows smaller errors than the normal approach at high confidence intervals. He also found that normal distribution approach underestimates VaR at very high levels of confidence and overestimates it at lower confidence levels.

Varma (1999) carries out an empirical analysis of VaR models for the Indian stock market. The results indicate that VaR model estimates are critically dependent upon the estimates of the volatility of the underlying asset and that exponentially weighted moving average (EWMA) models do well at higher risk levels, namely at 10% or 5%, but break down at 1%.

Maria Coronado (2000) compared the results of historical simulation, variance–covariance methods, and the Monte Carlo simulation method as a measurement of market risk for actual nonlinear portfolios in the context of the supervision of bank solvency. In the results, she found that VaR estimates differ significantly across the methods, and the difference is even higher if the confidence level is higher.

Nath and Samanta (2003) calculate the VaR figures and corresponding capital charges for two portfolios with different VaR models such as variance–covariance approach, historical simulation, and tail-based approach. Results show that the variance–covariance approach in the form of risk metrics database underestimates VaR figures, whereas the historical simulation approach provides quite reasonable VaR estimates.

Aktham I. & Haitham (2006) compare the performance of VaR models for seven Middle Eastern and North African (MENA) countries. Results demonstrate that the extreme value theory approach provides accurate VaR estimates. This implies that the MENA market returns are characterized by fat tails.

Harmantzis et al. (2006) analyse VaR for the daily returns of six equity indices and four currency pairs for a period covering 10 years. They considered various equity indices and currency pairs such as S&P500, DAX, US dollar vs. euro, or US dollar vs. yen. Results show that the historical simulation model produces accurate forecasts compared to models based on normal distribution approach.

Kisacik (2006) examines the performance of VaR methods in the presence of high volatility and heavy tails. He categorizes VaR methods into traditional and alternative approaches, where the later includes the extreme value theory

approach. He observes the existence of non-normal distribution. From the empirical comparison of VaR methods, he observes that generalized Pareto distribution works well in the tail of distribution, that is, where the quantile is 99% or more. Traditional methods provide good results in lower quantiles, that is, less than 99%. Thus, in the presence of high volatility and heavy tails, EVT provides better results than traditional methods for examining tail events.

Dutta and Bhattacharya (2008) show that bootstrapped historical simulation VaR is a better technique than the ordinary historical simulation approach as it keeps the true distributional property along with tackling the scarcity of adequate data points. They calculate VaR and expected shortfall with the historical simulation method and bootstrapped historical simulation method by taking the S&P CNX Nifty data over the period of 1 April 2000–31 March 2007. They use 95% confidence level with a five-day time horizon. From the graphical plot of profit and loss of index return and Quantile-Quantile (QQ) plot, they show that the assumption of normal distribution is not appropriate for the return distribution. In their VaR estimation, they find that the bootstrapped historical simulation VaR figure is lower than the ordinary historical simulation estimate.

Sollis (2009) evaluates various VaR approaches under the Basel II regulatory framework. The author mentions that there are flaws in the VaR models which failed to predict the global financial crisis of 2008. The author criticizes the variance–covariance model developed by RiskMetrics. He mentions that variance–covariance is used by many financial institutions because of its simplicity in understanding and calculation. The variance–covariance model assumes that assets are normally distributed. The author observes that assets' returns do not follow the normal distribution. As such, the VaR estimates based on the variance–covariance approach will underestimate true VaR.

Samanta et al. (2010) study the market risk of selected government bonds using VaR models in India. The authors employ distributions based on non-normal assumptions about asset returns such as historical simulation and the extreme value theory. The authors empirically observe that the historical simulation method is able to provide accurate VaR numbers for the Indian Bond Market.

Emrah, Sayad, and Levent (2012) compared and ranked the predictive ability of different VaR models. They argue that the credit crisis period (2007–2009) offers an exclusive opportunity for analysing the success of different VaR models both in developing and developed countries. They propose a VaR ranking model which tries to minimize the magnitude of errors between predicted losses and actual losses, also reducing the autocorrelation problems of the residuals. Results demonstrate that EGARCH gives better VaR estimates. Their results also indicate that the performance of different VaR models depends on how effectively the asymmetric behaviour is captured by the VaR models and not so much on whether they belong to parametric, non-parametric, semi-parametric, or hybrid models.

Chowdhury & Bhattacharya (2015) studied the appropriate VaR method following the global financial crisis by focusing on major Indian sectors listed on the National Stock Exchange. They created the hypothetical portfolio with selected sectorial indices and used VaR to estimate the portfolio risk. They conclude that the Monte Carlo simulation method provides the most appropriate results.

Poornima & Reddy (2017) compared the market risk of domestic and international hypothetical portfolios using the VaR–CoVaR (variance–covariance) model. They used daily closing prices from 2000 to 2014 of Nifty Spot (NSR), Nifty Future (NFR), INRUSD currency pair Spot (USR), and INRUSD currency pair Future (UFR) for constructing a hypothetical domestic portfolio. Data from January 2000 to December 2014 of BRICS nations, US, and UK equity market indices are taken for constructing an international portfolio. They find that the VaR–CoVaR model provides accurate results at 95% and 90% confidence intervals.

Overall, it has been observed empirically by many studies that financial asset returns are very often non-normally distributed, characterized by heavy tails, and in need of being incorporated by using appropriate statistical methods which can incorporate this non-normality and heavy-tailed behaviour.

3. Methodology of the Study

The various methodologies of VaR can be divided into two broader categories. The first one includes the “parametric methods” of VaR (variance–covariance (VcV), exponentially weighted moving average (EWMA), and generalized autoregressive conditional heteroskedasticity (GARCH). These methods mainly involve the estimation of parameters (volatility) of the assumed theoretical probability distribution function. All three parametric methods use different ways of estimating volatility but assume the underlying return distribution to be normal. The second category is based on simulation methods. In this category, the two major model methodologies are the historical simulation (HS) and Monte Carlo simulation (MCS) methods. These methods do not involve any estimation of the parameters of the distribution. They use simulations to generate the return distribution.

3.1 The Variance–Covariance Method

In this method of calculating VaR, the main focus is on the volatility of the underlying asset’s return. It is a parametric method and assumes that multiple asset returns are multivariate normally distributed. The most important input in parametric VaR is the volatility of past return series. Various methods are there to estimate the volatility, and most of them require analysing past data series. Standard deviation is the simplest and most widely used method of calculating volatility

from past data and is used in the present study for generating VaR estimations based on the variance–covariance method. This method uses data on volatilities and correlations of various assets, and then it calculates VaR by applying weights to the positions. It involves the following steps: (a) mark-to-market the current portfolio, (b) set the time horizon, (c) set the confidence level, and (d) draw the VaR figure.

This method calculates the 1-day VaR with 99% confidence level as:

$$VcV \text{ VaR} = \text{Amount of the position} \times 2.33\sigma_t, \quad (1)$$

where σ_t is standard deviation and 2.33 is the z value of standard normal distribution (corresponding to the 99% confidence interval selected).

And the VaR for k days' period is estimated as:

$$VaR(k) = \sqrt{k} \times 1 \text{ day VaR} \quad (2)$$

This is referred to as the square root of time rule in VaR calculation. The square root of time rule implicitly assumes that daily returns are independent and identically distributed random variables. The variance–covariance method is suitable when the return distribution under analysis is either normal or very close to normal distribution. It is not able to capture fat-tailed behaviour if observed in the financial return series.

3.2 Exponentially Weighted Moving Average (EWMA)

It has been empirically observed that volatility tends to occur in clusters, which means that the periods of high volatility are followed by periods of higher volatility and periods of low volatility are followed by periods of lower volatility. This phenomenon can be referred to as “volatility is autocorrelated over time”. However, in technical terms, it is known as the “volatility clustering” phenomenon. In this method for calculating volatility, more weight is given to the recent observations, and, as the observation goes back in the past, its importance for volatility calculation reduces. This mechanism captures volatility clustering very well. EWMA variance is computed as follows:

$$\sigma_t^2 = \lambda \cdot \sigma_{t-1}^2 + (1 - \lambda) \cdot \Delta r_t^2 \quad (3)$$

σ_t^2 = conditional variance,

λ = decay factor,

r_t^2 = squared returns at time t.

The EWMA name derives from the fact that weights to past observations decline exponentially rather than linearly as in the standard deviation calculation. This technique is used by J. P. Morgan's Risk Metrics (1996) while calculating the volatility of financial asset returns. The closer the lambda (λ) is to zero, the more weight is given to recent period squared return, and if the return series is highly volatile, then conditional variance will be highly volatile as well. Risk metrics forecasts of volatility are calculated using a constant λ equal to 0.94 for daily data and equal to 0.97 for monthly data. These values are found to better capture the conditional volatility from their empirical research on financial returns series (Morgan (1996)). The study has also used λ equal to 0.94 for calculating EWMA VaR. Finally, EWMA VaR is computed in a similar way as VcV VaR, only the volatility is calculated by *Equation 3* above.

The method calculates the 1-day VaR with 99% confidence level as:

$$EWMA \text{ VaR} = \text{Amount of the position} \times 2.33\sigma_t, \quad (4)$$

where σ_t is EWMA volatility and 2.33 is the z value of standard normal distribution (corresponding to the 99% confidence interval selected).

3.3 Generalized Autoregressive Conditional Heteroskedasticity (GARCH)

This is another important method of calculating volatility from past return series which captures volatility clustering phenomenon very well. This method assumes that there exists a "mean reversion" in long-term volatility and that over a sufficiently longer period of time volatility will tend towards its long-term equilibrium mean level. To check the presence of volatility clustering, the study has estimated various generalized autoregressive conditional heteroskedasticity (GARCH) models using the overall return series. A GARCH (p, q) model is specified as follows:

For a log return series r_t , let $a_t = r_t - \mu_t$, which is the mean corrected log return. Then, a_t follows a GARCH (p, q) process if:

$$a_t = \sigma_t \varepsilon_t$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^p \alpha_i a_{t-i}^2 + \sum_{j=1}^q \beta_j \sigma_{t-j}^2, \quad (5)$$

where $\{\varepsilon_t\}$ is a sequence of IID variable with zero mean and variance one. Then, $\alpha_0 > 0$, $\alpha_i \geq 0$, $\beta_j \geq 0$, and $\sum_{i=1}^{\max(p,q)} (\alpha_i + \beta_j) < 1$. When $\alpha_i > p$, α_i will be taken as zero, and so $\beta_j = 0$ for $j > q$. The constraint on $(\alpha_i + \beta_j)$ implies that the unconditional variance of a_t is finite, where σ_t^2 evolves over time as its conditional variance.

To keep the GARCH model parsimonious and avoid overfitting, the study has analysed GARCH models with a maximum of four total lags, i.e. GARCH (1, 1), GARCH (1, 2), GARCH (2, 1), and GARCH (2, 2) for the return series. The results are presented in *Table 1*.

Table 1. *GARCH models estimate of Sensex return*

GARCH (p, q)	Parameters				
	α_0	α_1	α_2	β_1	β_2
GARCH (1, 1)	1.74E-06 (0.000)	0.070015 (0.000)		0.910085 (0.000)	
GARCH (1, 2)	1.69E-06 (0.000)	0.778 (0.000)		0.9452 (0.000)	-0.0326 (0.8733)
GARCH (2, 1)	9.76E-06 (1.000)	0.0766 (0.000)	0.0043 (0.8103)	0.9090 (0.000)	
GARCH (2, 2)	3.04E-06 (0.0471)	0.0742 (0.000)	0.0655 (0.2469)	0.1915 (0.8104)	0.6515 (0.3704)

Source: author's computation

Note: Values in the parentheses represent the respective p-values.

The parameter estimates show that none of the different orders of the GARCH model other than GARCH (1, 1) should be used for conditional volatility estimation as they are becoming insignificant (p-value is greater than 5%). Overall, it has been observed from Sensex return series that volatility clustering is best captured by GARCH (1, 1). The stationary condition for GARCH (1, 1) is $\alpha_1 + \beta_1 < 1$. For Sensex, the coefficients of GARCH (1, 1) are significant (i.e. $\alpha_1 = 0.070$ and $\beta_1 = 0.910$). As is typical of GARCH model estimates for financial asset return data, the sum of the coefficients of the lagged squared error and lagged conditional variance is generally found closer to unity ($\alpha_1 + \beta_1$ is 0.98). However, as the sum is less than unity, the conditional variance equation tells us that we have “stationarity” in conditional variance. For stationary GARCH models, conditional variance forecast values will converge upon the long-term average value of variance as the prediction horizon increases. As the return series is best captured by GARCH (1, 1), the study has calculated volatility by using the form GARCH (1, 1). GARCH VaR is then computed by using the GARCH volatility and the parametric formula for VaR.

The method calculates the 1-day VaR with 99% confidence level as:

$$\text{GARCH VaR} = \text{Amount of the position} \times 2.33\sigma_t, \quad (6)$$

where σ_t is GARCH volatility and 2.33 is the z value of standard normal distribution (corresponding to the 99% confidence interval selected).

3.4 The Historical Simulation Method

This is the non-parametric method for calculating VaR. The main characteristic of simulation methods is that they use full valuation approach. This method does not assume that returns follow any particular distribution. The actual distribution of returns is generated from past data, and VaR is obtained from finding the relevant percentile (e.g. 1st percentile for 99% VaR). It assumes that past data contain all the relevant information required to generate expected future returns. Hence, the quality of data becomes very important for this approach. Implicitly, it is assuming that the distribution of returns is not changing and is stationary over time.

3.4.1 Steps for VaR Calculation

In this method, the return series is generated over the past data window. The data series is then arranged in ascending order, having the return data start from the lowest and reach the highest point in the given period. VaR is then calculated by finding the required percentile as decided by the researcher.

The length of the past data is very important here as the number of days of past data should be sufficient to incorporate the tail of the return distribution. The data period should ideally capture economic scenarios which are expected in the near future. Also, if the number of past days from which market returns are generated is low, then the tail of the distribution may not be captured with sufficient accuracy. Empirically, the asset returns have moved to more extreme values in either side of the mean than what is suggested by the normal distribution curve (Venkatraman, 1997; Robert, 2009). This behaviour is known as leptokurtosis, wherein actual asset return distribution has thin waists and fat tails at the extremes (*Figure 2*).

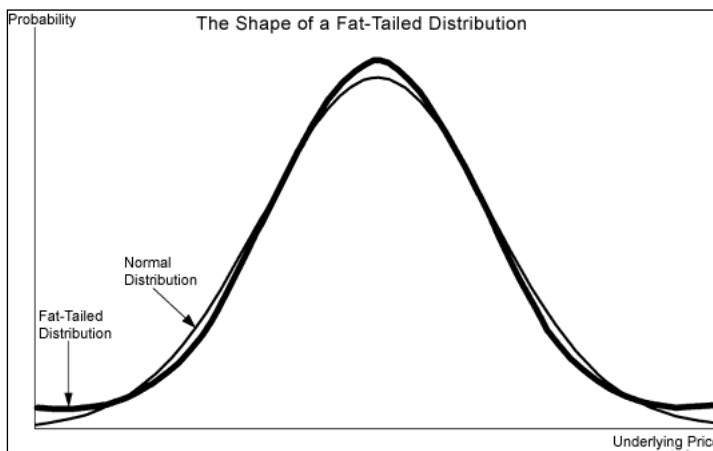


Figure 2. *Fat tails of financial returns*

As *Figure 2* above shows, if normal distribution is used as an approximation, then it would underestimate the probability of large extreme moves on either side of the distribution. As VaR is concerned with estimating extreme losses, it is very important that these fat tails are captured appropriately by the model. Empirically, it has also been observed that asset returns have reached much higher values on both sides of the mean of the normal distribution, which is not predicted well by the theory. Historical examples include the Black Monday (1987), the dot-com bubble (2001), and global financial crisis (2008). Historical simulation does not assume any distributional assumption. It is able to fully capture the fat-tailed behaviour of financial returns if they are contained in the past data, and it will accordingly show the VaR figure to reflect the true volatility of the asset under consideration.

3.5 The Monte Carlo Simulation Method

The basic concept of “Monte Carlo” is to repeatedly simulate a random process for the financial asset covering a wide range of possible situations. This method makes no distributional assumptions for return distribution, nor is the distribution generated by using past data. Here one assumes a suitable generating mechanism, and the data is generated by simulations through computer software applications. The designers of the risk measurement system are free to choose any distribution that they think appropriately describes the possible future changes in the market factors. Generally, if there is no significant market change expected, the beliefs about future market behaviour are based on the past behaviours observed. Therefore, designers of the system are free to choose any distribution that they think appropriately describes the past distribution. This approach is the most suitable one and, in most cases, the only option available to a researcher when the asset under analysis has non-linear payoff profiles such as options.

3.5.1 VaR Estimation Procedure Steps

a) A sequence of random numbers in the range from 0 to 1 is generated by using algorithms in a spreadsheet. The quantity depends upon the number of simulations needed to be performed. If it is believed that the algorithm process is not generating true random numbers, then the whole sequence of generated random numbers can be divided into various subparts, followed by taking the average of each subpart and then, finally, taking the sequence of these average numbers to further simulate the price path.

b) A distribution for generating the expected future natural log of asset price is assumed. The study assumes that the price (p_t) follows a “random walk” process. This process is described as:

$$\ln(p_t) = \ln(p_{t-1}) + u_t \quad (7)$$

For generating the asset price, the study assumes that prices are continuous variables, and the asset price follows the geometric Brownian motion (GBM). This is the continuous counterpart of random walk process and is described as:

$$ds = \mu s_t dt + \sigma s_t dz \quad (8)$$

Here, μ_t is the expected rate of return on asset at time t , s_t is asset value at time t , and σ_t is the volatility of the stock price. The dz random variable has the mean zero and variance dt , which inflicts price shock randomly to the portfolio value, and it does not depend on past information. In the above equation, two main parameters are very important to be determined: the expected return (μ) and the volatility of the underlying stock (σ).

Determination of μ : The study assumes that if the asset belongs to the market-traded portfolio, it must bear the systematic risk arising from market movements. A rational investor will therefore always expect that the return on shares must be at least equal to the risk-free rate available in the market, the proxy of which can be taken as return on government securities, which are assumed to be risk-free in nature. Also, for taking additional risk, the investor must be expecting some risk premium over and above the risk-free interest rate. In theory, however, it is possible to eliminate the market risk completely by constructing a portfolio of shares and options. The famous “Black and Scholes option pricing model” used this approach when valuing options. This model values the options by assuming a risk-neutral portfolio. A risk-neutral portfolio is one that is not affected by market risk and gives the return independent of market risk movements. So, it is not totally unrealistic to assume that investors demand only the return equivalent to the risk-free rate of interest. The present study assumes that the expected return is simply the opportunity cost of capital, which is nothing but the risk-free rate of interest available elsewhere in the market. In the GBM equation, expected return is related linearly with time.

Determination of σ : In the GBM, volatility is positively correlated to the time period over which it is estimated. It increases with the square root of time. Since for longer periods there are more expected variations in asset price, it is reasonable to assume that volatility increases with time. The square root formula for updating volatility is only applicable when the returns are uncorrelated over time.

c) Next, by using the inverse cumulative distribution function on the series of random numbers generated, the study obtains another series of observations of standard normal distribution having a mean of zero and a variance of one. This technique is called transformation method. This is required for modelling the GBM of asset prices.

d) Next, the asset prices are generated using the GBM formula and the stochastic terms generated above. Finally, different scenarios generated will lead to different

values for the asset. The profit and loss distribution can then be formed, and VaR can be calculated using the appropriate percentile.

3.5.2 Merits of the Monte Carlo Simulation Method

The large number of scenarios generated provides a more reliable and a more comprehensive measure of risk than the analytic methods. Due to the various scenarios generated, this method captures well the fat-tailed behaviour of financial markets. As it assumes that prices are log-normally distributed, a significant amount of error compared to when we assume normal distribution is corrected. It is the only option which can handle very well non-linear payoffs that are associated with options. In many cases when we are dealing with complex exotic options, their risk can only be captured by Monte Carlo simulations and not by the other two methods mentioned earlier. It can incorporate different kinds of risks and is thus suitable for when the portfolio is exposed to various risks at the same time. It captures convexity of non-linear instruments and updates the volatility when dealing with a longer time period. It can be used to simulate several alternative hypotheses about returns behaviour, which we assume to be such as white noise, autoregressive, etc.

3.5.3 Limitations of the Monte Carlo Simulation Method

The problem with this method is the computational effort required. When there is a very complex portfolio including a lot of options, the researcher will need to perform millions of simulation trials. It is both time- and energy-consuming. When the stochastic-process-generating mechanism does not match the actual return-generating mechanism, the final conclusions drawn would be misleading. This method also needs an assurance that the random numbers generated are truly random. If this is not assured, then the only way is to do simulations over a very large number of scenarios.

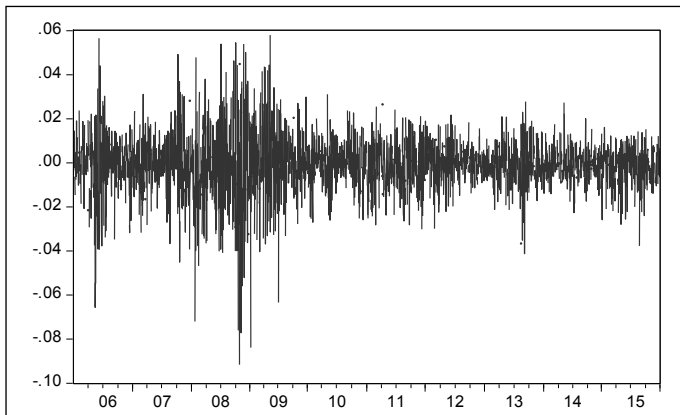
4. Empirical Results

The study uses daily Bombay Stock Exchange (BSE) Sensex index values as the benchmark for measuring equity market risk in India. The data extend over the period of 1 January 2006–31 December 2015, covering a time span of 10 years and a total of 2,480 observations. This range of 10 years of data allows us to draw meaningful insights from actual return distribution as the period is sufficiently long to study the behaviour of equity market. As per the required mandate for stress-testing framework from many regulatory bodies across the world (e.g. Comprehensive Capital Analysis and Review (CCAR) and Dodd Frank Annual Stress Testing (DFAST) in the USA and International Financial Reporting Standard (IFRS 9)), the modelling period must

include at least one macro-economic slowdown period. The period undertaken includes the global financial crisis of 2008–2009. The modelling framework thus includes a macro-economic stress period, and the final model is suited for both baseline and stress macro-economic projections for a future time period.

The data is obtained from the official website of BSE. Continuously compounded returns are generated for the index as $R_t = \ln(I_t / I_{t-1})$, where, R_t is the return at time t , I_t is the index value at time t , and I_{t-1} is the index value at time $t - 1$. \ln indicates the natural logarithm to base 'e'. The positive return (R_t) indicates rising index value and is favourable while the negative return indicates losses and is unfavourable for the holder of the financial asset. The study uses continuously compounded returns. The percentage returns are not used as they are not symmetric in nature. Due to lack of symmetry, when the index value rises from the current value to a higher value, the calculated return will not be equal when the index value falls from the same increased value to the previous level.

Figure 3 shows the graphical plot of index returns. It is evident that the return series is highly volatile. The level of volatility is higher during the global financial meltdown of 2007–2009. The asymmetric behaviour in volatility is also observed. The volatility is much higher on the negative side (returns are reaching to -9%, whereas positive returns are reaching a maximum of close to 6%). Regarding the normally made assumption for continuously compounded returns, it has also been observed that daily returns are on an average 0% while daily volatility is not, and it is generally found to be significant. This behaviour is observed as over the 10 years' period returns are more or less hovering around 0%, but significant spikes in volatility are observed.



Source: author's generation

Figure 3. Sensex return plot for the period of 2006–2015

Table 2 below shows the descriptive statistics of Sensex returns. From the descriptive statistics, it becomes evident that the returns over this period are negatively skewed,

with a skewness value of -45%. It is also observed that daily mean returns are close to 0%, while daily standard deviation is found to be relatively significant (1.34%). Fat-tailed behaviour in return series is also observed as the kurtosis value (7.29) is much higher than the value assumed for a normal distribution (3). It is evidencing that empirically Sensex returns have reached extremes on both positive and negative sides much more frequently than what is predicted by a normal distribution.

Table 2. *Descriptive statistics of Sensex return*

Metric	Sensex Return Series
Mean	-0.087%
Median	-0.065%
Maximum	5.799%
Minimum	-9.15%
Std. Dev.	1.34%
Skewness	-45.74%
Kurtosis	7.290
Total Observations	2,480

Source: author's computation

The study now attempts to examine the critical assumptions made under financial models since if these assumptions are not satisfied, the results generated by models may be inappropriate. If any assumption is found not to hold, then the study has tried to find what alternative distributional assumptions are best at describing the present data series.

Normality of the data series is a crucial assumption for parametric methods. In order to determine whether daily returns of Sensex are normally distributed or not, normality of the return distribution is tested by the Jarque–Bera (JB) test, the Anderson–Darling (AD) test, and the Kolmogorov–Smirnov test. The results are presented in *Table 3* below.

Table 3. *Normality tests of Sensex returns*

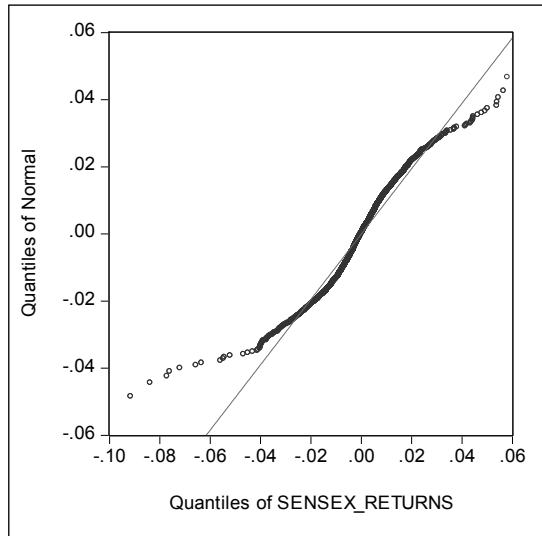
Normality Tests	Sensex Return Series
Jarque–Bera	1995 (0.0000)
Anderson–Darling	26.68 (0.0000)
Kolmogorov–Smirnov	0.074 (0.0000)

Source: author's computation

Note: Values in the parentheses represent the respective p-values.

As the p-values of all three tests of normality are 0, the null hypothesis of normality is rejected, and it can be strongly inferred that Sensex returns are non-normal over the said period.

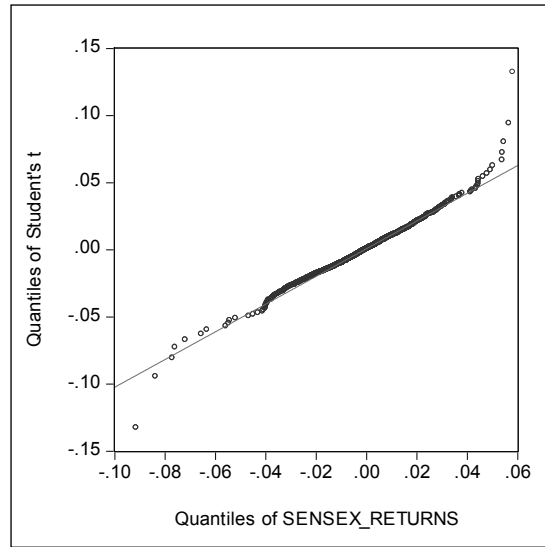
The study further uses graphical technique (Q–Q plot) to test for normality and the presence of heavy tails. The Q–Q plot of the returns is shown in *Figure 4*. It has steeper slopes at the tails, and the tails have their slope different from their central mass. These facts suggest that the empirical distribution of Sensex returns is not normal and has heavier tails than the reference normal distribution (*Figure 4*).



Source: author's generation

Figure 4. Q–Q plots of Sensex return with normal distribution

To better capture the return distribution, the study further makes an attempt to see if the return distribution can be better approximated by other leptokurtic distributions which have higher kurtosis than the normal distribution. The t-distribution is a leptokurtic distribution having higher kurtosis than the normal distribution. Leptokurtic distributions are fat-tailed distributions having thicker tails, which are better able to capture the extreme moves of the distribution by providing a significant probability of exceeding from a given value in the tails of the distribution. As can be seen from *Figure 5*, the Q–Q plot of returns is better approximated by t-distribution than the normal distribution. The quantiles of Sensex returns are found closer to t-distribution quantiles, and hence it can be inferred that t-distribution is better able to capture the tails of the return series.



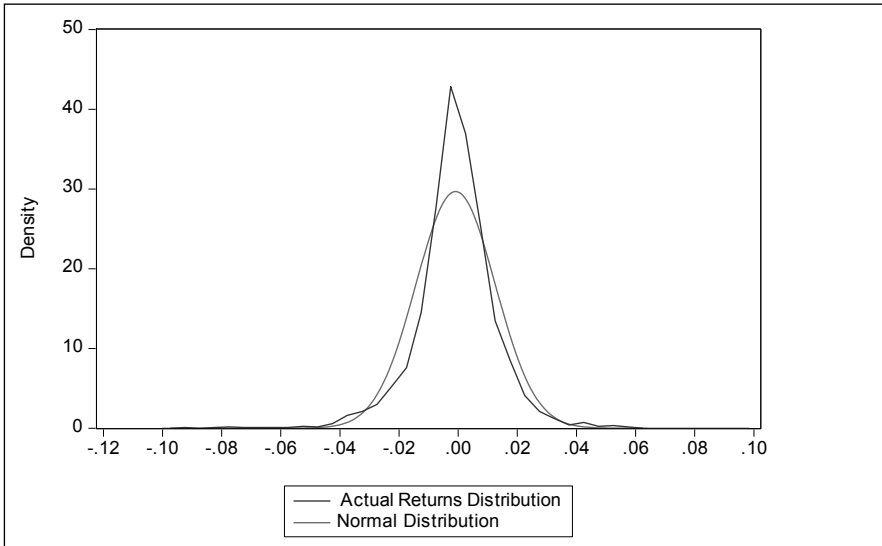
Source: author's generation

Figure 5. *Q-Q plots of Sensex return with student's t-distribution*

The study further compares the actual distribution of returns with both normal and t-distributions (*figures 6 and 7*). The original empirical distribution of returns is plotted in *Figure 6* with a superimposed normal distribution curve for making comparison. It is observed that actual returns are peaked at the mean value, thin at the waist, and thick at the bottom as the normal distribution, matching all the characteristics of fat-tailed behaviour. The actual returns series has further been compared with the more “leptokurtic” t-distribution in *Figure 7*. It shows that leptokurtic distribution such as “t” is better able to capture the actual empirical distribution of returns observed in the financial markets.

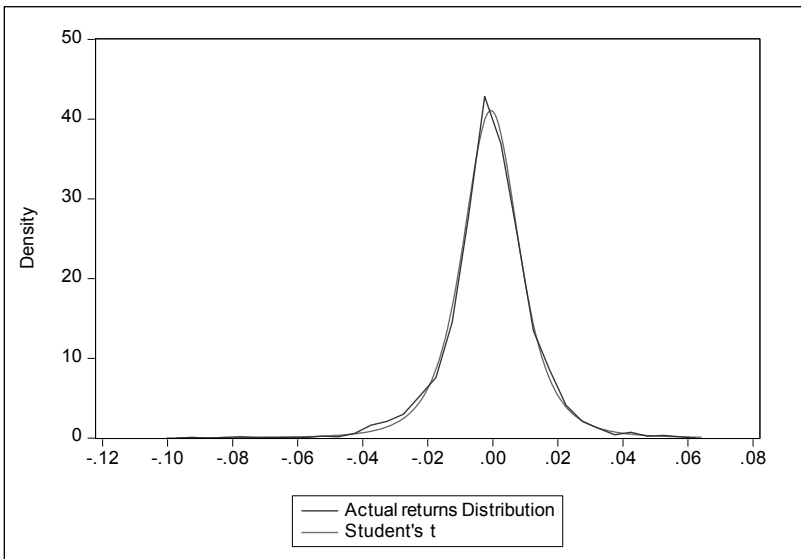
Overall, it can be inferred that Sensex returns are characterized by having thicker tails, and they are best captured by leptokurtic t-distribution, rather than the normal distribution.

Another very important assumption and requirement for financial return modelling is that the return series considered need to be stationary over the considered time period, otherwise the results may not be relied upon for future forecasting period. Stationarity of the variables is desirable and required whenever the past data is used to build models for future forecasting purposes. This is tested with the help of unit root test in *Table 4* with the help of Augmented Dickey–Fuller “tau” statistics. This test checks for non-stationarity with three different functional forms: random walk, random walk with drift, and random walk with drift and trend.



Source: author's generation

Figure 6. Actual return distribution compared with normal distribution



Source: author's generation

Figure 7. Actual return distribution compared with student's t-distribution

Table 4. *Checking the stationarity of Sensex returns*

Null Hypothesis: Sensex returns has a unit root						
Model	Trend parameter	Drift	Lagged coefficient	Tau-statistics	Critical values (5% level)	H
Random walk	NA	NA	-1.049	-52.31	-2.56	1
Random walk with drift	NA	-0.0009	-1.054	-52.53	-2.86	1
Random walk with drift and trend	-1.60E-07	-0.0007	-1.0542	-52.53	-3.41	1

Source: author's computation

Note: "H" stands for Boolean decision-making, where H = 0 means null hypothesis cannot be rejected. H = 1 means null hypothesis can be rejected.

The results of all three tests indicate that the null hypothesis of non-stationarity should be rejected, and it can be concluded that the return series is stationary, the behaviour shown by Sensex returns in the past is expected to continue in the future forecasting period as well, and any modelling exercise on the returns series can be statistically relied upon.

Table 5 below presents the results of VaR computation for Sensex using parametric (VcV, EWMA, GARCH) and non-parametric (HS and MCS) methods.

Table 5. *VaR computation for Sensex*

Method	VcV VaR	EWMA VaR	GARCH VaR	HS VaR	MCS VaR
Value at Risk for 1-day horizon (VaR)	-3.219%	-1.716%	-1.581%	-3.908%	-1.661%

Source: author's computation

Note: VaR figures are at 99% level of confidence with 1-day horizon.

It can be seen that the highest VaR figure is observed by using the historical simulation method (-3.908%). This means that there is a 99% probability that on a typical trading day investors can expect that Sensex will fall in value by a maximum of 3.908% from its opening value, and there is only 5% probability that it can fall more than that. This information can help market participants to form appropriate market trading strategies and portfolio-management-related activities. VaR calculated with other parametric methods (VcV, EWMA, and GARCH) and non-parametric MCS predicts lower VaR estimates. Results suggest that Sensex returns have reached lower levels in the past which are not captured well by the normal-distribution-based parametric methods. This suggests that normal distribution assumption is not adequate for the Indian equity market, and it can be expected

that the returns may very well deviate from the normal distribution in the near future. Overall, to be on the conservative side, it can be inferred that historical simulation is the best method for VaR estimation for the Indian equity market as represented here by Sensex. The study further tests this finding statistically in the next section of backtesting.

5. VaR Backtesting

The study finally tries to find the most appropriate VaR method which best captures the market risk arising from the Indian equity market (Sensex) by performing backtesting. Backtesting is a statistical process to ascertain the accuracy of the statistical model employed for prediction. This methodology compares the actual results with the results predicted by the model employed. If the actual loss on a given day exceeds the VaR predicted, then it means that the model is unable to predict accurately on that day, and it is considered as an actual exception. Exception is defined as a violation and indicates that the model employed is unable to predict the VaR accurately for the given day. The study uses 1-period ahead rolling window forecast to calculate the predicted number of exceptions. The study uses the first 500 (1–500) data points from the beginning of the total historical time series data (1 Jan 2006 to 15 Jan 2008) to project VaR for the 501st day (16 Jan 2008), then data from day 2 to 501 to project VaR for the 502nd day, and so on. This process of updating VaR estimates continues up to 31 Dec 2015, and the total data points available to perform backtesting are 1980 (up to 31 Dec 2015). Finally, the actual and predicted exceptions are compared in the backtesting. The study uses 3 different tests to perform backtesting as mentioned below, and all of these tests use the total number of exceptions occurred as an input.

1. Actual number of exceptions test;
2. The Basic Frequency Backtest;
3. Proportion of Failure Likelihood Ratio (LR) test.

1) Actual Number of Exceptions: This test calculates the actual number of exceptions over the time period and compares them with the expected number of exceptions. For example, over a 100 days' time period and at 95% and 99% confidence levels, the expected number of exceptions are 5 and 1 respectively. This test only provides the direction that whether total exceptions are under- or overpredicted by the model employed. This test should be used in combination with the other two below-mentioned robust statistical methods to select the best VaR method.

2) The Basic Frequency Backtest: The basic frequency (or binomial) tests whether the observed frequency of tail losses (or frequency of losses that exceeded VaR)

is consistent with the frequency of tail losses or the number of VaR violations¹ predicted by the model. In particular, under the null hypothesis that the model is consistent with the data, the number of tail losses “x” follows a binomial distribution. Given “n” return observations and a predicted frequency of tail losses equal to “p”, this tells the probability of x tail losses as:

$$p_r(x|n, p) = \binom{n}{x} p^x (1-p)^{n-x}, \quad (9)$$

where “n” is the total number of observations, “p” is one minus confidence level, “x” is the actual numbers of exceptions. The relationship between x and binomial test probability value is that the probability value declines as x gets bigger. When the number of observations increases, the binomial distribution can very well be approximated by a normal distribution. As the present study has a significant number of observations for backtesting (1980), it has employed the normal approximation test as given below:

$$Z = \frac{(x - np)}{\sqrt{n \cdot p(1-p)}}, \quad (10)$$

where $n \cdot p$ is the expected number of exceptions and $[p \cdot (1-p) \cdot T]$ is their variance. This test follows the standard normal distribution with mean 0 and variance 1. The test statistic uses left-tailed “z” statistic as VaR is concerned with predicting losses, and thus the left side of return distribution is used for calculating the number of exceptions. The null hypothesis assumes that the model is correctly calibrated, and if the value of the statistic is higher than the critical value of the Z distribution, then the null hypothesis is rejected and the model is recognized as being incorrectly calibrated and unable to predict VaR accurately.

3) Proportion of Failure LR Test: This is the likelihood ratio test suggested by Kupiec (1995) for backtesting, and it predicts whether there is a significant difference between actual and observed failure rate. Failure rate is defined here as the total number of exceptions (x) observed over the total number of days (n). This test uses LR statistic as:

$$LR = -2 \ln \left[\frac{p^x (1-p)^{(n-x)}}{\left(\frac{x}{n}\right)^x \left(1 - \frac{x}{n}\right)^{(n-x)}} \right] \sim \chi^2(1) \quad (11)$$

1 Tail losses or VaR violation refers to the exceedance of actual VaR from the calculated VaR. Therefore, the number of VaR violation is the number of times it exceeds the calculated VaR.

The LR statistic follows a chi-square distribution with 1 degree of freedom. The null hypothesis assumes that the model is correctly calibrated, and if the value of the statistic is higher than the critical value of the distribution, then the null hypothesis is rejected and the model is recognized as being incorrectly calibrated and unable to predict VaR accurately. *Table 6* below provides the statistics obtained by using different VaR methods for 1-day holding period using 95% confidence interval.

Table 6. VaR backtesting statistics at 95% confidence interval

METHOD	VCV VaR	EWMA VaR	GARCH VAR	HS VaR	MCS VaR
Actual number of exceptions	98	111	160	96	114
The Basic Frequency Backtest z value	-0.103	1.237	6.289	-0.309	1.546
Proportion of Failure LR test χ^2 values	0.016	1.237	33.617	0.096	2.285

Notes: expected number of exceptions = 99 (5% of 1980); z critical value at 5% level = 1.645; χ^2 (1) critical value at 5% level = 3.841

From the above table, it becomes evident that both statistical tests (the Basic Frequency Backtest and the LR test) find that VcV, EWMA, HS, and MCS are able to predict well the VaR as the null hypothesis cannot be rejected for all of them. From the actual number of exceptions, however, VcV and HS exceptions are very close to the expected number of exceptions (99). Hence, the study finds that at 95% CI both VcV and HS are able to predict VaR reasonably well compared to other methods. However, at 95% confidence level, the tails of the distribution are not captured appropriately by the models; furthermore, the study observes tail behaviour by finding VaR at 99% confidence interval. *Table 7* below provides the exceptions obtained by using different VaR methods for 1-day holding period using 99% confidence interval.

Table 7. VaR backtesting statistics at 99% confidence interval

METHOD	VCV VaR	EWMA VaR	GARCH VAR	HS VaR	MCS VaR
Actual number of exceptions	37	39	69	28	41
The Basic Frequency Backtest z value	3.88	4.33	11.11	1.85	4.77
Proportion of Failure LR test χ^2 values	12.01	14.66	75.12	3.03	17.51

Note: expected number of exceptions = 20 (1% of 1980); z critical value at 1% level = 2.33; χ^2 (1) critical value at 1% level = 6.63

From the above table, it becomes evident that from both statistical tests (the Basic Frequency Backtest and the LR test) only the historical simulation method is predicting well, and the null hypothesis cannot be rejected for both of the tests. None of the other methods is found to be predicting well, and the null hypothesis of the model being correct needs to be rejected for all other methods (VcV, EWMA, GARCH, and MCS). It is also observed from the actual number of exceptions that only historical simulation is predicting the exceptions closer to the expected. Hence, the study concludes that at 99% confidence interval only historical simulation is the best method for predicting VaR. Results also confirm the earlier observed phenomena of fat-tailed behaviour in the Indian equity market (Table 2). 99% confidence interval is better able to capture the tail behaviour and can capture the variation in the tails of distribution as the historical simulation method does not make any distributional assumption and provides the VaR figure incorporating the fat-tailed behaviour.

Overall, combining the results of 95% and 99%, the study concludes that historical simulation is the best predictive VaR model for the Indian equity market (Sensex).

6. Summary and Conclusions

The study shows the empirical findings related to the Indian equity market. It is observed that equity returns are non-normal, left-skewed, and characterized by excess kurtosis and exhibit fat-tailed behaviour. It is observed that “non-normal” Sensex return series is best captured by using “leptokurtic distributions”, which allow for fat-tailed behaviour such as the t-distribution. It is further observed that return series is exhibiting the volatility clustering phenomenon. The return series is found to be stationary, and any statistical model can be relied upon for future forecasting period as well. The study supports the empirical findings of Venkatraman (1997), Nath and Samanta (2003), Sollis (2009), and Samanta et al. (2010). The findings proved to be different from those of Varma (1999), Chowdhury and Bhattacharya (2015), and Poornima and Reddy (2017). The study finds that the best method of VaR computation for the Indian equity market (Sensex) is historical simulation, which allows for non-normality, excess kurtosis, and the fat-tailed behaviour of financial returns. This finding is validated by three robust statistical backtesting methods. The backtesting is performed at 95% and 99% confidence intervals. At 95%, results indicate that VcV, EWMA, HS, and MCS are able to predict well the VaR. For capturing the fat-tailed behaviour, the study further performs backtesting at 99% confidence interval, where only HS stands as the best method for predicting VaR. Hence, the study concludes that the best method of VaR computation is historical simulation.

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Demographic Profiles for Cross-Cultural Adjustment of Expatriates in Nigeria

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Abstract. This paper offers insight into the demographic profiles of expatriates for successful cross-cultural adjustments in the context of Nigeria. It considers the following demographics: age, gender, marital status, international work experience, and time spent in the host country. The study adopted cross-sectional survey research by utilizing a questionnaire to collect data from one hundred and fifty-two (152) expatriate residents in Nigeria, who relocated from 22 different countries and who have worked and lived in Nigeria for over six months. The paper discovered that marital status, international work experience, and length of stay in Nigeria rather than age and gender are the demographic profiles influencing and required for the successful cross-cultural adjustment of expatriates in the Nigerian context. It concludes that the more organizations recruit, select, and deploy expatriates whose demographic profiles reflect the higher length of stay/time in Nigeria, higher level of international work experience, and single/unmarried, the higher the successful cross-cultural adjustment of such expatriates in the Nigerian context.

Keywords: age, gender, international experience, psychological adjustment, sociological adjustment

JEL Classification: M, M12, M16, M54, N3 N30, 015

1. Introduction

Skilled expatriates remain the most valuable assets utilized by foreign-owned organizations in Nigeria in developing the competencies of local employees, coordinating the establishment of new ventures, transferring technological knowledge, and stimulating the standardization of products (Samuel and Adeniyi, 2015). Unfortunately, many of the expatriates recruited, relocated, and deployed to perform such strategic roles in Nigeria were reported to have failed to complete

a time-based assignment occasioned by unsatisfying work settings, difficulty in communicating/interacting with the local hosts, exposure to different climate conditions, and difficulties to adjust well to the sociocultural conditions of Nigeria (Costa, Cunha, and Rego, 2014; Okpara, 2016; Heirmsac, Edwin, Agumadu, and Ohaegbu, 2015). This confirmed the Global Relocation Services (2016) report on expatriation that 40% to 70% of expatriates relocated and deployed to foreign locations across the globe usually experience maladjustment to the foreign assignment destination every year.

Consistent with theoretical and practical relevance, the failure of expatriates to psychologically adjust and perform well in foreign assignments may be contingent upon mismatching the demographics of the expatriates to the host location's social-cultural and work conditions. This assumption is based on a person–culture fit theory suggesting that demographics (differences in biological and physical make-ups among individuals), which are associated with unnoticeable personality traits, are personal resources enabling an individual to cope with the stress of living, working, and interacting in a difficult environment. Matching expatriates' demographics to the host location's sociocultural and work conditions tends to reduce maladjustment and its consequences on cognitive, psychological, and behavioural withdrawals from the foreign assignments (Stoermer, Haslberger, Froese, and Kraeh, 2018).

Extant studies (Salamin and Davoine, 2015; Selmer & Luring, 2013b, Nolan and Morley, 2014) have over time validated the theoretical assumption of person–culture fit that the greater the fit between expatriates' demographics and the host country's sociocultural values, the greater the psychological adjustment and the higher the intention to complete foreign assignments. They profiled expatriates' cross-cultural adjustment according to demographics for relocation, selection, and recruitment purposes. But demographic profiles of expatriates for successful cross-cultural adjustments and performance were conflicting across countries.

This conflicting evidence, therefore, called for the scholarly attention of Okpara (2016) and Eze and Awolusi (2018), who revisited the influence of demographics on expatriates' cross-cultural adjustment/performance in the Nigerian context to debunk or confirm existing findings and draw practitioners' attention to the demographic profiles of expatriates that are required for their success and adjustment to Nigeria. However, Okpara (2016) and Eze and Awolusi (2018) focused only on age, gender, and the previous work experience of expatriates, with little or no attention paid on how marital status, international work experience, and time spent in the host country directly influence expatriates' cross-cultural adjustment in Nigeria. It is on the basis of these gaps that this study is being carried out to examine the influence of demographics (marital status, international work experience, time spent in the host country, age, gender) on expatriates' cross-cultural adjustment in Nigeria.

Section 2 of this paper covers conceptual reviews on cross-cultural adjustment and its dimensions. Section 3 reviews extant literature focusing on demographics and their influence on expatriates' cross-cultural adjustment. Section 4 contains the theoretical framework of the paper. Section 5 highlights the methodology adopted. Section 6 presents the results and discussions. Section 7 contains the discussion of findings, while section 8 covers the conclusions and policy implications of the findings of the paper.

2. Literature Review on Expatriates' Cross-Cultural Adjustment

Expatriates' cross-cultural adjustment is used interchangeably with expatriates' intercultural adjustment, expatriates' intercultural adaptations, expatriates' cross-cultural adaptation, or expatriates' acculturation in cross-cultural management literature. It is a broad term, lacking a specific or standard definition. Mendenhall and Oddou (1985) specifically hold that expatriates' cross-cultural adjustment is not a one-dimensional (adjustment to the work and host residents as well as the general environment) concept but a multi-dimensional (adjustment to the general environment, work, and host nationals) concept given that expatriates can get adjusted well to weather conditions, languages, the standard of living, and interactions with host nationals and yet (at the same time) maladjusted to new work roles in the foreign assignments. Searle and Ward (1990) concur that cross-cultural adjustment is a multi-dimension concept embedded in psychological and social-cultural adjustments.

Psychological adjustment is the degree to which expatriates are comfortable and happy living in a new culture (Demes and Geeraert, 2014). This is concerned with and related to overall satisfaction with living conditions in the new environment and the subjective well-being experienced by expatriates in residing and living in the host culture (Takeuchi, Wang, and Marinova, 2005). Psychological adjustment focuses more on the attitudes and feelings among expatriates, which corresponds to the hypothetical concept of subjective well-being and contentment with regard to various aspects of life in the host culture (Sterle, Vervoort, and Verhofstadt, 2018). Over time, this has been measured using a subjective well-being scale, which contains several questions concerning how people are feeling and enjoying everyday experiences (Selmer and Lauring, 2009; Selmer and Lauring, 2014), are comfortable with and feel at home in the assigned country (Shaffer and Harrison, 2001), the amount of cultural stress and strains, including anxiety, helplessness, and irritability experience in the host country, which usually result in homesickness and longing for the more predictable and gratifying environment (Selmer and Lauring, 2014).

Sociocultural adjustment is an expatriate's capability to successfully adjust to daily life and work conditions in the host locality (Ward and Kennedy, 2001). It involves the amount of ease in coping with a host country's living, working, and interacting conditions (Hemmasi and Downes, 2013). Social-cultural adjustment is the extent to which expatriates fit into the work and general environment of the host culture (Aycaan, 1997) or the ability or inability to fit in, effectively negotiate, and integrate into everyday life situations. It is grounded within the learning paradigm derived from sociocultural learning theory that emphasizes practical social skills, social behaviours, and the ability for adapting and coping with the culture shock, which occurs when one changes from one culture (work norms, friends, and living conditions) to another one that may be unfamiliar and demanding (Ong and Ward, 2005). Social-cultural adjustment corresponds more to the practical and behavioural parts of adapting to a new job, the language of host nationals, and living conditions, including weather, food, health facilities, security, and public utilities encountered in the host country (Malo, Tremblay, and Brunet, 2015).

Cross-cultural adjustments have also been categorized based on work, general, and interaction adjustment to enable content analysis and the easier development of measurement scales and to enable practitioners to focus on the specific characteristics of the social-cultural environment of the host country, which expatriates are less or more adjusted to for intervention purposes. Adjustment to the General Living Environment is the degree to which expatriates cognitively and psychologically adapt to and are comfortable with living conditions: for example, housing conditions, healthcare, and the cost of living in the host country (Nolan and Morley, 2014). It is the successful adaptation to and the satisfaction derived from the pattern of shopping for goods and obtaining services, store opening and closing hours, the common language of the people, security situations, transport systems, power supply, social and family relations, the nature and quality of food, policies and programmes of host countries, public life, order and conducts in a host country, religious beliefs and value systems of the host country as well as customs, social relations, and family relations in the host country (Haslberger, Brewster, and Hippler, 2013). It is the degree to which expatriates experience a state of happiness with the new environment or experience subjective well-being in the new cultures and cognitively adapt to living conditions, work challenges, and the cultural norms, values, and styles of social interaction in the host country (Searle and Ward, 1990).

Adjustment to work conditions is a cognitive adaptation to work demands in the host countries as well as a psychological comfort experienced among expatriates with various aspects of work (Selmer and Lauring, 2011a). Assessments are often made with respect to: how well expatriates are coping with and adapting to supervisory and job responsibilities; work roles and procedures (Zhang and

Oczkowski, 2016); the derived satisfaction in meeting work-related demands of the foreign assignments. The adjustment to social interactions is the degree to which expatriates have cognitively adapted to and are psychologically comfortable in developing an interpersonal exchange, interacting and relating with host locals in work and non-work settings (Selmer and Luring, 2014). This is also about the amount of positive/negative moods that expatriates obtain from communicating with host nationals, developing interpersonal relationships, and socializing with host nationals (Varma, Pichler, Budhwar, and Kupferer, 2012). The adjustment to social interaction is the extent to which expatriates integrate themselves into host culture identities (styles of communication, local language as well as behaviours, gestures, and stories of the host nationals) (Chen, Kirkman, Kim, Farh, and Tangirala, 2010), which has been addressed by intercultural communication including an effective understanding of the language, interacting with the language, and the effective tailoring of communication (Mordi, 2017).

Haslberger, Brewster, and Hippler (2013) assert that cross-cultural adjustment is not only a cognitive and psychological/emotional response but also a behavioural response among expatriates to the standard of living in the host country, host nationals, and job demands in the host environment. The behavioural adjustment is the acceptance or withdrawal from foreign assignments or early return to the home country (before the time originally planned), which is used to gauge an expatriate's failure in a global assignment (Haslberger et al., 2013). It also involves being alienated from the general environment (food, climate, living conditions, health facilities) in host cultures; working conditions (job tasks, roles, and responsibility) in the host culture, and social interactions, including the communication pattern and common language of host nationals in work and non-work settings in a foreign culture (Jannesari, Wang, McCall, and Zheng, 2017). Behavioural adjustment is occasioned by the experience of the negative emotional state resulting from a negative evaluation of host cultures (Hippler, Caligiuri, and Johnson, 2014), and it has been studied over time from the angle of premature return from foreign assignments, usually measured with expatriates' intentions to return earlier from a foreign assignment or foreign location.

3. Demographics and Cross-Cultural Adjustment of Expatriates

Demographics are associated with differences in biological and physical make-up among individuals. They are associated with gender, age, education, location, life experience, language ability, and marital status among others. This study, therefore, focuses on gender, age, marital status, international experience, and time spent in Nigeria.

Gender: Men and women tend to be characterized by different unnoticeable personality traits. This is given that men are assertive, competitive (focused on material success), aggressive, and emotionally stable, while women tend to be considerate, sensitive, emotionally unstable, and social activity-seeking in general. In the light of this, women are likely to experience low psychological adjustment levels in masculine cultures and experience high psychological adjustment in feminine cultures, while men are likely to fit in and experience psychological adjustment in masculine countries/cultures unlike in feminine cultures. This suggests that gender moderates the relationship between the cultural distance and cross-cultural adjustment of expatriates to host culture. Caligiuri and Tung (1999) empirically confirmed that men adjusted better to masculine and uncertainty avoidance countries but adjusted in an equal measure with women in feminine cultures, using data from 98 expatriates of American origin in Asia, Europe, and South America.

Sinangil and Ones (2003) revealed that the performance of male and female expatriates in Turkey is not statistically different. This confirms the findings of Fisher and Härtel (2003) that gender is not important in determining the success of expatriates in Thailand, using data collected from 30 females and 25 males. Luring and Selmer (2015) further empirically revealed that, except for job performance, males and females are not significantly different in the level of time to proficiency, job satisfaction, and adjustment to foreign cultures – data collected from 1,215 academic staff in 35 higher institutions in five Northern European countries. Similarly, Bastida (2018) demonstrated that females and males experienced the same levels in all the criteria for measuring success in foreign assignments. Empirical studies in Nigeria by Heirsmac (2015) and Eze and Awolusi (2018) further revealed that gender does not significantly explain the dimensions of adjustments and success in performance among expatriates in Nigeria. Even when males made up the majority of the expatriate population, Heirsmac (2015) and Eze and Awolusi (2018) concluded that the performance of males is not significantly different from that of females in a foreign assignment. These findings are, however, contrary to those of Okpara's (2016) study, which revealed that gender significantly influences the predictors of adjustment in Nigeria.

Making use of data on expatriates and their partners living in the UK, the US, and Spain, Haslberger (2010) also empirically showed that women generally tend to be better adjusted than men and are mostly ahead in contextual performance. Selmer and Leung (2003) also revealed that female SIE (self-initiated expatriate) academics perform better than their male counterparts – using data from 309 male and 79 female expatriates in Hong Kong – even when female and male business expatriates were significantly different in all of the six personal characteristics (age, tenure in parent's organization, length of stay in a host country, position and international experience, previous expatriate assignment, and marital status). Using data from 152 expatriates

from thirty countries, Salamin and Davoine (2015) further report that, except adjustment to the general environment, female expatriates adjusted better to social interaction and work. Selmer and Lauring (2011b) also confirmed that males are less adjusted to social interaction and work in a foreign assignment as compared to females. Against this backdrop, it is, therefore, hypothesized that:

H₁: female expatriates experience a greater cross-cultural adjustment than male expatriates in Nigeria.

Age: age denotes the number of years one has lived. It is associated with greater self-control, sensitivity to ethical behaviours, and an increase in symbolic characteristics, especially in collectivist cultures (Asian and African societies), where respect for old age is particularly emphasized and perceived as high-quality personal resources (Selmer, Lauring, and Feng, 2009). Exploring the role of self-control associated with age in the adjustment of expatriates to a foreign culture, Lauring and Selmer (2018) demonstrate that self-control (discipline) tends to be more intense in older people than in younger ones, which has a significant positive impact on adjustment outcomes, including job performance, and negatively influences time to proficiency.

Moreover, growing older has also been revealed to increase sensitivity to ethical behaviours. This is especially valid in corruption, which in turn is revealed to influence adjustment to the host culture (Costa, Cunha, and Rego, 2014) because age is linked to greater lifelong learning, increase in self-cultivation, and greater sensitivity to unethical behaviour. Selmer and Lauring (2013a) further revealed that as age increases the possession of high-quality personal resources increases too, which in turn impacts on the ability to adjust and perform well in the Chinese cultural setting. They recommended that organizations should not discriminate against older job applicants when using age in expatriates' selection in the context of China. This finding aligned with Okpara's (2016) from an empirical study conducted in Nigeria that age influences expatriates' adjustment in Nigeria. They also confirmed the content analysis of Mohr and Klein (2004) showing that older expatriates and older spouses reported a favourable adjustment to the host country's living conditions and higher satisfaction than younger spouses during the overseas assignment.

However, an increase in age may result in biological and psychological changes that may alter the physical strength, meta cognitive ability, and performance of the individual. In this regard, extant literature, including Fonseca, Dias, Baptista, and Torgal (2017), revealed that psychological distress increased with age among the three hundred and fifty-two Portuguese civil expatriates working and living in Angola and Mozambique. Eze and Awolusi's (2018) investigation on the critical challenges faced by expatriates in the Nigerian oil and gas sector also discovered that those expatriates who are younger and more experienced perform better. Okpara (2010) also found that age significantly influences expatriates' cross-cultural

adjustment in Nigeria. On the contrary, Lauring and Selmer (2015) showed that age does not play a significant role in the work outcomes (work performance, work effectiveness, and work adjustment) of expatriates. Similarly, Fisher and Härtel (2003) collected data from 30 females and 25 males and revealed that age was not important in determining the success of expatriates in Thailand. It is, therefore, hypothesized that:

H₂: the younger the expatriates, the higher the cross-cultural adjustment in the context of Nigeria.

Marital Status: this indicates whether the investigated individuals are married, single, divorced, separated, or living with a partner in a foreign location. Examining the influence of marital status, Selmer and Lauring (2011b) showed that married western expatriates who relocated with their spouses tend to fare better, are more satisfied with their lives in a host country, and are healthier physically and psychologically than their unmarried and married peers who have not relocated with their spouses to Taiwan, Hong Kong, or Japan.

Lauring and Selmer (2015) further rate married expatriates higher than their unmarried peers for work performance and effectiveness. These findings supported the crossover theory indicating that spouses' sense of well-being (psychological adjustment) in a new culture spilled over into expatriates' adjustment, better effectiveness, and performance – especially among expatriates assigned to culturally and linguistically distant countries. However, the failure of a spouse to adjust well to a foreign country is usually harmful to the performance and adjustment of expatriates, and it is the most common cause of premature termination of the assignment (Shaffer and Harrison, 2001). The effect is stronger in male expatriate spouses given that female expatriate spouses receive more adjustment supports from organizations unlike the male spouses, who receive little or no adjustment support from organizations (Shaffer and Harrison, 2001).

Moreover, it has been demonstrated that married expatriates experience more difficulty in adjusting to foreign locations when their spouses find it difficult to get a job in the host culture. Often occasioned by host language barriers, visa and work permit restrictions as well as lack of marketable skills, educational/professional qualifications (Lazarova, McNulty, and Semeniuk, 2015), the inability of expatriates' spouses to get the desired job in foreign countries makes them lose their self-esteem (Shaffer and Harrison, 2001). This is especially true in cases when they were gainfully employed in their home country before relocating with their spouse. The changes in the identity of spouses tend to create conflicts in the family, which in turn spills over into expatriates' adjustment to a foreign assignment. This has been empirically supported when a study revealed that dramatic changes in the identity of expatriates' spouses from being gainfully employed in the home country to becoming caregivers or housekeepers in a foreign country mediate the effect of marital status on expatriates' adjustment to the host culture (Lazarova,

McNulty, and Semeniuk, 2015) because unemployment can make people feel frustrated, insecure, depressed, and anxious about their careers. Lazarova et al. (2009) and Lazarova, Westman, and Shaffer (2010) also reported that change in employment does not only create a stressful relationship but also makes married expatriates experience higher adjustment difficulties than unmarried expatriates. It is, therefore, hypothesized that:

H₃: expatriates' cross-cultural adjustment capacity in Nigeria significantly vary based on marital status in that single expatriates experience greater cross-cultural adjustment than married expatriates.

Previous International Experience: this is the extent to which expatriates have previously worked, lived, and studied in foreign countries before the current location's assignment (Shaffer, Harrison, and Gilley, 1999). Foreign international experience is measured by the number of countries previously lived, worked, and studied in as well as the amount/length of time spent living abroad or spent in each of the countries previously worked, studied, and lived in before the current location's assignment (Caligiuri, Hyland, Joshi, and Bross, 1998). The experience gained in multiple foreign countries, especially through direct observations and meeting nationals of other countries, facilitates global mobility orientation, which in turn increases the creativity and development of cultural shock coping skills (Albrecht et al., 2014). The experience gained in work- and non-work-related domains in foreign countries aids the development of values, attitudes, behaviours, and knowledge base, which in turn helps the affected expatriates to adjust and perform better in the current foreign job, which may be novel in terms of new job tasks, roles, procedures, policies, and task requirements in the new foreign country (Shaffer, Kraimer, Chen, and Bolino, 2012). The experience enhances expatriates' cognitive ability in reaching an optimal level of work outcomes and adjusting to different working styles, social interactions, and behaviours in a current foreign location (Takeuchi, Tesluk, Yun, and Lepak, 2005).

However, the knowledge gained through direct observation/participation in work and living conditions in a previous assignment location can only be effective in adjusting to other cultures when the expatriates are assigned to a country with a similar culture but not when they are assigned to countries with dissimilar cultures. This was confirmed by Takeuchi, Tesluk, Yun, and Lepak (2005) when they observed that intercultural communication, relocation, cognitive skills, and other knowledge gained from working and living in foreign countries can only be transferred to, utilized or applied in another country with similar culture, but attempt to apply them across different countries may backfire. This suggests that cultural distance can mediate the influence of international experience on expatriates' adjustment, which is still subjected to empirical investigation.

Nevertheless, international work experiences have historically been employed when selecting, promoting, and appointing expatriates to head and manage foreign

assignments/portfolios (Takeuchi and Chen, 2013). This is because an increase in prior foreign experiences stimulates an increase in cross-cultural competence and personality traits, which facilitates expatriates' psychological comfort in interacting with work and non-work situations in the new international assignment.

In confirmation with this, several studies (Hemmasi and Downes, 2013) using global data from expatriates living in China, Taiwan, Hong-Kong, Singapore, Taiwan (Selmer and Luring (2015), and Northern Cyprus (Tanova and Ajayi, 2016) showed that global mobility orientation and international experience in terms of numbers and time-based measurements of international experience influence expatriates' adjustment. Similarly, Takeuchi, Li, and Wang (2019) examined the influence of different work experiences (international, job, and organizational) garnered before current foreign assignments on performance change patterns among expatriates during foreign assignments, using data from two hundred and thirty-seven engineers and one hundred and ninety-one expatriates' managers working in China. They observed that the performance of expatriates with work experience that is neither low nor high has a u-curve pattern. The performance of expatriates with high international work experience has a learning curve pattern. The performance of expatriates with high work experiences was high throughout the foreign assignments. The performance of expatriates with low work experiences was low throughout the foreign assignments.

In alignment with this, Zhu, Wanberg, Harrison, and Diehn (2017) empirically demonstrated that the initial level of cross-cultural adjustment of expatriates with previous foreign work experience was higher than that of expatriates without international experience. Waxin and Panacciom (2005) also empirically revealed that previous foreign work experience mediated the influence of cross-cultural training on expatriate adjustment using data on expatriates originating from France, Germany, Korea, or Scandinavian countries and living in India. Similarly, Yedgarian (2018) examined and found that only previous overseas experiences influence adjustment among Americans living and working in Russia, using data from 197 American expatriates working in US-based multinationals in Russia. Albrecht, Dilchert, Deller, and Paulus (2014) tested data collected from 2,096 expatriates between 2005 and 2010 to reveal that openness to internal experiences (feelings) and external experiences (actions, ideas, and values) strongly influences accepting international assignments and significantly influences self- and other ratings such as general adjustment or interaction adjustment, except for job and life satisfaction among self- and organization-sponsored expatriates.

On the contrary, Selmer, Luring, Normann, and Kubovcikova (2015) empirically showed that foreign academic job experiences do not influence performance, job satisfaction, and adjustment among the expatriates in China and Taiwan. This finding is consistent with Abdul-Malek et al's (2015) finding that prior foreign

work experience is uncorrelated with the adjustment of expatriates and their spouses and the performance of expatriates. Emerging evidence also suggests that experience gained in different domains of work and life in one country may not help expatriates adjust to working and living conditions in another country given that those countries and organizations are culture-bound (Shaffer, Kraimer, Chen, and Bolino, 2012). Valuable international work experience acquired by expatriates can only help them to get along in similar work environments and unrelated work environments, which may be uncertain and complex (Takeuchi, Li, and Wang, 2019). In alignment with this, Selmer (2002) utilized data from western expatriates in Hong Kong to reveal that prior international experience outside Asia does not influence western expatriates' adjustment in Hong Kong but prior international experience within Asia does. Similarly, Froese and Peltokorpi (2013) revealed that international experience does not influence adjustment to social interaction but the length of international experience does. Takeuchi, Tesluk, Yun, and Lepak (2005) further revealed that the length of international experience in work and travel had a weak influence on adjustment facets but moderates the influence of current assignment tenure on only general adjustment. They also revealed that prior international experience positively influences adjustment to work, and this is stronger among those expatriates with less international experience. However, the positive influence of current assignment tenure on adjustment to social interaction and work is stronger among expatriates with more international experience. Moreover, prior international work experience moderates the influence of current assignment tenure on work adjustment, which in turn negatively influences expatriates' early return intentions. It is, therefore, hypothesized that:

H₄: *the higher the international experience of expatriates, the higher their cross-cultural adjustment in the context of Nigeria.*

Time Spent in Current Country: this is the number of years/months expatriates have spent in the current host country. The longer the time spent in the host country, the more the expatriates are familiar with different lifestyles, procedures, norms, and rules of the host country (Harrison, Shaffer, and Luk, 2005). The length of time spent in the host country also provides an avenue for expatriates to have better knowledge of the transportation systems, shopping patterns, housing, different local foods, and the cost of living in the host country. It provides more opportunities for expatriates to learn about the host country's language, work norms, behaviours, and rules through direct observations, modelling, and participation (Nasholm, 2012).

Following the learning curve theory, expatriates' adjustment to a new job abroad, living standards, and interactions occur over time. Expatriates who have spent more years in the current country are more likely to acquire more information to facilitate interaction and relationships with host country nationals. The duration

of stay in the host country can help expatriates to build and develop contacts. The longer the time in a current location, the larger the networks including the friends that the expatriates develop (Shaffer, Kraimer, Chen, and Bolino, 2012). The networks enable expatriates to adjust to self-behaviours and the host country. The networks offer social support to expatriates as well as enable the expatriates to learn new behaviours for effective coping and adaptation to the new culture (Li-Yueh, Veasna, and Wu, 2013).

This assumption concurs with Tharenou's (2013) finding that expatriates with a longer stay in the host country have a wider social network, from which they can easily obtain more information about the host country's way of life and job tasks to adjust themselves in the foreign culture and deal with cultural friction. It also supports the work of Peltokorpi and Froese (2009), who opined that because expatriates with longer duration in the current host country develop larger social networks, higher social self-efficacy, and stronger cultural intelligence within the host country context, they may find it easier to overcome the uncertainty about many different aspects of both life and work, often faced by newcomers in the host country. This suggests that longer duration in the current host country facilitates socialization with host nationals, familiarity with procedures, values, expected behaviours, and social knowledge that govern the conducts of individuals within and outside the workplace in the foreign countries, which may help expatriates to adjust in the host country and improve their job performance. Peltokorpi and Froese (2009) further showed that time in a host country influences adjustment to host culture. It is, therefore, hypothesized that:

H₅: the higher the duration of time spent in the host country, the higher the cross-cultural adjustment of expatriates in the context of Nigeria.

4. Theoretical Framework

This paper builds on the person–culture fit theory as popularized by Van Vianen, De Pater, Kristof-Brown, and Johnson (2004) and Ward, Leong, and Low (2004). The person–culture fit is defined as the extent to which personality, values, ability, needs, preferences, and desires of expatriates match, align, and are compatible with various socio-cultural elements (values, beliefs, patterns of social interactions, consumption patterns, transport systems, housing conditions) of the host country. It specifically addresses the compatibility/fit between a person's characteristics and the characteristics of the broader external cultural environment (food, weather, traditional values, belief systems, and housing conditions). The theory upholds that the adjustment of expatriates to a foreign country can be contingent upon matching individual (ability, personality, demographics) to host location requirements as certain abilities (language/verbal,

analytic, or social skills) and certain demographics are usually required to meet environmental demands in foreign locations (Stoermer, Haslberger, Froese, and Kraeh, 2018). It posits that the greater the fit between expatriates' demographics and the host country's socio-cultural conditions (food culture, weather, transport systems, infrastructural facilities, social norms, values, and interactions with host nationals), the greater the psychological adjustment and the higher the intention to complete foreign assignments.

5. Methodology

Research Design and Sampling: This study adopted a cross-sectional survey design because the data needed on variables of interests (expatriates' cross-cultural adjustment and demographics) were collected with the use of a questionnaire, from expatriates resident in Nigeria, who relocated from 22 different countries to work and live in Nigeria for over six months.

According to InterNations (2019), 3.8 million people are fully registered as expatriates with InterNations as of April 2019. Of this number, 6,352 individuals registered with InterNations as expatriates currently living and working in Nigeria as of July 2019. This suggests that 6,352 expatriates constituted the population of this study.

To access, engage, connect, and contact such expatriates to fill copies of the questionnaire, the researcher, therefore, has been registered with InterNations since January 2019 under the Lagos forum, paying an annual fee of \$50 as an Albatross member. The registration has over time offered the researcher an automatic ticket to participate in the different weekly and monthly events organized by InterNations in Lagos as well as to connect and interact with and contact 381 expatriates who attended the different events organized by InterNations and to collect data on their well-being in Lagos, Nigeria. Expatriates registered with InterNations under the Lagos forum rather than those under the Abuja forum were in the researcher's focus because Lagos serves as a nerve centre and industrial hub of Nigeria. Besides, such expatriates, irrespective of the state they are working in Nigeria, are usually invited to weekly, monthly, and yearly events organized by local ambassadors of InterNations in Lagos, Nigeria. These events usually bring expatriates from a different location in Nigeria to Lagos to connect them to relevant others.

The 381 individuals contacted at different times in the course of their participation in the various weekly and monthly events organized by InterNations were informed about the nature of the study and were asked about their willingness to cooperate in filling in the questionnaire for the study. Of this number, 223 expatriates cooperated and volunteered to help fill in the questionnaire. The expatriates were given hard copies the moment they agreed to fill the questionnaires.

However, only 149 out of the total expatriates who volunteered to respond provided answers, and 127 questionnaire retrieved from them were filled in properly and valid. The rest of the expatriates who volunteered to fill in the questionnaire failed to do so because they were either too busy or left the events the moment the questionnaires were given to them. The low response rate, therefore, prompted the researcher to also resort to a Google form in the distribution of soft copies of the questionnaire to expatriates who had not been physically contacted and present at the different events organized by InterNations under the Lagos forum as expatriates working and living in Nigeria. The Google form link containing the questionnaire was sent to 160 expatriates who were on the researcher's contact list of InterNations. However, 48 expatriates responded altogether. Of these responses, only 25 were valid. The 25 valid responses were added to the 127 valid responses elicited previously through the physical distribution of the questionnaire. This brought the number of expatriates surveyed to a total of 152.

Measurement of Variables: The dependent variable is the cross-cultural adjustment of expatriates in Nigeria. This was operationalized using a seven-item scale on adjustment to the general living environment, a four-item scale on adjustment to social interaction, and a three-item scale on adjustment to work in the host country, which was developed by Black and Stephens in 1989. The seven-item scale on the general living environment includes healthcare facilities, shopping, cost of living, nature of food, housing conditions, entertainment/recreation facilities, and opportunities. To the general living environment adjustment scale developed by Black and Stephens in 1989, the paper added 3 items, which include adjustment to transportation/road systems, state of electricity supply, and security conditions, obtained from the works of Costa et al. (2014) and Heirmsmac et al. (2015), reflecting the social-cultural environment of Nigeria. The adopted four-item scale on the social interaction adjustment of expatriates includes socializing with local hosts, interacting with local hosts on a daily basis, speaking with local hosts as well as interacting with them outside the work environment. The three-item scale on adjustment to work includes expectations on the job/standard for measuring job performance, supervisory responsibilities as well as specific job responsibilities. Each item was measured with a five-point Likert rating scale, which ranges from completely unadjusted to completely adjusted.

Method of Data Analyses: The data collected from the sampled respondents were analysed using descriptive statistics, which include percentage, mean, and standard deviation, as well as inferential statistics, which include analysis of variance and independent t-test. ANOVA and t-test were employed in testing the hypothesis formulated. The tests were done at a 5% level of significance.

6. Results and Discussions

Demographic Profile of Expatriates in Nigeria

Table 1 presents the demographic profiles considered in this study. Expatriates' demographic profiles consist of: gender, age, the length of time spent in Nigeria, their international work experience, and marital status.

Gender: male expatriate respondents constituted 127 (83.6%) while the surveyed female expatriates 25 (16.4%) of the total respondents, as indicated in *Table 1*. This suggests that male expatriates formed the majority of the respondents.

Age: The age distribution in *Table 1* shows that most expatriates, comprising 56 (36.8%) of the total expatriates surveyed, are within the age-group of 41–50 years, followed by expatriates within the age-group of 31–40 years, which comprised 44 (28.9%) of the total respondents. Expatriates within the age-group of above 50 years constituted 32 (21.1%), while expatriates within the age-group of 25–30 years and below 25 years accounted for 16 (10.4%) and 4 (2.6%) of the total respondents respectively.

Length of time in Nigeria: *Table 1* also reveals that the majority of the expatriates surveyed, which comprised 72 (47.4%) of the total expatriates surveyed, have spent 1–2 years living and working in Nigeria. This was followed by expatriates who had spent 3–4 years working and living in Nigeria, which constituted 41 (27%) of the total expatriates surveyed. Expatriates who had spent 5–6 years working and living in Nigeria accounted for 18 (11.8%), while those expatriates who had spent above 6 years and less than a year working and living in Nigeria comprised 14 (9.2%) and 7 (4.6%) resp. of the total respondents.

International Work Experience: *Table 1* shows that most expatriates surveyed, which comprised 42 (27.6%), have 2–4 years of international work experience, which means work experience outside the home and the current host country. This is followed by expatriates with 5–7 years of international work experience, which accounts for 35 (23%), expatriates with less than 2 years, which constituted 26 (17.1%), expatriates with 8–10 years of international work experiences, which also accounted for 26 (17.1%), and expatriates with over 10 years of international work experience, which constituted 23 (15.1%) of the total respondents.

Marital Status: *Table 1* further reveals that most expatriates surveyed are married. This category of expatriates constituted 82 (53.9%) of the total respondents. Expatriates divorced or separated from their spouses comprised 51 (33.6%) of the total respondents, while single expatriates accounted for 18 (11.8%) of the total respondents.

Table 1. Demographic profiles of expatriates in Nigeria

S/N	Variable	Category	Frequency	Percentage (%)
1	Sex	Male	127	83.6
		Female	25	16.4
		Total	152	100.0
2	Age	Below 25 years	4	2.6
		25–30	16	10.5
		31–40	44	28.9
		41–50	56	36.8
		Over 50 years	32	21.1
		Total	152	100.0
3	Length of time in Nigeria	less than 1 year	7	4.6
		1–2 years	72	47.4
		3–4 years	41	27.0
		5–6 years	18	11.8
		Over 6 years	14	9.2
		152	100.0	
4	International work experience (excluding the one in the current location (Nigeria))	less than 2 years	26	17.1
		2–4 years	42	27.6
		5–7 years	35	23.0
		8–10 years	26	17.1
		Over 10 years	23	15.1
		152	100.0	
5	Marital status	Married	82	53.9
		Divorced/separated	51	33.6
		Single	18	11.8
		Total	151	99.3
		Missing	1	.7

Source: researcher's fieldwork (2020)

Hypothesis Testing

Table 2 presents the demographic profiles for the cross-cultural adjustment of expatriates in Nigeria.

Table 2. Demographic profiles for cross-cultural adjustment of expatriates in Nigeria

S/N	Variable	Category	Mean	F-statistic	P-values	Remarks
1	Female expatriates experience a greater cross-cultural adjustment than male expatriates	Male	2.6507	.440	0.508	Rejected
		Female	2.5848			
2	The younger the expatriates, the higher the cross-cultural adjustment in the context of Nigeria	Below 25 years	2.6310	.441	0.779	Rejected
		25–30	2.5238			
		31–40	2.6331			
		41–50	2.6811			
3	The higher the duration of time spent in the host country, the higher the cross-cultural adjustment of expatriates in the context of Nigeria	less than 1 year	2.3333	10.682	0.000	Accepted
		1–2 years	2.4858			
		3–4 years	2.7184			
		5–6 years	2.8836			
		Over 6 years	3.0425			
4	The higher the international experience of expatriates, the higher their cross-cultural adjustment in the context of Nigeria	less than 2 years	2.3462	24.233	0.000	Accepted
		2–4 years	2.4138			
		5–7 years	2.6401			
		8–10 years	2.9386			
		Over 10 years	3.0466			
5	Cross-cultural adjustment expatriates in Nigeria significantly vary based on marital status	Married	2.4684	25.641	0.000	Accepted
		Divorced/separated	2.7537			
		Single	3.0926			

Source: researcher's fieldwork (2020)

The P-values on the gender and age of expatriate respondents, which are 0.508 and 0.779 respectively, are less than the 0.05 (5%) critical value (level of significance). This is indicated in *Table 2*. However, the P-values on the length of time, international work experience, and marital status of expatriate respondents, which are 0.000, 0.000, and 0.000 respectively, are greater than the 0.05 (5%) critical value (level of significance).

Based on the p-values, the stated hypothesis that female and younger expatriates experience greater cross-cultural adjustment is rejected, while hypotheses stating that the higher the duration of time in the host country and the higher the international experience, the higher the expatriates' cross-cultural adjustment are accepted. Moreover, the paper accepts the hypothesis that expatriates' cross-cultural adjustment capacity in Nigeria significantly varies based on marital status.

The mean value, as depicted in *Table 2*, further shows the differences in the level of cross-cultural adjustment of expatriates in Nigeria based on the length of time, international work experience, and the marital status of expatriates, which are the demographic factors influencing the cross-cultural adjustment of expatriates in Nigeria. The mean value suggests that the cross-cultural adjustment of expatriates in Nigeria is higher among single expatriates, those with a greater length of time spent in Nigeria, and those with a greater international work experience.

7. Discussion of Findings

This paper discovered that marital status, international experience, and time spent in Nigeria are the demographics influencing the cross-cultural adjustment of expatriates in Nigeria. It has been observed that the higher the length of stay/time in Nigeria, the higher the level of international work experience and the higher the level of expatriates' cross-cultural adjustment in the Nigerian context. The paper also discovered that age and gender have no significant influence on the cross-cultural adjustment of expatriates in Nigeria.

The finding of this paper that the higher the international work experience, the higher the cross-cultural adjustment in Nigeria corroborates the position of Hemmasi and Downes (2013), Selmer and Lauring (2015), Tanova and Ajayi (2016), Zhu, Wanberg, Harrison, and Diehn (2017), Yedgarian (2018), Zhu, Wanberg, Harrison, and Diehn (2017), and Takeuchi, Li, and Wang (2019). However, this deviates from the studies of Selmer (2002), Selmer, Lauring, Normann, and Kubovcikova (2015), Abdul-Malek et al. (2015), and Froese and Peltokorpi (2013). The finding of this study also confirms the social learning theory that posits that expatriates with foreign experience can easily learn from past mistakes and use the knowledge and skills gained from previous foreign locations to improve on future expatriation including adjustment to work and social interaction in the new international assignment.

Moreover, the finding of this paper that the longer the time spent in Nigeria, the higher the cross-cultural adjustment in Nigeria corroborates the position of Harrison, Shaffer, and Luk (2005), Shaffer, Kraimer, Chen, and Bolino (2012), Li-Yueh, Veasna, and Wu (2013), and Peltokorpi and Froese (2009) that time in a host country influences adjustment to the host culture. This confirms the learning curve theory that the adjustment of individuals to a new environment occurs over time. The higher the duration of stay in the host country, the greater the knowledge about the lifestyles and behaviours of the hosts, which is the foundation of cultural intelligence or the formation and development of cognitive frameworks required for effective coping and adaptation to the new culture.

The finding of this inquiry that single expatriates experience a higher cross-cultural adjustment in Nigeria disconfirmed the position of Selmer and Luring (2011b) and Luring and Selmer (2015) that expatriates who have relocated with spouses tend to fare better, are more satisfied with their lives in a host country, and are physically and psychologically healthier than their unmarried and married peers who have not relocated with their spouses. The lower cross-cultural adjustment among married expatriates as compared to single expatriates in Nigeria could be attributed to family exposure to poor electricity supply, poor transportation systems, poor healthcare facilities, insecurity, deplorable road networks as well as a decaying educational system. This may lead to poor family/spouse adjustment, which in turn could spill over into the poor adjustment of married expatriates.

The finding of this investigation that gender does not significantly influence the cross-cultural adjustment of expatriates in Nigeria supports the studies of Sinangil and Ones (2003), Fisher and Härtel (2003), Heirsmac (2015), Luring and Selmer (2015), Bastida (2018), and Eze and Awolusi (2018) that female expatriates are just as successful as their male counterparts overseas as men and women expatriates on average were rated quite similarly in time to proficiency, job satisfaction, and adjustment to foreign cultures.

The finding of this paper that age does not significantly influence the cross-cultural adjustment of expatriates in Nigeria supports the position of Fisher and Härtel (2003) and Luring and Selmer (2015) that the age of expatriates is not important in determining their performance, work effectiveness, and work adjustment. However, this contradicts the studies of Okpara (2010, 2016) and of Eze and Awolusi (2018) that age significantly influences expatriates' adjustment and performance in Nigeria.

8. Conclusions and Policy Implications

This paper offers insight into the demographic profiles of expatriates for successful cross-cultural adjustments in the context of Nigeria. The paper concluded that marital status, international work experience, and length of stay in Nigeria rather

than age and gender are the demographic factors that should be considered when recruiting and selecting expatriates to manage firms' operation in Nigeria, in order to eliminate the maladjustment of expatriates and its consequences on their failure and performance in the Nigerian context. It can be concluded that the more organizations recruit, select, and deploy expatriates whose demographic profiles reflect a higher length of stay/time in Nigeria, a higher level of international work experience, and the marital status of single/unmarried, the higher the successful cross-cultural adjustment of such expatriates will be in the Nigerian context.

This supports the applicability of the theory of person–culture fit in the selection, relocation, and recalling of expatriates in the context of Nigeria.

The paper also concludes that the overall cultural integration of expatriates in Nigeria is poor, which is consistent with the position of existing literature that expatriates find it difficult to adjust well psychologically to the socio-cultural conditions in Nigeria. Such poor cultural integration and its consequences on the intention to complete time-based assignments in Nigeria can be mitigated when expatriates with a higher length of stay/time in Nigeria, a higher level of international work experience, and having the marital status of single/unmarried are recruited, deployed, or relocated to work and live in Nigeria.

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The Asymmetric Impact of Oil Price and Electricity Consumption on Economic Growth: Evidence from Nigeria

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Abstract. The study examines the asymmetric impact of oil price and electricity consumption on economic growth in Nigeria between 1981 and 2018 using the Non-Linear Autoregressive Distributed Lag (NARDL) model. Results reveal that falling and increasing oil prices as well as gross capital formation affect economic growth in Nigeria negatively and significantly in the short-run, while electricity consumption affects economic growth positively and significantly in the short-run. In the long-run, the impact on economic growth of negative changes in oil price is negative and insignificant, while positive changes in oil price have a positive but insignificant impact on economic growth. The impact on the economic growth of electricity consumption remains positive but insignificant while that of gross capital formation is positive and significant. The results suggest that both in the short and the long run positive changes in oil price have greater impact on the economic growth than negative oil price changes. Capital formation is a significant determinant of Nigerian economic growth both in the short and the long run.

Keywords: oil price, electricity consumption, economic growth, NARDL

JEL Classification: C22, O40, Q31, Q43

1. Introduction

Electricity is one of the significant inputs considered by investors and households in economies. It has been recognized to be important for social and economic development in Africa and as a factor for improving economic activities (International

Energy Agency (IEA), 2002; Constantini and Martini, 2010). Oil price is identified as one of the factors that drive electricity consumption in an economy, leaving its impact on economic growth unstable. Oil price impact varies across economies depending on the demand or supply side they belong to. In petroleum exporting countries, the price of petroleum has been observed to influence the nations' economic growth positively (Farzanegan and Markwardt, 2009; Timilsina, 2015). In contrast, a negative relationship has been observed in this respect in oil importing countries (Lardic and Mignon, 2006; Jayaraman and Choong, 2009). The variation in impact is due to what the price of petroleum means to different economies. To petroleum-exporting nations, petroleum price is considered as an income, while to petroleum-importing nations, it is considered as an expenditure.

The Nigerian electricity sector has been known for its deficient electricity supply, leaving the nation exposed to high costs of energy despite its endowment in energy resources. This state of affairs can be traced to low capital investment in public utilities (Paul, Albert, and Adeiza, 2015). According to Iwayemi (1998), deficiencies in the electricity sector prompted capital release with limited government intervention. The liberalization policy therefore urged the sale of the power-generating companies and a 60% sale of government shares in the power distribution companies in 2013 (Nwachukwu, 2015; MBendi, 2016; NERC, 2017). However, the electricity shortage problem persists, causing more consumption of the conventional energy (fossil fuel products) as an alternative source whose cost is indirectly determined by the movement in oil prices.

There is limited literature on the price of petroleum, electricity use, and GDP. Among the few studies – such as Sarwar et al. (2017) and Shahbaz et al. (2017) on the connection between oil price, electricity use, and economic growth –, panel data are commonly used, while others are country- and variable-specific, including the ones on the Nigerian economy (Akinlo, 2009; Shahbaz et al., 2017; Sarwar, Chein, and Waheed, 2017).

On the methodological front, the Linear Autoregressive Distributed Lag (ARDL) method developed by Pesaran et al. (2001) has been commonly employed in literature in studies on oil price and growth for time series and cross-sectional data analysis (Shahbaz and Dube, 2012; Shahbaz et al., 2017). However, in the Nigerian context, we acknowledge that the reviewed existing literature has concentrated on the nexus that exists between oil price and GDP as well as between electricity use and GDP, with diverse findings (among others: Akinlo, 2009; Omitogun, Longe, and Shehu, 2018; Iwayemi and Babajide, 2011; Nwanne and Eyeday, 2016). To the best of our knowledge, none of the previous studies has considered the asymmetric model of Shin et al. (2014) on examining the effect of asymmetric petroleum price and electricity consumption on economic growth by taking a partial sum decomposition of petroleum price and incorporating the break periods effect. The study considered oil price and electricity consumption as input factors to be

considered for production and that have relationship with the Nigerian economic growth.

The scope of the paper is sectioned as follows: a detailed review of the literature is presented in the next section, while section three provides the theoretical and methodological framework. Section four presents the results in line with the objectives of the study, and section five provides detailed concluding remarks from the results of the study.

2 Literature Review

Theoretically, there is no unified explanation on the link between the price of petroleum and GDP. Therefore, several theories were born in the literature to determine this link. The so-called Dutch disease is one of the theories. It explains the problems that happen in case there is a rise in the production of raw materials (crude oil in relative to this study) which leads to decrease in other sectors of an economy. Overreliance on raw material affects the growth of an economy; for a country to develop, it must produce finished goods. An economy must not depend on excess import of goods and services. The Dutch disease can lead to a wide gap between the rich and the poor in Nigeria. The realization of crude oil in Nigeria has led to overreliance on raw material, excess imports of finished goods, increase in wages, and income inequality. Nigeria as a country forgoes agriculture and shifts attention to crude oil due to its large deposits in the Niger Delta area. Crude oil has been the main source of revenue for Nigeria since its discovery, and this is a curse because there is a persistent decline in petroleum price.

The neoclassical growth model authored by Solow and Swan (1956) states that economic growth results from three (3) factors: technology, capital, and labour. While the contribution of labour and capital to economic growth is restricted, technology has limitless contribution to the growth of an economy. Recently, capital availability has been a major constraint to improvement in economic activities as many investors are panicking about possibilities of making loss in the Nigerian environment. However, in order to increase capital level and accessibility, efforts have been concentrated on increasing banks' loan-to-deposit ratio from 60% to 65% by the Central Bank of Nigeria (CBN) while considering capital formation as an incentive to the growth of the economy.

In this study, we partitioned related empirical studies into two parts: electricity/energy use and economic growth, oil price and economic growth.

Electricity/Energy Consumption and Economic Growth

Among studies in developed countries such as the United States, Kraft and Kraft (1978) pioneered their study on the causal link that exists between electricity use and GNP and noted the existence of a unidirectional causal relationship. Akrarca and Long's (1980) study on the same subject observed no causal relationship. Ghosh (2002) noted the absence of long-run connection between energy use and growth and a unidirectional causal link from energy use to growth.

Using bounds and causality tests in their study on per capita energy use and economic growth performed in developing and emerging economies, for 17 countries between 1971 and 2001, Wolde-Rufae (2006) observed a long-term cointegration among the variables for six nations (Nigeria, Cameroun, Ghana, Zimbabwe, Senegal, and Zambia) and causal relationship running from economic growth to energy use in three countries. Squalli (2007) noted for OPEC nations in the long term a cointegrating link and bi-directional nexus among economic growth and electricity use. Jamil and Ahmad (2010) concluded from their study that in Pakistan economic planning exercise, electricity production, and management should be incorporated.

Belke et al. (2011) asserted for 25 OECD countries based on their findings that a cointegration and a bidirectional relationship exists among GDP, energy price, and energy use. Based on their findings in Pakistan, Shahbaz and Dube (2012) established a positive effect of coal use, capital use, and labour participation rate on economic growth between 1972 and 2009. Enu and Havi (2014) in Ghana noted a positive effect of electricity use on economic growth in the long term, while in the short term the impact was found negative. They further confirmed a causality link going from electricity use to economic growth. Relying on results from a sectoral analysis in Pakistan, Tang and Shahbaz (2013) hold that electricity use Granger causes manufacturing and service sectors, while there is no direction of causality between electricity use and agricultural sector. Using data spanning between 2000 and 2012, Kasperowicz (2014) confirmed in Poland a bidirectional link between capital formation, electricity use, and economic growth. Dagon (2015) also confirmed a unidirectional causal link between electricity generated and economic growth in Turkey. In his study carried out in 18 Sub-Saharan African countries between 1980 and 2011, Fatai's (2014) findings testify to a steady long-term connection between energy use and economic growth. However, the causal relationship varies across the sub-regions. Sama and Tah (2016) used GMM and established that petroleum and electricity consumption impacted positively on economic growth in Cameroon.

Shahbaz et al. (2017) observed a bidirectional link between electricity use and economic growth in both high and upper-middle income countries, East Asia Pacific countries, OECD countries, and Central Asia and European countries in

the long run. In contrast, one-way causality link running from economic growth to electricity use was noticed in South Asia, the Middle East, low-middle income and North African countries. For 75 net-energy-importing countries, Esen and Bayrak's (2017) study shows a significantly positive connection between energy use and economic growth. Samu et al's (2019) study in Zimbabwe showed that electricity use positively and significantly affects economic growth.

Akinlo (2009) employed the Hodrick–Prescott (HP) filter in examining the causal link between energy use and economic growth. The findings confirmed a one-way link moving from electricity use to economic growth in Nigeria. Odularu and Okonkwo (2009) noted that energy use positively affects economic growth. Nwankwo and Njogo (2013) observed that electricity use, industrial production, and economic development in Nigeria are positively connected through the electricity generated and consumed by the sector. Ogundipe and Apata's (2013) study results show a two-way causality nexus between electricity use and economic growth in Nigeria. Oyaromadeet al. (2014) confirm no causal link between energy use and economic growth in Nigeria. Ogunjobi (2015) observed a significant positive impact of electricity consumption on industrial outputs in Nigeria. Bernard and Adenuga's (2016) study attests to a long-term significant connection between energy use and industrial productivity in Nigeria.

Oil Price and Economic Growth

Mory (1993) in the United States confirmed that rise in the price of petroleum caused by reduction in economic activities and decreases in the price have no relationship with the economy. In European Countries, Lardic and Mignon's (2006) findings reject standard cointegration between petroleum price and GDP, but they noted an asymmetric cointegration between petroleum price and GDP in the majority of the countries considered. While focusing on the asymmetric link in oil exporting countries, Mehrara (2008) noted that negative oil shocks negatively affect the growth of the economies. Jayaraman and Choong's (2009) causal investigation on the sudden changes in the price of petroleum and economic growth revealed a one-way causality link running from international reserves and petroleum price to economic growth in Pacific Island Countries. Farzanegan and Markwardt (2009) found economic growth response in Sub-Saharan Africa to be positive for high oil prices due to Nigeria's dominance as an oil exporter in the region and a major determinant of the economy.

Timilsina's (2015) study using Computable General Equilibrium (CGE) revealed that oil price increase causes GDP in emerging nations, i.e. in China, India, and Thailand, to decline. Considering Venezuela, Saudi Arabia, Kuwait, and the United Arab Emirates, Ftiti et al. (2016) argued that the surprises to the price of petroleum directly affect the economic growth in the countries during financial turmoil.

Using the OLS method, Jahangir and Dural (2018) showed a positive significant impact of crude oil price on the growth of the Caspian Sea region's economy. They also confirmed a one-way causality link running from crude oil price to economic growth. Benliet al's (2019) asymmetric study on oil price in Turkey's economy revealed that positive petroleum prices negatively and significantly influence economic growth in the long run. Their study noted that output negative response to positive changes in the price of petroleum is greater than that of the negative changes. In their study on the impact of oil price and economic growth of some low-income oil importing Sub-Saharan African countries, Akinsola and Odhiambo (2020) revealed that negative oil price changes positively and significantly impact the economic growth, while the rises in the price of petroleum have a negative and significant effect.

Iwayemi and Babajide (2011) in their study on Nigeria concluded from their findings that shock in oil price affects the economy's output when it is negative. Adeniyi et al. (2011) ascertained that the surprises to the petroleum price do not add up to the amount to be considered significant in the movement of macroeconomic aggregates. Nwanna and Eyeday's (2016) study revealed that petroleum price volatility portends an adverse effect on the growth of the Nigerian economy. Ogboru, Rivi, and Park's (2017) study is in contrast with Nwanna and Eyeday (2016), who state that the price of petroleum exerts a positive effect on the growth of the Nigerian economy. Omitogun et al. (2018) concluded from their study that the price of petroleum and public income variations are robust drivers of the Nigerian economic growth. Adedeji et al. (2018) noted that variations in the price of petroleum (positive or negative) significantly affect economic growth in Nigeria, while in Angola only negative oil price is significant to economic growth. Yakubu and Akanegbu's (2019) findings revealed that the price of petroleum and Nigerian economic growth are connected in the long term, but there is no evidence of causal relationship. However, it is noted that the literature review shows a diverse picture with different findings stemming from the adoption of methods, scope and objectives of the studies. We, therefore, add to the existing literature by considering oil price and electricity consumption as a factor input in the neoclassical production model applying the NARDL model to investigate the effect on the economic growth in the Nigerian context.

3. Theoretical and Methodological Framework

This paper examines the impact of electricity use on economic growth in Nigeria while integrating asymmetric petroleum price into the modified production function by Shahbaz et al. (2017). The hike in the price of petroleum is responsive to both petroleum importing and exporting nations (Shahbaz et al., 2017). Shahbaz

et al. (2017) noted that oil price impacts on economic activities on both the supply and demand side. From the viewpoint of supply, oil price is considered as a factor of production which affects the cost of production as it fluctuates and leads firms or industries to lower outputs. On the demand side, the effect of petroleum price is not limited only to its usage but also includes investment activities. A rise in the price of petroleum production, reduced real wage rate as demand for labour declines due to decline in economic activities. As further noted by Shahbaz et al. (2017), oil price is an input cost that may reduce investment activities through its impact on exchange rate, inflation rate, and energy costs, which finally leads to a declining economic growth. However, for this study, we consider oil price as a factor affecting both the demand side (electricity consumed) and the supply side (revenue) of the economy in Nigeria. Therefore, we modified the augmented production function by Shahbaz et al. (2017) by retaining electricity consumption, oil price, and capital as the factors that determine the Nigerian economic growth. The model is specified as:

$$Y_t = f(E_t, O_t K_t), \quad (1)$$

where E , O , and K are electricity use, oil price, and capital formation resp., while Y is the output, and t is the time period.

Shahbaz and Lean (2012) contended that specifying a model in a log-linear form increases the efficiency and reliability of empirical evidence provided by the model comparative to a simple linear specification. To achieve this assertion, the variables in *Equation 1* are transformed into a natural logarithm form and are modelled as:

$$\ln Y_t = \alpha_0 + \beta_1 \ln E_t + \beta_2 \ln O_t + \beta_3 \ln K_t + \mu_t, \quad (2)$$

where $\ln Y_t$, $\ln O_t$, $\ln K_t$, and μ_t are the natural log of real GDP per capita (i.e. economic growth), oil price, gross fixed capital formation per capita, and a white-noise error term resp.

As the study focuses on the effect of electricity use and of petroleum price asymmetries' on economic growth, the Non-Linear Auto-Regressive Distributed Lag (NARDL) model of Shin et al. (2014) is adopted. The model is an asymmetric modification of the symmetric linear model of Pesaran et al. (2001). Following Pesaran et al's (2001) symmetric linear ARDL model, the conditional error correction model of the link between electricity use, oil price symmetry, and economic growth is modelled as:

$$\begin{aligned} \Delta \ln Y_t = & \alpha_0 + \theta_1 \ln Y_{t-i} + \theta_2 \ln E_{t-i} + \theta_3 \ln O_{t-i} + \theta_4 \ln K_{t-i} + \sum_{k=1}^{n_1} \alpha_{1k} \Delta Y_{t-i} + \sum_{k=0}^{n_2} \alpha_{2k} \Delta E_{t-i} \\ & + \sum_{k=0}^{n_3} \alpha_{3k} \Delta O_{t-i} + \sum_{k=0}^{n_4} \alpha_{4k} \Delta K_{t-i} + \mu_t, \end{aligned} \tag{3}$$

where $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ are the long-term coefficients of the parameters, while $\theta_1, \theta_2, \theta_3,$ and θ_4 are the short-term coefficients of the parameters; $n_1 - n_4$ are the optimal lag lengths of the parameters automatically selected using the Akaike Information Criterion (AIC); α_0 is the model intercept; μ_t remains the whitenoise error term at time t .

To mirror an asymmetric impact, Shin et al. (2014) developed a NARDL model that permits the partial decompositions of a parameter to evaluate the long-term and short-term effect.

$$O_t^- = \sum_{j=1}^t O_t^- = \sum_{j=1}^t \max(\Delta O_j, 0) \tag{4}$$

$$O_t^+ = \sum_{j=1}^t O_t^+ = \sum_{j=1}^t \max(\Delta O_j, 0) \tag{5}$$

From equations 4 and 5, O_t^- and O_t^+ represent the negative and positive fluctuations, resp., in petroleum price. These parameters are thus incorporated into the linear ARDL model to replace oil price, therefore transforming the model into a NARDL model. The model is rewritten as:

$$\begin{aligned} \Delta \ln Y_t = & \alpha_0 + \theta_1 \ln Y_{t-1} + \theta_2 \ln E_{t-1} + \theta_3^+ \ln O_{t-1}^+ + \theta_3^- \ln O_{t-1}^- + \theta_4 \ln K_{t-1} \\ & + \sum_{k=1}^{n_1} \alpha_{1k} \Delta Y_{t-k} + \sum_{k=0}^{n_2} \alpha_{2k} \Delta E_{t-k} + \sum_{k=0}^{n_3} \alpha_{3k}^+ \Delta O_{t-i}^+ + \sum_{k=0}^{n_4} \alpha_{3k}^- \Delta O_{t-i}^- \\ & + \sum_{k=0}^{n_5} \alpha_{4k} \Delta K_{t-1} + \mu_t \end{aligned} \tag{6}$$

α_3^+, α_3^- are the long-term coefficients of negative and positive fluctuations in the price of petroleum, while θ_3^+, θ_3^- are the short-run coefficients of positive and negative changes in oil price. Other denoted parameters remain as defined earlier.

However, to account for structural breaks, a dummy variable $\sum_{r=1}^s B_r Dummy_{rt}$ to explain the breaks identified in the study is incorporated into *Equation 6*. The dummy variable takes the value of 0 before the structural break date and of 1 after the structural break occurs. The model is respecified as:

$$\begin{aligned} \Delta \ln Y_t = & \alpha_0 + \sum_{k=1}^n \alpha_{1k} \Delta Y_{t-k} + \sum_{k=0}^n \alpha_{2k} \Delta E_{t-k} + \sum_{k=0}^n \alpha_{3k}^+ \Delta O^+_{t-i} + \sum_{k=0}^n \alpha_{3k}^- \Delta O^-_{t-i} \\ & + \sum_{k=0}^n \alpha_{4k} \Delta K_{t-1} + \theta_1 \ln Y_{t-1} + \theta_2 \ln E_{t-1} + \theta_3^+ \ln O^+_{t-1} + \theta_3^- \ln O^-_{t-1} \\ & + \theta_4 \ln K_{t-1} + \sum_{r=1}^s B_r Dummy_{rt} + \mu_t \end{aligned} \tag{7}$$

The study employed macroeconomic data spanning between 1981 and 2018. The variables are real GDP per capita (constant 2010 US\$), which proxied economic growth (GDP), oil price (O), US\$ obtained from BP Statistical Bulletin (2019), gross fixed capital formation at constant 2010 US\$ (GCF), and electricity consumption (EC)—electricity consumed in kW per capita. Aside from OP, all other data were obtained from the World Development Indicator (WDI) (2019).

4. Results

4.1 Correlation Matrix Test

The correlation test was done to establish the kind of link that exists among the variables, whether they are highly correlated or not, and to ensure there was no multicollinearity problem. The correlation matrix in *Table 1* shows that the variables studied are positively and significantly correlated. A strong correlation exists between GDP and oil price.

Table 1. *Correlation matrix test results using raw data*

	GDP	OP	E	GCF
GDP	1			
OP	0.875**	1		
E	0.864**	0.815**	1	
GCF	0.924**	0.761**	0.704**	1

Source: authors' computation

** connotes significant level at 5%

4.2 Descriptive Statistics

The nature of the variables over the period covered is captured in the descriptive statistics results. The average values of the variables, kurtosis, and the Jarque–Bera results are considered in this study. From the results, the study confirms that the average values of the variables included in the model range within the maximum and minimum values. This, therefore, establishes that the trend of the variables over the period studied is not an extreme one. The kurtosis result confirms that the distribution is platykurtic (flat relative to the normal). The Jarque–Bera statistics verified that the variables are abnormally distributed as the values of their probability are less than 5% level of significance (see *Table 2*).

Table 2. *Descriptive statistics results (raw data)*

	GDP	O	E	GCF
Mean	1708.336	42.94185	104.46884	3.34E + 10
Maximum	2563.14	111.6697	156.733	7.46E + 10
Minimum	1151.126	12.71566	50.87268	9.57E + 09
Kurtosis	1.65536	2.864166	1.906792	1.911192
Jarque–Bera	4.895887	7.234318	2.217986	5.439937
Probability	0.086471	0.026859	0.329891	0.065877
Observations	38	38	38	38

Source: authors' computation

4.3 Unit Root Test

To avoid having a spurious result and to verify if the variables are mean regressing in the long term, the study considered testing for the presence of unit root problem among the variables. To do this, the Phillips–Perron (PP) test by Phillips and Perron (1988) and the Augmented Dickey Fuller (ADF) test by Dickey and Fuller (1979) were adopted. The variables are tested at levels and after first differencing. The result presented in *Table 3* confirmed that the variables have unit root problem as they are stationary after first differencing. This result suggests that the variables are not mean regressing in the long term.

Table 3. *Unit root test*

	ADF	PP		ADF	PP
	Level			1 st Difference	
GDP	-2.356	-2.315	D(GDP)	-4.528**	-4.524**
O	-2.233	-2.233	D(OP)	-5.190**	-5.141**
E	-2.749	-2.883	D(E)	-7.697**	-7.882**
GCF	-3.902**	-3.883**	D(GCF)	-5.378**	-4.763**
CV1%	-4.235				
5%	-3.540				
10%	-3.202				

Source: authors' computation

** implies significance level at 5%, CV denotes critical values

4.4 Non-Linear Autoregressive-Distributed Lag (ARDL) Bounds Test

The study follows Pesaran et al's (2001) guide on ARDL bounds test for its long-term cointegration estimation. The F-statistics is compared with the upper [I(1)] and lower [I(0)] bounds class. From the results presented in *Table 4*, the F-statistic value is above both the upper and lower bound values at a significance level of 5%. Due to this, it is concluded that an asymmetric long-term cointegrating link exists between the variables used in the study.

Table 4. *NARDL Bounds Test Results*

F -Statistics	K	I(0)	I(1)
9.032**	4	3.47	4.57

Source: authors' computation

** implies significance level at 5%; I(0) and I(1) denote the upper bound and lower bound class respectively

4.5 Bai–Perron Structural Break

To identify the break ranges in this study, the Bai–Perron (2003) test is chosen for the purpose. The test helps identify significant periods that may affect the model. The test identified 5 periodic breaks including 1987, 1992, 2004, 2009, and 2014. In 1987, oil price tumbled following the previous year’s unfaithful act of Saudi Arabia in adhering to their own quota of oil production cut at 30 mb/d agreed by the cartel, therefore leading to a dispute within OPEC members (Baffes, Kose, Ohnsorge, and Stocker, 2015). The impact of the first Gulf War in 1990 leads to the break identified in 1992, when a slow growth was recorded in oil price. In 2004, oil price started gaining momentum on the back of the rise in the demand for crude oil as China’s demand for crude oil exceeded 1 mb/d (Baffes et al., 2015). The break identified for 2009 was a result of the severe contraction in global demand for commodities, which led the world to a great recession (Baffes et al., 2015). The 2014 break identified by the test was a period of slowdown in global economic activities, but it mostly came from the demand and supply surprises in the petroleum market (Baffes et al., 2015). The break periods are included in the model as dummy variables and connoted in the estimation as B1, B2, B3, B4, and B5 in order to identify significant break periods. Results are presented in *Table 5*.

Table 5. *Bai–Perron (2003) structural break dates*

Variable	Identified Break Periods
Oil Price	1987
	1992
	2004
	2009
	2014

Source: authors’ compilation

4.6 NARDL Estimation

The study estimated the parameters using an Akaike Information Criteria (AIC) automatic lag selection. The automatic lags selected by AIC are [4, 4, 1, 3, 3] for *GDP*, *EC*, *O⁻*, *O⁺*, and *GCF*. We reported the long-term and short-term estimation of the parameters and found a long-term cointegration existence between the variables at 5% significance level. Following the lag selected, electricity use impacted positively on economic growth in Nigeria and was significant at 5% in the short term. The result confirms that 1% change in electricity use influences economic growth by 13.7% in the short term. This means that the electricity consumed

per head in the Nigerian economy is growth-driven in the short term. Recently, the country has been placing emphasis on promoting awareness about the use of energy efficient products and on adopting a conservative behaviour towards the use of energy in the environment. Therefore, the policies will increase the growth of the economy. The short-term impact of negative as well as positive shocks to the petroleum price have a significantly negative effect at 5% on the economic growth in Nigeria. 1% positive and negative shocks to the price of petroleum contracts the economic growth of Nigeria by 17.8% and 8.1%, respectively, in the short term. Nigeria largely depends on oil as its mainstay. Surprises to the price of petroleum in the short term affect both the supply and demand side of the economy. While focusing on the supply side, it can be deduced from the results that the economic growth of Nigeria is expected to contract as negative shocks to the price of petroleum may favour producers since the price of petroleum products may decrease, therefore reducing cost of production and increasing profit making (this explains the demand side effect of the negative changes). However, as oil price decreases, government revenue contracts. This may initiate the need to review budgetary plans as experienced in the recent oil price shocks caused by the Covid-19 pandemic, which influenced the review of budget oil price from \$59 pb to a third review of \$28 pb from a first and second review of \$30 pb and \$25 pb respectively. On the other hand, positive shocks to the petroleum price favour the government as the revenue increases but are detrimental to investors or producers as they increase the cost of production through rise in the price of petroleum products. This has been recently evidenced by the rising prices of PMS from N125/litre to N143.80/litre for the month of July 2020. This increase is expected to impact on production activities in the economy as many of the producers depend on oil products as an alternative means of generating electricity for their activities. As activities are slowed down, economic growth is predicted to decline. The effect of gross capital formation on Nigerian economic growth in the short run is negative and significant at 5%. As gross capital formation changes by one percent, Nigerian economic growth declines by 10% in the short term. This means that capital accessibility by investors in Nigeria is not sufficient enough to increase the Nigerian economic growth in the short term. The error correction model coefficient is negative and significant at 5%. This means that the independent variables are capable of correcting about 142% deviation of economic growth from the short-term equilibrium to the long-term equilibrium. The result also suggests an oscillatory convergence in the long term and in real time it means that a stable positive trend in oil price and electricity consumption will correct disequilibrium in economic growth within a minimum of 1 year and 4 months. After considering the break periods in the model, it was confirmed from the estimation that the break period of 1987 positively but insignificantly affects Nigerian economic growth. The 1992 and 2009 break periods impact negatively and significantly on Nigerian economic

growth. The 2004 petroleum price break impact on economic growth was positive and significant, while the 2014 petroleum price break negatively but insignificantly affected Nigerian economic growth.

The correctness of the model specification was tested using diagnostic test. From the results, the Ramsey RESET test validates that the model is correctly specified as its F-statistic probability value is greater than 5%. The model is free of serial correlation and is homoscedastic. The CUSUM test confirmed the stability of the model; however, it is unstable considering the CUSUM test model.

In the long-term, the impact of electricity use on economic growth is positive but insignificant. This implies that as electricity consumption increases by 1% in the long term, it insignificantly increases the growth of the economy by 11.8%. Albeit electricity is considered a significant catalyst of economic growth in the Nigerian context, the consumption pattern of electricity contributes to the Nigerian economic growth in the long run, but not towards the expected growth dimension. Negative changes in oil price show a negative but insignificant effect on economic growth in the long term. Results reveal that as oil price declines by 1% in the long term, the Nigerian economic growth declines by 8.8%, which is, however, insignificant. Although Nigeria's revenue reacts negatively to negative changes in oil price, diversification strategies adopted by the government in recent years towards its revenue base may render the effect of shocks to oil price on the economic growth insignificant in the long term. Positive shocks to the price of oil in the long term show that Nigeria's economic growth increases by 19.5% for every 1% positive fluctuation in oil price. This implies that as the petroleum price trends positively in the long term, the government's capacity to finance other strategic sectors of the economy increases and positively impacts on the economic growth of Nigeria. However, the mismanagement factor may render the positive trends in the effects of petroleum price on economic growth positively insignificant in the long term. In the long run, gross capital formation will positively and significantly (at 5% significance level) impact Nigerian economic growth. 1% change in gross capital formation increases economic growth by 30.3% in the long term. Policies on capital accessibilities in the Nigerian economy (e.g. the increase of loan-to-deposit ratio by banks from 60 per cent to 65 per cent and fiscal stimulus to support businesses during the recent pandemic) are expected to increase production activities and promote the economic growth of Nigeria in the long term.

Table 6. *NARDL short-term and long-term estimation*

Selected Model: ARDL (4, 4, 1, 3, 3)	
Short-Run Estimates	Nigeria
Variables	
C	-0.314(0.031)**
Trend	0.001(0.001)**
$\Delta \ln EC_{t-1}$	0.087(0.044)***
$\Delta \ln EC_{t-2}$	-0.182(0.039)**
$\Delta \ln EC_{t-3}$	-0.053(0.056)
$\Delta \ln EC_{t-4}$	0.137(0.038)**
$\Delta \ln O^+_{t-1}$	-0.081(0.017)**
$\Delta \ln O^-_{t-1}$	-0.040(0.028)
$\Delta \ln O^-_{t-2}$	-0.168(0.039)**
$\Delta \ln O^-_{t-3}$	-0.178(0.032)**
$\Delta \ln GCF_{t-1}$	0.161(0.028)**
$\Delta \ln GCF_{t-2}$	-0.159(0.039)**
$\Delta \ln GCF_{t-3}$	-0.100(0.026)**
B1	0.005(0.012)
B2	-0.040(0.010)**
B3	0.129(0.017)**
B4	-0.041(0.006)**
B5	-0.011(0.007)
e_{cm}_{t-1}	-1.429(0.174)**
Diagnostic Test	
Ramsey RESET	1.248[0.2723]
Serial Correlation	3.456[0.0722]
Heteroskedasticity	1.311[0.2862]
CUSUM Test	Stable
CUSUMQ Test	Unstable
Long-Run Estimates	
$\ln EC_t$	0.118(0.142)
O^-_t	-0.088(0.064)**
O^+_t	0.195(0.173)
$\ln GCF$	0.303(0.047)**

Source: compiled by the authors

** , *** connotes significance level at 5% and 10% respectively. The parenthesis () denotes the std. error of the estimation. B1, B2, B3, B4, and B5 are the structural

break periods identified by the Bai–Perron test and incorporated in the estimation process. [] are probability values for the diagnostic F-statistic values

5. Concluding Remarks

Adopting Shin et al's (2014) NARDL model, this paper investigates the asymmetric effect of the price of oil and electricity consumption on Nigerian economic growth. The study takes a fractional sum decomposition of oil price. Study pre-estimation results suggest that the variables are stationary after first differencing, which implies that there is a unit root problem among the variables. Due to this unit root problem, the study adopted the NARDL bounds test to assess the long-run cointegration among the variables. Results revealed that a 5% significant long-term cointegrating link exists between the variables. After confirming the cointegrating link, we further assess the long-term and short-term impact of oil price asymmetry and electricity consumption on economic growth. Results show that gross capital formation, electricity use, and negative as well as positive shocks to the oil price significantly affect the economic growth, only electricity use having a positive effect. In the long run, the positive shocks to the price of petroleum have a positive impact, while negative shocks have a negative impact on economic growth – although insignificant. Electricity use positively but insignificantly affects economic growth. However, gross capital formation shows the possibility of having a long-term significant positive effect on the economic growth of Nigeria. Our findings provide a support to the theoretical Dutch Disease argue on the Nigerian economy. Notably, starting out from Solow and Swan's (1956) framework on the importance of capital flow as a catalyst to the growth of an economy, our study supports that capital formation is a significant factor of economic growth. The study findings corroborate Benli et al. (2019) in that the effect of positive shocks to the price of petroleum is greater than the impact of the negative shocks. However, our results are in contrast with the findings of Adedeji et al. (2018) that while measuring negative and positive shocks to petroleum prices as a determinant of economic growth in Nigeria, the significance level differs in the short and the long term.

Comparing our findings with those of studies on developed countries, such as Belke et al. (2011) or Kasperowicz (2014), carried out in OECD countries and Poland deviations can be found. These deviations are results of the difference in the focus of the studies. The studies examined the causal impact between electricity consumption and economic growth, while we estimate the short-run and long-run impact of electricity consumption on economic growth in Nigeria. Compared to studies on countries being at the same level of development as Nigeria – such as Fatai's (2014) study on Sub-Saharan Africa, Enu and Havi's (2014) study on electricity consumption and economic growth in Ghana –, our findings corroborate

their study in that for developing countries, including Nigeria, the long-term connection between electricity consumption and economic growth is positive, while this relationship is positive and significant in the short run. We conclude from our findings that positive shocks to the price of petroleum have a greater impact on the Nigerian economic growth in the short as well as long term than negative shocks have. Capital formation should be considered as a growth catalyst in the government's long-term and short-term economic growth plans. However, major policy implications should be that the government, at all levels of the economy, should work towards increasing energy efficiency in their jurisdictions and encourage electricity consumers to adopt energy conservation policies. Nigeria should also seek to reduce its dependency on crude oil to avoid the consequence of the shocks to oil price on the economic growth of the country. This can be done by diversifying excess crude earnings to other strategic sectors such as agricultural production or industrial metals, among others, which have more economic cost power. Promoting such sectors will help mitigate the risk imposed by the unstable nature of the price of petroleum on the economic growth of Nigeria.

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Price Markups and Upstreamness in World Input-Output Data

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Abstract. This research uses the publicly available World Input-Output Database (WIOD) to investigate the relationship between an industry's markup and its *upstreamness*, the industry's position in the vertical chain of production; the research also identifies common attributes among high-markup industrial sectors: higher-markup industries display a higher level of capital compensation and a lower share of labour and other inputs in the value of output. Finally, it is found that upstream industries, those producing mostly raw materials and intermediate products enjoy higher market power than their downstream counterparts. This result could be among the first in the literature to find evidence of double marginalization at an industry level of aggregation. It also suggests that virtually all final product prices may incorporate substantial markups through their inputs.

Keywords: world input-output table, price markup, upstreamness

JEL classification: D24, D42, L11, L12, L41, L42

1. Introduction

While mainstream economics has firmly embraced theories of rent seeking and market power, many economists and policy makers are still convinced that markets are mostly competitive and efficient. This erroneous belief has consequences on some of the most pressing of today's global problems such as economic inequality (Han and Pyun, 2020; Thomas, 1980; Ennis, Gonzaga, and Pike, 2019), indebtedness, and financial crises (Montero and Urtasun (2021) address to some extent the connection between markup and financial pressure in times of crisis).

Economists and policymakers make better decisions concerning pressing global problems when they have access to accurate measures of market power and become aware of its prevalence. This paper consolidates previous contributions to measuring market power, suggesting that market power is the norm rather than the exception in world economies. To that end, it uses the World Input-Output Database (WIOD,

the 2017 and 2012 releases) provided by the European Commission (Timmer et al., 2015). As for the method, it uses a production approach model pioneered by a series of papers (Robert E. Hall, Blanchard, and Hubbard, 1986; Robert E. Hall, 1988) and subsequently developed by others (De Loecker, 2011; De Loecker and Warzynski, 2012; De Loecker et al., 2016; De Loecker and Eeckhout, 2017; Robert E. Hall, 2018); it also uses an *upstreamness* model proposed by Antràs et al. (2012b).

Many markets depart to various degrees from the perfectly competitive model, a departure that can be measured by the ratio between price and marginal cost (markup). This paper finds a median markup of 1.36 with an average of 1.5, consistent with other measurements (De Loecker and Eeckhout, 2018; De Loecker, Eeckhout, and Unger, 2020) but higher than other estimates (Montero and Urtasun, 2021 – Table 5). Differences in estimates are to be expected given the diversity of regions, industries, periods, and aggregation levels that are used in different studies.

Why would market power be the norm rather than the exception in the economies of the world? I dub a *complex market structure* a market where a final product incorporates intermediate (upstream) products that come from both vertical and horizontal markets with various degrees of monopolization (Machlup and Taber, 1960). In a *successive*, or *vertical* monopoly model, an upstream monopoly sells an intermediate product to a downstream company, which is itself a monopoly selling an intermediate product to its further downstream counterpart, and so on. In a vertical chain like this, each transaction happens at a price reflecting a company's market power, a process known as *double marginalization* (Spengler, 1950; Bresnahan and Reiss, 1985) but which should indeed be named *multiple* marginalization. In another possible arrangement, *parallel* monopolies (or *side-by-side* monopolies in the language of Machlup and Taber (1960)) sell intermediate, complementary inputs separately to a final-product manufacturer or to another intermediate-product one.

Virtually, every final good or service incorporates substantial upstream monopoly markups because every final good and service is the product of interdependent, complex markets. Here is an example: The production of wheat, which is many economics teachers' preferred example of a highly competitive market, uses inputs produced in quasi-monopolistic sectors such as steel, agricultural machinery, chemicals, pesticides, and others. To my knowledge, a theoretical model of a complex market structure as described here is yet to be developed.

World input-output tables are used here to calculate aggregate markups at sector and country levels; while several authors estimate price markups to assess macroeconomic effects, here the interest is mostly to identify the common attributes of high-markup sectors and to explore the relationship between a sector's position in a vertical production chain (its *upstreamness* index) and its market power. (The words *sector* and *industry* are used interchangeably.)

This paper establishes a positive relationship between price markup measured by the price to marginal cost ratio and an *upstreamness* index in the vein of Antràs et al. (2012b), with its more extended version – Antràs et al. (2012a). Besides developing a method of calculating upstreamness (defined as an industry’s distance from final product) based on input-output tables, Antràs et al. (2012b) calculate upstreamness indices for a set of countries and seek common features among high-upstreamness countries.

The remaining of the paper is structured as follows. Section 2 provides a simplified version of the theory behind production-based markup calculations. Section 3 identifies the data source and calculates descriptive statistics. Section 4 calculates markups and *upstreamness* indices for each sector-country-year observation and shows their averages at country and sector levels. Section 5 develops a linear regression model seeking relationships between markup and various sector attributes. Finally, Section 6 contains conclusions and suggests directions for further research.

2. The Production Approach to Markup: Theory and Method

Here is a simplified version of the markup model envisioned by Robert E. Hall (1988) and his followers, in particular De Loecker and Warzynski (2012), of which a simpler version is available in De Loecker, Eeckhout, and Unger (2020). The method has been dubbed the *production approach* to markup calculation in De Loecker and Warzynski (2012) and can be described as follows. Given a target level of production, Y_0 , a producer minimizes costs in the short run by choosing the amount of a generic intermediate input, L ; this generic input can be any variable input such as an intermediate product or labour. A variable input is one whose quantity can be changed at any time without an adjustment cost. In this context, capital is not adjustable and counts as a fixed input, which cannot be adjusted for minimizing costs. Equation (1), where $Y(L)$ represents the production function, describes the cost minimization problem, with its first-order condition given by Equation (2).

$$\text{Min}\{wL + rK\} \text{ such that } Y(L) = Y_0 \quad (1)$$

$$w = \lambda \frac{\partial Y}{\partial L} \quad (2)$$

By the envelope theorem, the Lagrangean multiplier in the cost minimization problem, λ , is equal to the change in the cost function, which is our objective function at its minimum level, when the target quantity of output increases by one small unit; this makes λ the marginal cost of production. Let us multiply Equation (2) by L/PY , where P is the price of output, and slightly re-arrange the resulting equation:

$$\frac{wL}{PY} = \frac{\lambda}{P} \frac{\partial Y}{\partial L} \frac{L}{Y} \quad (3)$$

Equation (3) can be easier to interpret using the following notations, where θ_L is the elasticity of output with respect to the variable input, α_L is the share of the cost of the variable input in the revenue from selling the quantity of output Y at price P , and μ is the markup ratio, price over marginal cost:

$$\theta_L = \frac{\partial Y}{\partial L} \frac{L}{Y}; \quad \alpha_L = \frac{wL}{PY}; \quad \mu = \frac{P}{\lambda} \quad (4)$$

As the subscript L indicates in Equation (4), the input elasticity, θ_L , and the input cost share in revenue, α_L , are specific to each variable input, while the markup ratio, μ , is the same for all inputs. This observation allows us to use any variable input for which we can find data to estimate the markup. With these notations, we can re-write Equation (3) as follows:

$$\mu = \frac{\theta_L}{\alpha_L} \quad (5)$$

Equation (5) gives a remarkably compact expression for the markup of each company (or sector) and for each period; the difficulty is to estimate the share of input expenditure in total revenue and the elasticity as data on input and output prices and quantities are often not available. As De Loecker and Warzynski (2012, 2444) show, an input elasticity can be estimated by modelling a production function under certain restrictions.

Industry input elasticities, θ , are calculated here by estimating a constant elasticity production function using the R package *prodest* (Rovigatti 2017a). The estimation is based on a method proposed by Olley and Pakes (1996), with subsequent amendments by Levinsohn and Petrin (2003) and Ackerberg, Caves, and Frazer (2015). This method uses a consistent, two-step estimation of the production function shown in Equation (6), as given in Rovigatti (2017a, 2).

$$y_{it} = \beta_0 + l_{it}\beta_l + k_{it}\beta_k + \omega_{it} + \epsilon_{it} \quad (6)$$

In Equation (6), y is a measure of output, l is labour (the *free* variable in the language of Rovigatti (2017a)), and k is capital (the *state* variable). Subscript i identifies one country-sector entry, and t is the time variable.

3. Data

The data used in these calculations come from the World Input-Output Database, Socio-Economic Accounts (WIOD-SEA), funded by the European Commission and freely available at WIOD-SEA (2018). The database collects yearly data for the period 1995 through 2009 for 40 countries and 35 industrial sectors. Erumban et al. (2012) give a detailed description of the primary data sources and the methods that have been used to compile the WIOD-SEA dataset.

Table 1 shows descriptive statistics of the data, including four calculated variables in its last rows. The variables *year*, *country*, and *industry code* are not shown in the table, but the lists of sectors and countries are available in figures 1 and 2. Although the dataset has a panel data structure, the regression model treats it as a pooled dataset, assuming production function parameters remain stable for longer periods.

As a side note, an interesting fact revealed in Table 1 is that the overall average of the *Capital Compensation* variable is a large share (67%) of *Compensation of Employees*. In other words, a relatively small number of capital owners receive a relatively large share of income.

Table 1. Descriptive statistics

Code	Var. Name	Mean	Max
CAP	Capital Compensation (mil)	3.3E+05	6.4E+07
COMP	Compensation of Employees (mil)	4.9E+05	5.5E+07
EMP	No. of Persons Engaged (1000)	1.5E+03	3.6E+05
EMPE	No. of Employees (1000)	6.4E+02	1.0E+05
GFCF	Gross Fixed Capital Formation	3.1E+05	5.4E+07
GFCF_P	Price Level GFCF	3.1E+02	4.7E+03
GO	Gross Output (mil)	2.2E+06	2.8E+08
GO_P	Price Level Gross Output	3.4E+02	5.0E+04
GO_QI	Gross Output, Volume Indices	1.5E+02	4.7E+03
H_EMP	Hours Worked by Persons Engaged (mil)	3.0E+03	6.1E+05
H_EMPE	Total Hours Worked by Employees (mil)	1.2E+03	2.3E+05
H_HS	Hours Worked by High-Skilled Persons (share)	1.9E-01	9.2E-01
H_LS	Hours Worked by Low-Skilled Persons (share)	3.2E-01	9.8E-01

H_MS	Hours Worked by Medium-Skilled Persons (share)	4.9E-01	9.3E-01
II	Intermediate Inputs, Value (mil)	1.2E+06	2.1E+08
II_P	Intermediate Inputs, Price	3.3E+02	5.0E+04
II_QI	Intermediate Inputs, Volume Indices	1.6E+02	5.5E+03
K_GFCF	Real Fixed Capital Stock	3.5E+06	1.1E+09
LAB	Labour Compensation (mil)	6.5E+05	7.8E+07
LABHS	High-Skilled Labour Compensation (share)	2.7E-01	9.7E-01
LABLS	Low-Skilled Labour Compensation (share)	2.7E-01	9.8E-01
LABMS	Medium-Skilled Labour Compensation (share)	4.7E-01	9.1E-01
VA	Gross Value Added (mil)	9.9E+05	7.3E+07
VA_P	Gross Value Added, Price Levels	3.6E+02	5.0E+04
VA_QI	Gross Value Added, Volume Indices	1.4E+02	1.2E+04
theta	Intermediate-Input Elasticity	7.6E-01	9.8E-01
alpha	Intermediate-Input Share in Output	5.5E-01	1.0E+00
mu	Markup (Price to Marginal Cost Ratio)	1.5E+00	1.4E+01
upstrIndex	Upstreamness (More Upstream = Higher Index)	2.1E+00	2.2E+01

4. Markup and Upstreamness Calculations

The purpose of this section is to determine price markup and upstreamness indices for each sector-country-year observation and to visualize these results at country and sector levels. To do so, we first calculate input elasticities, θ , and input expenditure shares, α ; then we use these two variables in Equation (5) to calculate the markups. Identifying the determinants of sector-level markups in a regression model is reserved for the next section.

4.1 Input Elasticities and Input Shares

To determine input elasticities, Equation (6) is estimated using the following variables: GO_QI (volume indices of gross output, the dependent variable), II_QI (intermediate inputs, volume indices), K_GFCF (real fixed capital stock), and GFCF/GFCF_P (nominal capital formation divided by the relevant price index). Gross fixed capital formation has been collected from the Socio-Economic Account part of WIOD 2012. The calculations are performed using the *prodest* package (Rovigatti 2017b), namely its *prodestOP* function.

The result of this calculation is the technological parameter θ , which is the same for all countries and years but specific to each sector. Separately, I calculate the

share of intermediate inputs in total revenue, α , directly from the socio-economic accounts part of the WIOD table, as the ratio II/GO ; since α is different for each sector-country-year observation, the markup, μ , will also be different for each observation.

4.2 Markup by Sector

Figure 1 displays markups and their 95% confidence intervals by industry, averaged over countries; industry categories correspond to the ISIC Rev. 3 standard. The graph shows that real estate, financial intermediation, and retail trade make the top of the list with the highest markups, with public administration, some energy sectors, and food industries showing the lowest markups. One should keep in mind, though, that this picture could be very different at a lower level of aggregation.

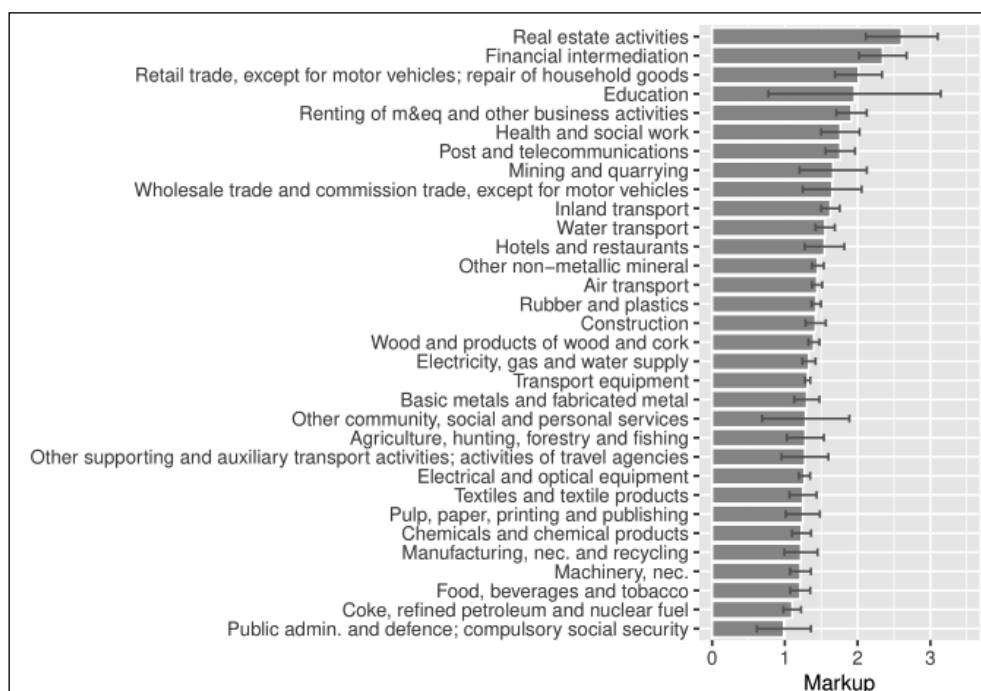


Figure 1. Average markup by sector

4.3 Markup by Country

Figure 2 shows markups with their 95% confidence intervals by country from highest to lowest. The countries with the highest aggregate markup are India, Mexico, Greece, Cyprus, and Brazil, while Estonia and the Czech Republic have

the lowest markups. Such a comparison, though, may not be very relevant because of the high level of aggregation across sectors: A balanced, diversified economy may have a lower aggregate markup than a non-diversified one, although variance across sectors may be higher.

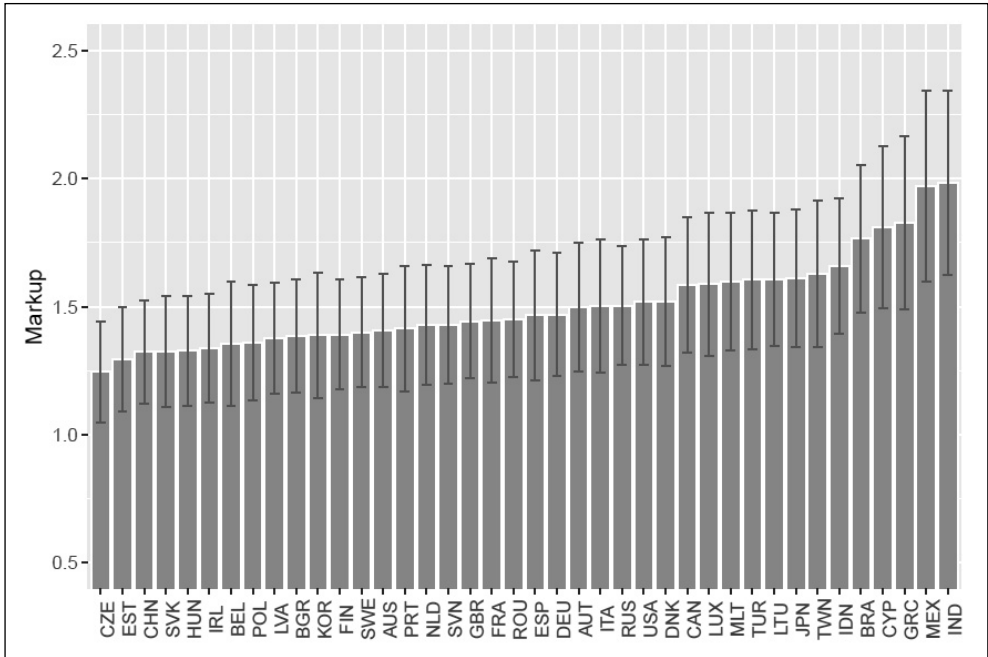


Figure 2. Average markup by country

4.4 Calculating the Upstreamness Index

The upstreamness index is calculated using the complete input-output tables, not only the Socio-Economic Accounts part, of World IO Tables (2018), which are also provided by the European Commission and are freely available. Upstreamness can be calculated based on a method developed by Antràs et al. (2012b), using the R package *ioanalysis* (Wade and Sarmiento-Barbieri, 2019). Equation (7) follows Joolman (2020: 14).

$$d_{ij} = a_{ij} \frac{x_i}{x_i + e_{ij} - m_{ij}}; \quad U = (I - D)^{-1}; \quad u_i = \sum_{j=1}^n U_{ij} \quad (7)$$

In the language of Joolman (2020), the notations in Equation (7) have the following meanings: a_{ij} represents the share of input i in industry j , x_i represents the total output generated by sector i , e_{ij} stands for exports, m_{ij} for imports, and D is the matrix having d_{ij} for its elements; u_i represents industry i 's upstreamness index, which is “weakly” bounded downward by 1 (Wade and Sarmiento-Barbieri, 2019).

Higher values of the upstreamness index indicate a more “upstream” sector, one that provides a higher share of its output as input to other, downstream industries. Intuitively, the upstreamness index associated with sector i can be thought of as “the dollar amount by which output of *all* sectors increases following a one-dollar increase in value added in sector i ” (Antràs et al., 2012b: 413). *Figure 3* shows the calculated upstreamness indices by sector. The results are consistent with those in other sources such as Antràs et al. (2012b: 415).

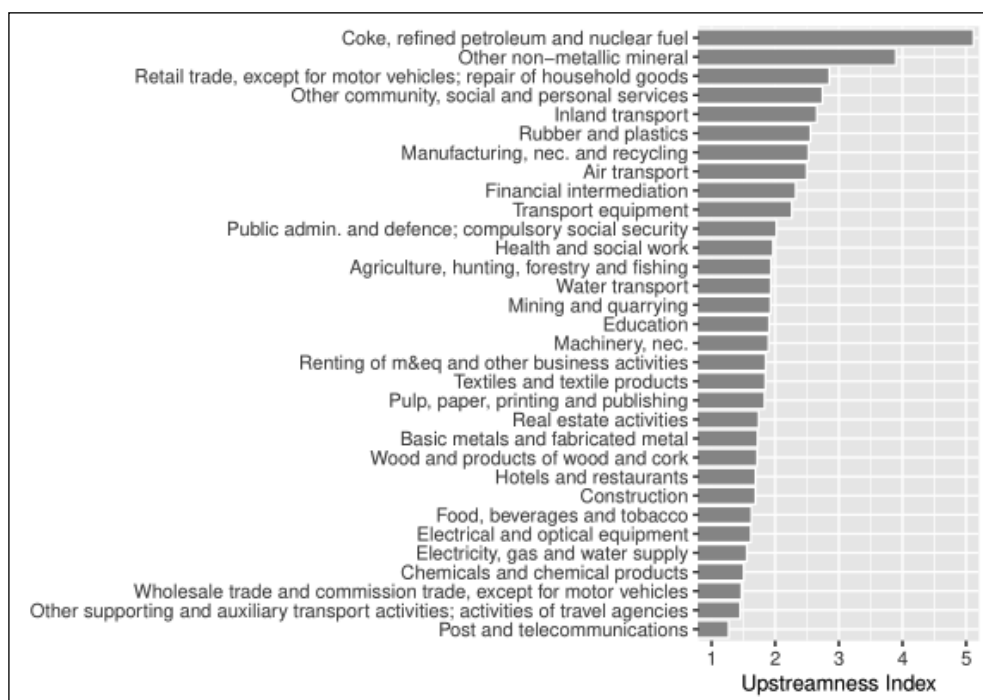


Figure 3. Average upstreamness by sector

Figure 4 shows upstreamness levels by country, although country averages may be less informative at this level of aggregation. The graph shows Spain at the highest level, followed at a distance by Japan and Australia. The lower end belongs to three Central-East European countries, Poland, the Czech Republic, and Slovenia, three relatively small economies.

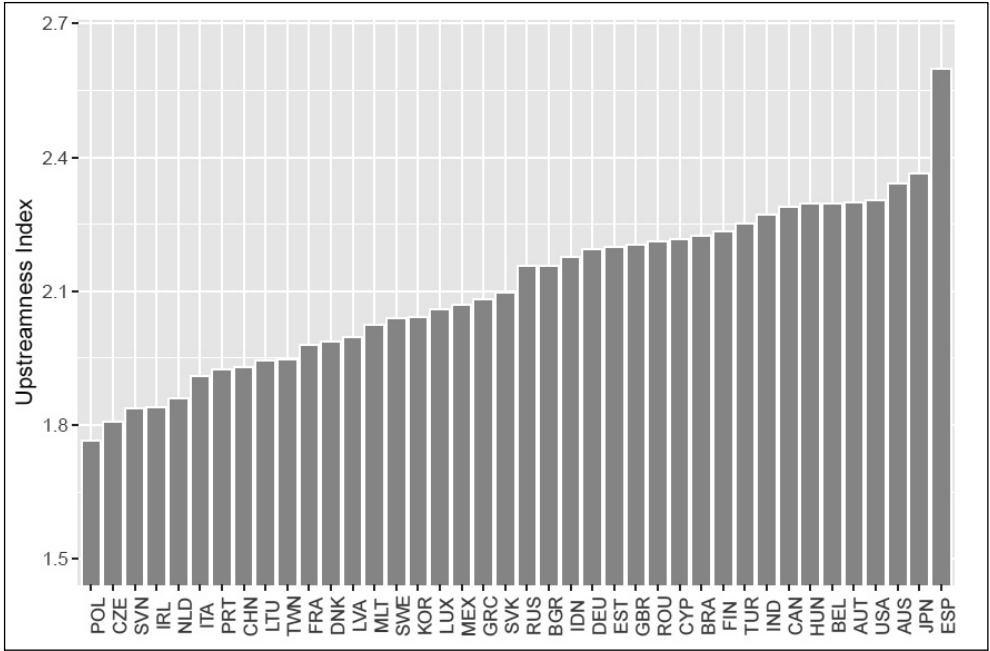


Figure 4. Average upstreamness by country

5. A Regression Model of Markup

What attributes are common to the sectors in the high-markup range? *Table 2* shows the results from an OLS regression model having markup, measured as the ratio between price and marginal cost, as its dependent variable. The regression model has the number of observations $N = 18\,799$, $R^2 = 0.81$, all variables in *logs* and standardized, and heteroskedasticity-corrected standard errors. Some of the variables in the dataset have not been included in the regression model to reduce multicollinearity; these have been identified by their high variance-inflation factor.

Table 2. Regression results, with markup as the dependent variable

Code	Var. Name	Estimate	Std. Error	p. Value
CAP	Capital Compensation (mil)	0.015	0.003	0.000
COMP	Compensation of Employees (mil)	0.014	0.006	0.012
EMP	No. of Persons Engaged (1,000)	-0.054	0.006	0.000
GFCF_P	Price Level GFCF	-0.014	0.009	0.100
GO_P	Price Level Gross Output	0.018	0.009	0.041

GO_QI	Gross Output, Volume Indices	0.121	0.010	0.000
H_HS	Hours Worked by High-Skilled Persons (share)	-0.058	0.013	0.000
H_MS	Hours Worked by Medium-Skilled Persons (share)	-0.172	0.016	0.000
II_QI	Intermediate Inputs, Volume Indices	-0.097	0.009	0.000
LABHS	High-Skilled Labour Compensation (share)	0.114	0.013	0.000
LABMS	Medium-Skilled Labour Compensation (share)	0.154	0.016	0.000
VA_QI	Gross Value Added, Volume Indices	-0.019	0.004	0.000
theta	Intermediate-Input Elasticity	0.717	0.005	0.000
alpha	Intermediate-Input Share in Output	-1.208	0.005	0.000
upstrIndex	Upstreamness (Upstream Sectors = Higher Index)	0.026	0.003	0.000

According to these results, a high-markup sector would be one that has high compensation to capital and employees of all categories, a high price level for output, low number of persons engaged, and a high volume of output. These results suggest that sectors relying more on capital than labour tend to practice higher markups. This idea is consistent with the effects of the calculated variables θ and α : the intermediate input elasticity variable, θ , has a positive effect of on markup. In other words, sectors having output more elastic with respect to the intermediate input are more likely to be in the high-markup category. (Note that labour qualifies as intermediate input in the production-approach model.) The same is true for sectors with low intermediate-input value share in output, α .

Our variable of interest, the upstreamness index, shows a positive effect on markup, indicating that sectors providing raw materials and primary intermediate inputs tend to enjoy higher market power. A possible reason could be that raw material sectors such as oil and gas are capital-intensive and enjoy long-term leases and government licences for the exploitation of natural resources.

Finding a positive effect of upstreamness on markup is important because it supports the idea that any final product, even one traded in an otherwise competitive market, can incorporate a significant markup in its price via intermediate input prices. In other words, this result contributes to a better understanding of the *double marginalization* problem in the *vertical* (or *successive*) monopoly model of market structure.

6. Conclusions

A method proposed in Robert E. Hall, Blanchard, and Hubbard (1986) and Robert E. Hall (1988) to calculate price to marginal cost ratios (markups) based on production data and applied to the publicly available World Input-Output Database (WIOD) allows calculating the distribution of markups across sectors and countries, some common features among high-markup sectors, and the effect of an upstreamness index on markups. Among the sectoral characteristics found to enhance market power are high levels of capital compensation, price levels of gross output, and a low share of intermediate-input value in output. This research also consolidates previous results concerning the levels of the price to marginal cost ratio at the industry level of aggregation.

A novel finding of this research is a positive effect of the upstreamness index on markup, showing that raw material or other intermediate product sectors tend to enjoy a greater market power than downstream sectors. To my knowledge, this is the first empirical study of double (or multiple) marginalization using global industry-level data. This finding is important in two ways. First, it validates successive monopoly models of market structure in the vein of Spengler (1950) and Machlup and Taber (1960). Second, it shows that virtually all final products incorporate substantial price markups via the intermediate goods used in their production.

A possible direction for further research might seek to identify commonalities among countries with similar levels of market power. Another useful direction could try to use a multilevel regression model for markup instead of OLS to consider country heterogeneity.

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Does Stock Market Respond to Disease Pandemic? A Case of COVID-19 in Nigeria

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Abstract. This paper investigates whether stock markets respond to disease pandemic referencing the case of COVID-19 in Nigeria. The paper employs three cointegrating regression models: Fully Modified Ordinary Least Squares, Dynamic Ordinary Least Squares, and Canonical Cointegrating Regression to analyse the effect of growth in total COVID-19 confirmed cases and related deaths in Nigeria and across the globe from 27 February 2020 to 4 September 2020 on the stock market performance. Key findings support the presence of long-run association between stock market returns and COVID-19 in Nigeria. The stock market is found to respond negatively to both domestic and global growths in total confirmed cases and deaths of COVID-19. Consequently, affected businesses in Nigeria should be assisted and bailed out by the government through practices such as tax filing, subsidies, targeted spending, and credit.

Keywords: COVID-19, pandemic, stock market returns, cointegrating regressions
JEL classification: I1, G2

1. Introduction

The effects of disease pandemic on countries' economies and the stock market in particular has attracted the attention of scholars and policy makers in recent time because a healthy population has been regarded as the engine of economic growth. Studies have shown that improvement in health boosts the economy of developing countries. Thus, in this case, health is viewed as education, which is an integral component of human capital (Meer et al., 2003; Bloom and Canning, 2000). Moreover, it is gaining global attraction because stock and economic growth are susceptible to diverse risks such as Ebola virus, Middle East respiratory syndrome (MERS), severe acute respiratory syndrome (SARS), and the economic meltdown of 2008 that culminated into devastating effects on the stock markets and other financial markets (Dang and Nguyen, 2020).

Thus, the outbreak of COVID-19 has become a source of concern because it poses several challenges to personal lives such as extreme occurrences of death and disease and subsequent economic lockdown for the purposes of curtailing the spread of the disease. This unexpected shock may have a negative impact on economic trends and investors' risk perception. For instance, havoc caused by COVID-19 may have negative effects on investment decisions and returns on assets because stock market performance is usually influenced by the behaviour of investors in such a way that when the market is bullish and risk perception is low, investors behave more optimistically, but when the market is bearish and risk perception is high, then investors become relatively pessimistic, and this can lead to short-term fluctuations in stock performance. This has, therefore, offered an opportunity to scholars and policy makers to assess the effect of pandemic on the stock markets. As a result, this paper examines the effects of COVID-19 on stock market performance in Nigeria by investigating its impact on stock market indices. Different from extant studies, the study contributes to existing literature on COVID-19 and stock market performance by quantitatively investigating the economic effect of lockdown.

Thus, the fundamental questions of this research based on the aforementioned are: What is the effect of the total reported cases of COVID-19 (both locally and globally) on stock market returns? What is the effect of COVID-19-related deaths on stock market returns? Does lockdown associated with COVID-19 affects the stock market? Consequently, the findings show that stock market in Nigeria responds more to the growth in domestic COVID-19 confirmed cases and global reported deaths caused by the pandemic than to the domestic reported deaths and global COVID-19 confirmed cases. Also, lockdown significantly affects stock returns in Nigeria.

The structure of the rest of the paper is as follows. Section 2 presents literature review. Section 3 discusses data and methodology. Section 4 presents results and discussion. Finally, section 5 provides the conclusion and recommendations.

2. Literature Review

Several research on the economic impact of pandemics, such as Ebola virus, Middle East respiratory MERS, and SARS, have been carried out. For example, an event study approach was used by Chen, Jang, and Kim (2007) to show a relatively negative impact of the SARS epidemic on the price movements of hotel stock in Taiwan. Their findings showed that the tourism industry felt the hit mostly, suffering the highest fall in stock price (about 29 percent) due to the epidemic. This finding was supported by other studies, such as Chen, Chen, Tang, and Huang (2009), which used the GARCH process event analysis method to confirm that

the SARS crisis had a negative effect on Taiwan's tourism and wholesale as well as retail sectors in Taiwan. However, using Mann–Whitney non-parametric tests to examine the impact of the SARS epidemic on the stock markets in a study on Canada, China, Singapore, Hong Kong, the Philippines, Indonesia, Thailand, and Vietnam, Nippani and Washer (2004) found rather mixed results. Their findings showed that, except for China and Vietnam, the SARS epidemic had no negative impact on the stock markets of the affected countries.

Recently, the sudden outbreak of COVID-19 confounded world health experts that no immediate medical respite was found for the pandemic. According to Fitzgerald (2020), "The accompanying effect of the Coronavirus pandemic has spiralled into different swings in the global stock and money markets, thus causing jitters amongst investors." Studies have shown that the COVID-19 pandemic infection and fatality rates revealed that no infectious disease epidemic had affected the stock market as strongly as the pandemic. From the current perspective, past pandemics have left only mild traces on the U.S. stock exchange. For instance, Baker et al. (2020) gave account of stock market response to COVID-19, and their findings suggested that the major factors for why the US stock market reacted to COVID-19 was the excessive control of government to restrict commercial activity and social activities. However, a surprising finding by other researchers, such as Onali (2020), who analysed COVID-19 and stock market fluctuations using the GARCH(1,1) model in the US and six additional countries, showed that variations in the number of cases and deaths did not affect the US stock market returns. A related research (Ngwakwe, 2020) on the early effects of the COVID-19 pandemic on three major regional stock indices worldwide supported a similar finding, that is: some stock markets, such as the Shanghai Composite Index, were immune to the COVID-19 pandemic.

The general opinion among academics, however, is that COVID-19 has a negative impact on the stock markets of the countries affected. This was supported by researchers such as Manzoor, Wang, Zhang, and Manzoor, (2020), who used a method of event analysis to demonstrate that stock markets in major Asian countries experienced more negative abnormal returns compared to other nations. Using an event study approach to examine the impact of COVID-19 on the stock markets of the six worst COVID-19 pandemic countries, Alber (2020) found that stock market returns were more susceptible to Coronavirus cases than deaths and more to new ones than to Coronavirus cumulative measures. In addition, research by Elsayed and Elrhim (2020) on the effects of COVID-19 spread on the Egyptian stock market showed evidence that the return of stock market sectors was more susceptible to cumulative mortality indicators on a regular basis than to deaths from corona viruses and to new cases more than to cumulative mortality indicators.

In the same vein, panel data regression analysis was used by Al-Awadhi, Al-Saifi, Al-Awadhi, and Alhamadi (2020) to demonstrate that regular growth in

both total reported cases and cases of death induced by COVID-19 had major negative effects on stock market returns in all Chinese stock market companies. Ashraf (2020), who used panel data techniques to investigate regular COVID-19 reported cases and deaths and stock market returns data from 64 countries between 22 January and 17 April 2020, also confirmed this finding. He found that stock markets reacted negatively to the growth confirmed in COVID-19 cases. That is, as the number of reported cases rose, stock market returns declined. The result also showed, however, that financial markets were more proactive in responding to growth in the number of reported cases relative to growth in the number of deaths. Similarly, Baiga, Butt, Haroona, and Rizvia (2020) in their study on deaths, panic, lockdowns, and US equity markets during COVID-19 crisis confirmed that market illiquidity and volatility are highly related to the rise in the number of confirmed COVID-19 cases and deaths. In addition, the illiquidity and instability of the markets are also linked to the decline in investor sentiments, government policies of economic shutdown, and the lockdown of public places.

Despite many evidence of the negative impact of COVID-19 on stock markets, some scholars went further to show that the effect quickly fizzled out shortly after the outbreak (see: Liu, Manzoor, Wang, Zhang, and Manzoor, 2020; He, Liu, Wang, and Yu, 2020; Okorie and Lin, 2020; Salisu, Ebu, and Usman, 2020). Many scholars have also looked into the impact of the disease pandemic on other macroeconomic variables such as diesel consumption (Ertuğrul, Güngör, and Soytaş, 2020), currency depreciation, and stock market (Narayan, Devpura, and Wang, 2020), and oil prices and COVID-19 (Gil-Alana and Monge, 2020).

The above indicate that, considering their numerous results and concentrations in America, Asia, and other developed countries, with very few in Africa, the few studies on the stock market's reaction to the COVID-19 pandemic are inconclusive. Most of these studies showed that stock market returns respond negatively to new COVID-19 cases and cumulative cases of death, but they did not consider the influence of the lockdown on the performance of the stock market, which could lead to inaccurate model estimates and skewed results. This study, therefore, explores the stock market's reaction to the COVID-19 pandemic in Nigeria in general, and it specifically examines the effects of the lockdown on the economy.

3. Data, Model, Methodology, and Preliminary Analysis

3.1. Data Description

The datasets used in this study are stock market index (All Share Index) sourced from *www.investing.com* and the number of COVID-19 reported cases and deaths at the daily level sourced from *Our World in Data*. The datasets cover a period from

27 February to 4 September 2020. To capture the overall effects of lockdown on stock market, we introduced a dummy variable, which takes value 1 in the period of the lockdown, i.e. from 30 March to 4 May 2020, and 0 otherwise.

We apply certain filters to refine the data. Observations with missing values are not accounted for because, while COVID-19 data is available every day, stock market data are not reported on the weekends or on national holidays. In the case of Nigeria, the stock market is open from Monday to Friday. After the adjustment, our final dataset has 129 data points over the period from 27 February to 4 September 2020.

Furthermore, from the daily closing index, we computed the daily returns as follows: $r_{i,t} = 100 * \log(p_t/p_{t-1})$, where $r_{i,t}$ is the daily stock returns of a firm i at time t , p_t is the current daily closing price of the stock index of a firm i at time t , and p_{t-1} is the preceding day closing price ($t-1$) for a firm i .

The growths in the COVID-19-related cases and deaths are computed using the following: $cg_t = (c_t/c_{t-1}) - 1$ and $dg_t = (d_t/d_{t-1}) - 1$, where cg_t and dg_t are the growths in the cases and deaths of COVID-19 pandemic at time t , c_t and d_t are the number of cases and deaths reported at time t , and c_{t-1} and d_{t-1} are the cases and deaths of the preceding day, that is, ($t-1$).

3.2. Model and Methodology

This study adopts the approach used by Narayan and Narayan (2005), Lee and Wang (2018), and Saboori et al. (2014). To enable us analyse the relationship between stock market index, total COVID-19 cases, and COVID-19-related deaths and growth of daily confirmed cases, the model below is proposed:

$$SMR_t = \sigma_0 + \sigma_1 CoV_t + D_t + \mu_t \quad (1),$$

where μ_t is the idiosyncratic error term, SMR_t is the dependent variable (here it is the stock market returns for Nigeria), σ_0 is the constant, σ_1 is the coefficient of the model, CoV_t is a vector of independent variables (which are total COVID-19 reported cases and deaths at the domestic and global level), and D_t is a time dummy, which captures the impact of lockdown on the stock market. The dummy variable takes the value 1 for the period from 30 March to 4 May 2020 and 0 otherwise.

We employed three cointegrating regression models for analyses – Fully Modified Ordinary Least Squares (FMOLS), Dynamic Ordinary Least Squares (DOLS), and Canonical Cointegrating Regression (CCR). Further, we provide explanations for the FMOLS method only (see Park, 1992; Saikkonen, 1992; Stock and Watson, 1993 – for more details on CCR and DOLS methods). The FMOLS regression method was first employed by Phillips and Hansen (1990) to present the best estimation

of cointegrating regressions. This method transforms OLS in order to eliminate the endogeneity challenges in the explanatory variables, which are due to the presence of cointegration relationship. The FMOLS approach likewise reduces the challenges resulting from the long-run association between the cointegrating equation and changes in the random regressor. According to Hansen (2002), “the FMOLS estimator is asymptotically unbiased and has fully efficient mixture normal asymptotics allowing for standard Wald tests using asymptotic Chi-square statistical inference”.

The linear regression model is specified as follows:

$$SMR_t = \sigma_0 + \sigma_1 CoV_t + D_t + \mu_t \quad t = 1, 2, \dots, n \quad (2),$$

where the $K \times 1$ vector of I(1) explanatory variables are not cointegrated themselves. Thus, CoV_t is a process with stationarity at first differences, which is stated as:

$$\Delta CoV_t = \eta + v_t, \quad t = 2, 3, \dots, n \quad (3),$$

in which η is a $K \times 1$ vector of drift parameters, and v_t is a $K \times 1$ vector of I(0), or stationary variables. It is assumed that $\zeta_t = (\mu_t, v_t)'$ is stationary with zero mean and a finite positive-definite covariance matrix, Σ .

Two stages are involved in carrying out the calculation of the FMOLS evaluation of σ . In stage one, the $SMRt$ long-run interdependence of μ_t and v_t is corrected. As a result, $\hat{\mu}_t$ is the OLS residual vector in equation (1), and:

$$\zeta_t = \begin{pmatrix} \hat{\mu}_t \\ \hat{v}_t \end{pmatrix}, \quad t = 2, 3, \dots, n \quad (4),$$

where $\hat{v}_t = \Delta CoV_t - \hat{\eta}$ for $t = 2, 3, \dots, n$ and $\hat{\eta} = (n-1)^{-1} \sum_{t=2}^n \Delta CoV_t$.

A consistent estimator of the long-run variance of ζ_t is given by:

$$\hat{\omega} = \hat{\Sigma} + \hat{\lambda} + \hat{\lambda}' = \begin{bmatrix} \hat{\sigma}^{11} & \hat{\sigma}^{21} \\ 1 \times 1^{\hat{\sigma}^{11}} & 1 \times k^{\hat{\sigma}^{21}} \\ \hat{\sigma}^{21} & \hat{\sigma}^{22} \\ k \times 1^{\hat{\sigma}^{21}} & k \times k^{\hat{\sigma}^{22}} \end{bmatrix},$$

where $\hat{\Sigma} = \frac{1}{n-1} \sum_{t=2}^n \hat{\zeta}_t \hat{\zeta}_t'$, $\hat{\lambda} = \sum_{s=1}^m w(s, m) \hat{Y}_s$, $\hat{Y}_s = n^{-1} \sum_{t=1}^{n-s} \hat{\zeta}_t \hat{\zeta}_{t+s}'$, and $w(s, m)$ is the lag of window with horizon m .

In stage two, the FMOLS estimator of σ is given by:

$$\hat{\sigma}_* = (W'W)^{-1} (W'SMR^* - nD\hat{Z})$$

where $SMR^* = (SMR^*_1, SMR^*_2, \dots, SMR^*_n)'$, $W = (\tau_n, CoV)$, and $\tau_n = (1, 1, \dots, 1)'$.

Therefore, the FMOLS estimator utilizes preliminary evaluations of the equality and the residuals of the one-sided long-run covariance matrices.

3.3. Preliminary Analysis

3.3.1. Descriptive Statistics

Summary statistics, such as maximum, minimum, average, standard deviation, skewness, kurtosis, and Jarque–Bera test, are displayed in *Table 1*. It can be observed in *Table 1* that, on the average, the stock market in Nigeria has a negative average return of about -0.02% for the period from 27 March to 4 September 2020, with a maximum return of about 1.33% and a standard deviation of approximately 0.49%. COVID-19 cases in Nigeria have an average growth rate of about 0.07%, with a maximum growth rate at 1.67%, and a variation rate of 0.18%, while COVID-19-deaths related cases grew by approximately 0.03%, with a maximum growth rate of 1.00% and a standard deviation of 0.09% within the period of study.

Moreover, on the global level, we observed that global COVID-19 cases have a growth rate of about 0.03%, with a maximum growth rate of about 0.14% and a rate of variation of about 0.03%. However, in terms of global fatalities, *Table 1* revealed that global COVID-19-related deaths have a growth rate of 0.03%, with a maximum growth of approximately 0.14% and a standard deviation of about 0.04%. Overall, we observed negative skewness for the stock market returns, while all COVID-19-related indicators, both domestic and global, are positively skewed.

Table 1. Descriptive statistics

	Smr	Gtc	Gtd	Gtwc	Gtwd
Mean	-0.018	0.068	0.034	0.031	0.031
Maximum	1.333	1.667	1.000	0.138	0.140
Minimum	-2.186	0.000	0.000	0.009	0.004
Std. Dev.	0.489	0.182	0.095	0.028	0.038
Skewness	-1.116	6.595	8.329	2.053	1.647
Kurtosis	7.062	53.092	83.253	6.340	4.332

	Smr	Gtc	Gtd	Gtwc	Gtwd
Jarque–Bera	115.481	14422.150	36109.790	150.592	67.852
Probability	0.000	0.000	0.000	0.000	0.000
Observations	129	129	129	129	129

Source: authors' calculation

Note: Smr represents stock market returns. Gtc and Gtd stand for growth in domestic COVID-19 cases and deaths. Gtwc and Gtwd represent growth in global COVID-19 cases and deaths respectively.

3.3.2. Correlation Analysis

Table 2 contains Pearson correlation coefficients between the series. As expected, there is negative correlation between the total growth of COVID-19 cases and the stock market returns in Nigeria, while the growth in fatalities is positively related to stock market returns. However, expectedly, the growths in both global COVID-19 cases and deaths have negative correlations with stock market returns in Nigeria. Also, lockdown represented by a dummy appears to positively relate to the stock market.

Table 2. Correlation

	Smr	Gtc	Gtd	Gtwc	Gtwd	Du1
Smr	1.000					
Gtc	-0.332	1.000				
Gtd	0.047	0.133	1.000			
Gtwc	-0.166	0.427	0.135	1.000		
Gtwd	-0.180	0.429	0.183	0.967	1.000	
Du1	0.115	0.089	0.400	0.281	0.381	1.000

Source: authors' calculation

Note: Smr represents stock market returns. Gtc and Gtd stand for growth in domestic COVID-19 cases and deaths. Gtwc, Gtwd, and Du1 represent growth in global COVID-19 cases, deaths, and dummy variable respectively.

3.3.3. Unit Root Tests

First of all, it is conventional and also required to ascertain the order of integration for each series as the FMOLS approach is only applicable for series that are I(0) or I(1) or fractionally integrated. However, according to the literature, the processes of

data generation for various economic series are described by random movements leading to incorrect conclusion if the features of the data are not examined with great caution. A variable is considered stationary over time if its autocovariances and the mean are time-independent, and the reverse is true for a non-stationary series, which means it has a unit root. In the literature, the conventional techniques to test for a series stationarity is the unit root test, and the common tests available for individual time series are the Augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1979, 1981), the Phillips–Perron (PP) test (Phillips and Perron, 1988), and the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test (Kwiatkowski, Phillips, Schmidt, and Shin, 1992).

Table 3 contains the results of ADF, PP, and KPSS. This is carried out on the natural logarithms of the levels and first differences of the series. The outcomes indicate that all the variables are stationary at first difference, which signifies I(1) order of integration. For the KPSS, it tests the null hypothesis that the series has no unit root – indicating stationarity of the series, whereas the alternative hypothesis states that the variable non-stationary has a unit root.¹ Therefore, from the unit root results, there is no evidence of I(2) for all the series, thus confirming the suitability of FMOLS, DOLS, and CCR approaches for the long-run association between stock market and COVID-19.

Table 3. *Unit root*

Tests	ADF(<i>l</i>)	ADF(<i>d</i>)	PP(<i>l</i>)	PP(<i>d</i>)	KPSS(<i>l</i>)	KPSS(<i>d</i>)
Smr	-5.037***	-	-7.904***	-	0.361*	0.106
Gtc	-2.143	-10.325***	-9.628***	-80.694***	0.927***	0.500
Gtd	-11.194***	-	-11.336***	-	0.485**	0.009
Gtwc	-2.688*	-2.680*	-1.738	-14.058***	0.704**	0.129
Gtwd	-3.012**	-5.993***	-1.506	-13.544***	0.776***	0.164
Du1	-1.852	-11.180***	-1.917	-11.180***	0.389*	0.090

Source: authors' calculation

Notes: Smr represents stock market returns. Gtc and Gtd stand for growth in domestic COVID-19 cases and deaths. Gtwc, Gtwd, and Du1 represent growth in global COVID-19 cases, deaths, and dummy variable respectively. Level and first differences are denoted by *l* and *d*. ADF and PP report *t*-statistics, while KPSS reports LM – statistic. *, **, and *** represent statistical significance at 10%, 5%, and 1% levels respectively. The null hypothesis is rejected at *p*-values set at 10% level of significance.

1 The decision to reject or accept the null hypothesis in the case of KPSS unit root test is based on the LM statistic probability values as specified in Kwiatkowski, Phillips, Schmidt, and Shin (1992).

3.3.4. Cointegration Test

The non-stationarity of two or more variables may be made stationary in a linear combination (Engle and Granger, 1987). The existence of stationary linear combination is an indication that there is cointegration among the non-stationary time series, resulting in long-run equilibrium among the series. For our current study, we employ the Johansen cointegration test (Johansen, 1988). The rationale for our choice is that the Johansen approach produces better results than other cointegration tests, e.g. the Engle–Granger single equation test method, since the maximum likelihood procedure has useful large and finite sample features (Cheung and Lai, 1993). Also, it employs two ratio tests – a trace test and a maximum eigenvalue test – to investigate the number of cointegrated relationships. However, in the event of disparity in results between the trace statistics and maximum eigenvalue statistics, the latter is preferred because of the advantage of performing separate tests on each eigenvalue. The Johansen cointegration test results are recorded in *Table 4*. We observed that both the trace test and the maximum Eigen statistic test confirm the existence of at least five cointegrating equations at the 5% level. Hence, we conclude that the null hypothesis of no cointegration among the series is rejected. Therefore, based on the Johansen cointegration test results in *Table 4*, we inferred the existence of a long-run equilibrium association between stock market returns and COVID-19 (proxied by the growth in total number of confirmed cases and number of deaths – domestic and global) in Nigeria.

Table 4. *Cointegration test*

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	p-value
None *	0.594	272.823	95.754	0.000
At most 1 *	0.379	162.864	69.819	0.000
At most 2 *	0.298	104.755	47.856	0.000
At most 3 *	0.242	61.620	29.797	0.000
At most 4 *	0.171	27.787	15.495	0.000
At most 5 *	0.039	4.873	3.841	0.027
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	
None *	0.594	109.959	40.078	0.000
At most 1 *	0.379	58.108	33.877	0.000
At most 2 *	0.298	43.135	27.584	0.000

At most 3 *	0.242	33.833	21.132	0.000
At most 4 *	0.171	22.914	14.265	0.002
At most 5 *	0.039	4.873	3.841	0.027

Note: Trace and Max-eigenvalue tests show 6 cointegrating equations at the 5% level. * represents rejection of the hypothesis at the 5% level.

4. Results and Discussion

Results for the three methods (FMOLS, DOLS, and CCR) are reported in *Table 5*. For domestic COVID-19 cases, our results indicate that the growth in total reported cases of COVID-19 have negative impact on stock market returns for all the three methods. An increase in the cumulative cases of COVID-19 led to decrease in the stock market returns by -0.76%, -1.42%, and 0.70% for the FMOLS, DOLS, and CCR models respectively. This shows that as the total COVID-19 cases in Nigeria increase, stock returns will decrease. In terms of level of significance, the results showed that all the coefficients on the total COVID-19 cases are statistically significant at the one percent level. Conversely, growth in cases of fatalities (deaths from COVID-19 in Nigeria) has a positive but insignificant impact on the stock market returns for all the models except DOLS.

Table 5. *Empirical results*

Estimation methods	FMOLS	DOLS	CCR
Gtc	-0.758*** (0.168)	-1.423*** (0.458)	-0.696*** (0.260)
Gtd	0.228 (0.314)	-0.946 (0.894)	0.293 (0.507)
Gtwc	9.236** (4.083)	20.266* (10.828)	9.385* (5.465)
Gtwd	-7.541** (3.268)	-13.792 (8.509)	-7.648* (4.585)
Du1	0.283*** (0.090)	0.637*** (0.207)	0.270** (0.117)
Intercept	-0.159 (0.104)	-0.386** (0.192)	-0.169** (0.074)
Cointegrating equation deterministics	0.001 (0.001)	0.003 (0.002)	0.001 (0.001)
R ²	0.172	0.35	0.171
Adj-R ²	0.131	0.28	0.130
Long-run variance	0.095	0.299	0.095

Cointegration Coefficient Diagnostic ¹	46.118 <i>df</i> = 121	21.642 <i>df</i> = 116	34.698 <i>df</i> = 121
Cointegration Test ²	40.853***	0.034	2.898***

Source: authors' calculation

Notes: the dependent variable for the three models is *Smr*, which represents stock market returns. *Gtc* and *Gtd* stand for growth in domestic COVID-19 cases and deaths. *Gtwc*, *Gtwd*, and *Du1* represent growth in global COVID-19 cases, deaths, and dummy variable respectively. The values in parenthesis represent standard errors. *, **, and *** represent statistical significance at 10%, 5%, and 1% levels respectively.

Furthermore, in the case of global COVID-19 cases and deaths, the results are contrary to *a priori* expectations. We found a positive relationship between the stock market returns and the growth in total global COVID-19 confirmed cases for all three models (FMOLS, DOLS, and CCR). This means that a rise in global COVID-19 cases improves the stock market returns in Nigeria for all three models. Statistically, the coefficients of the FMOLS are significant at 5% conventional level, while they are significant at 10% for the DOLS and CCR models. On the contrary, when we consider the growth in the number of fatalities, the results show that as the growth in global COVID-19-related deaths increases, the stock market returns in Nigeria decline. This indicates that as the number of global COVID-19-related deaths increases, stock returns in Nigeria decrease. For the FMOLS model, COVID-19-related death cases cause the stock market returns to decrease from a rise in the number deaths, and this is statistically significant at 5% level. For the DOLS model, increase in COVID-19-related deaths will give rise to a decrease in the stock returns, but it appears to be statistically insignificant. In the CCR model, an increase in the global COVID-19-death related cases causes the stock market in Nigeria to decrease statistically significant at 10%. The results show that increase in the growth of reported cases will cause the stock market to deteriorate.

Our results are consistent with other scholars' findings in the literature. For example, Alber (2020) found similar outcomes in a study on the top six countries hit by the COVID-19 pandemic. He reported that stock market returns appear to be more responsive to COVID-19 cases than deaths and COVID-19 cumulative cases than new ones. Al-Awadhi, Al-Saifi, Al-Awadhi, and Alhamadi (2020) investigated the effect of Coronavirus-infected cases and fatalities on stock market returns in two stock exchanges in China (Hang Seng Index and Shanghai Stock Exchange Composite Index); they documented that daily growth in total reported cases and total deaths as a result of Coronavirus have a significantly inverse effect on the stock returns of all companies.² Also, Elsayed and Abd Elrhim (2020) found that at the sectoral level, sectors' stock market returns are more sensitive to cumulative deaths than daily reported deaths from COVID-19, and there is greater responsiveness

2 Similar studies include Ashraf (2020), Baker, Bloom, Davies, Kost, Sammon, and Viratyosin (2020), Okorie and Lin (2020), Onali (2020), and Ramelli and Wagner (2020), among others.

to new COVID-19 cases than the cumulative cases. Further, Ru, Yang, and Zou (2020), who studied the different responses of stock markets to the 2003 SARS and Coronavirus, reported that countries that did not experience the 2003 SARS do not have timely and effective reactions to the current pandemic (COVID-19).

5. Conclusions

Following the data evaluation above, our study provided certain key findings. The baseline and subsequent results established the existence of long-run association between stock market returns and COVID-19 in Nigeria. Moreover, we found that the stock market in Nigeria responds negatively and significantly to both domestic and global growths in total COVID-19 cases and deaths. However, the effects of the growth in total domestic COVID-19 cases and the growth in global COVID-19-related deaths appear to exert greater negative and significant impact on stock returns in Nigeria. This signified that as the number of confirmed cases and deaths continued to grow, there would be a decrease in stock market returns in the country. On the other hand, the results indicated that domestic growth in COVID-19-related deaths had insignificant positive impact on stock returns, while the growth in global confirmed cases had positive and significant impact on stock returns in Nigeria. Also, as expected, the results supported the significant effect of government lockdown on stock returns. In sum, our results implied that the financial market of Nigeria responded more to the growth in domestic confirmed cases and global reported deaths than to the domestic reported deaths and global confirmed cases. This was not surprising since the number of fatalities in Nigeria was not as much compared to other countries in Europe and the United States. In general, the study indicated that the stock market in Nigeria reacted promptly to the Coronavirus deadly disease, but the reaction was dependent on the event measured.

Given our findings that stock market returns responded negatively to COVID-19 to the detriment of businesses, it is recommended that affected businesses in Nigeria should be assisted and bailed out by the government through practices such as tax filing and subsidies. The government should increase budget allocation to businesses and employees in order to enhance market and business confidence and should redirect the totality of debt, equity, and credit guarantees to affected businesses.

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Oil Price and Macroeconomic Fundamentals in African Net Oil-Exporting Countries: Evidence from Toda–Yamamoto and Homogeneous Causality Tests

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Abstract. Despite the wealth of literature on the oil price growth examinations, there is a shortage of research on the causality between oil prices and various macroeconomic fundamentals with regard to the group of net oil-exporting countries in Africa. This study examines the causality between oil price volatility and macroeconomic fundamentals in net oil-exporting countries in Africa using the Toda–Yamamoto and homogeneous causality techniques to gauge the nexus in the selected countries from 1995 to 2019. Our findings from the panel causality test suggest that oil price volatility significantly Granger causes the economic growth of the selected net oil-exporting countries in Africa. However, a mixed outcome was observed for the cross-sectional analyses using the Toda–Yamamoto causality test. Hence, the study offers the need for a policy framework that would drive the output growth as oil price changes continue to threaten macroeconomic variables.

Keywords: oil price volatility, macroeconomic fundamentals, net oil-exporting countries, Toda–Yamamoto causality

JEL Classification: C10, E32, Q43

1. Introduction

The dynamics of crude oil make it an integral part of sustainable development in developed countries, and net oil-exporting countries in Africa are no exception. The stylized fact of the net oil-exporting countries in Africa suggests that energy remains a driving and motivating force on which the economies rely. Predictably, volatilities in oil prices have significant impacts on macroeconomic fundamentals. Oil prices have been confronted with historical crises ranging from political, economic, and other changes since the 1970s, and maintain their volatility to date. In 2020, oil prices decreased significantly as a result of the coronavirus

pandemic lockdown, which indicates another dramatic chapter in the history of oil industry, as most oil investors and stakeholders did not prepare for the recent collapse. While oil prices have shown a modest rebound following the collapse, it is not clear whether most of the net oil-exporting countries' earnings from crude oil sales will be sustainable due to the continued decrease in their budgets. In addition, the prevailing COVID-19 pandemic across the world has dramatically reduced demand for the world's largest oil-consuming economies (International Energy Agency, 2020). It is therefore questionable, mostly in the context of the COVID-19 outcome, that low oil prices will benefit consumers as market forces continue to disrupt demand, which further upset the expansion plans of oil-exporting economies and, most relevantly, provide sufficient funding to healthcare industries to combat COVID-19.

From a theoretical standpoint, the impact of crude oil price volatility on macroeconomic activities could be transmitted through a multitude of channels, including supply side, wealth transfer, real balance, inflation, and sector adjustment effects (Brown and Yücel, 2002). As oil prices continue to rise, output and employment opportunities will be damaged as marginal production cost increases (Brown and Yücel, 2002). Aggregate demand can also be reduced as this price increase results in revenue redistribution between net oil suppliers and exporters. A plethora of empirical examination had focused on how oil price volatility impacts various phases of the macroeconomic factors in both oil-importing and oil-exporting countries (Hamilton, 1983; Ferderer, 1996; Guo and Kliesen, 2005; Hamilton, 1996; Lardic and Mignon, 2006; Cologni and Manera, 2008; Iwayemi and Fowowe, 2011; Farzanegan and Markwardt, 2009; Tang, Wu, and Zhang, 2010; Rafiq, Salim, and Bloch, 2009; Omojolaibi, 2013; Ogede, George, and Adekunle, 2020). These studies provide an outstanding overview of prior studies on this topic which have uncovered that the uncertainty with crude prices is directly linked to the supply chain and that the volatility of crude prices has a considerably significant impact on the economic indicators, such as output, inflation rates, unemployment, interest rates, and exchange rates, which have been identified to be asymmetric.

Also, another set of empirical investigations have argued that the relationship between unanticipated changes in energy prices and macroeconomic fundamentals has weakened over time due to the role of monetary authorities and call for alternative sources of energy (Iwayemi and Fowowe, 2011; Omolade, Ngalawa, and Kutu, 2019; Ogede, et al., 2020). Barsky and Kilian (2004) report a one-way relationship between macroeconomic variables and oil prices. Aliyu (2009) extends the literature on the subjects by exploring both linear and non-linear models for Nigeria. The author employs Wald tests, Granger causality, and VAR methodologies to gauge the nexus and provides evidence that oil price shocks do not Granger cause real GDP at 5 percent significance level. With regard to Nigeria, Babajide

and Soile (2015) report a similar result by exploring quarterly data spanning from 1980:Q1 to 2011:Q4. However, the recent oil prices collapsed amid the COVID-19 pandemic, and the economic slowdown across the globe has renewed debate on oil price-macroeconomic fundamentals. The interdependence between oil prices and macroeconomic indicators is, therefore, one of the debates that need to be discussed at length, considering the usefulness of oil as a key input for the production process and major global export products over years.

Remarkably, a review of macroeconomic activities in Africa's oil-exporting countries reveals that the economies have been linked to the oil sector, suggesting that the region's macroeconomy is exposed to volatilities of crude oil price. As oil prices and COVID-19 continue to threaten the global economies, the four largest net oil exporters in OPEC from Africa, namely Nigeria, Algeria, Angola, and Gabon, have begun to bear the attendant impacts of the volatilities in oil prices. Thus, given the dearth of the literature and the diversity in resources and macroeconomic frameworks of the selected countries with regard to the nexus between volatilities in oil prices and various macroeconomic fundamentals, the current study – in contrast to most existing literature – uses the Toda and Yamamoto (1995) causality technique along the homogenous panel causality test to investigate the nexus. Likewise, the evaluation of volatility models using the realized volatility (RV) model was adopted to gauge oil price volatility as against the erstwhile studies that modelled oil price volatility around the GARCH family models (see Salisu and Fasanya, 2013). Following Ogede (2020), realized volatility (RV) is measured as the sum of the intra-quarter rate of return squares following Andersen and Bollerslev (1998) and generates an unbiased and efficient model of volatility estimates (Chen and Hsu, 2012). This study, therefore, fills the knowledge gaps by using high-frequency data to model oil price volatility using a realized volatility model, while the ingenuity of this study will assist the government and stakeholders with the crucial tools for developing policy frameworks that ease the unfriendly outcomes of oil price volatility on macroeconomic fundamentals in Africa.

The remainder of this study is systematized as follows. Section 2 discusses an overview of the literature, while section 3 focuses on methodology and sources of data. Section 4 summarizes the empirical results, while Section 5 concludes the study.

2. Review of Relevant Literature

There is a vast empirical literature focusing on the examination of the relationship between oil prices and various macroeconomic indicators for diverse nations and periods with diverse methodologies. Among the major empirical standpoints that focused on how oil price volatility significantly impacts macroeconomic indicators,

see: Guo and Kliesen, 2005; Hamilton, 1996; Lardic and Mignon, 2006; Cologni and Manera, 2008; Iwayemi and Fowowe 2011; Farzanegan and Markwardt, 2009; Tang, Wu, and Zhang, 2010; Rafiq, Salim, and Bloch, 2009; Omojolaibi, 2013; Ogede, et al., 2020. However, an appraisal of the literature shows that most of the previous empirical examinations assumed linear specification and largely confirm causality stemming from oil prices to output growth. Hamilton (1996) argued, for example, that the specification for a net increase in oil prices significantly improves the model description of the relationship between oil prices and economic output. A further review of extant studies suggests that the outcomes depend on the directions of causalities (see Barsky and Kilian, 2004; Aliyu, 2009; Korhan, Vahid, and Nigar, 2015). For example, Korhan et al. (2015) examine the causal relationship between oil price and macroeconomic indicators using the data between 1961 and 2012. The study reports a unidirectional relationship from oil price to output growth. In a similar vein, Apere and Ijomah (2013) report a one-way causality between the interest rate, the exchange rate, and the price of crude oil.

Besides, several empirical pieces of literature have modelled volatilities using techniques such as vector autoregressive (VAR), autoregressive distributed model (ARDL), elasticity estimation, generalized autoregressive conditional heteroskedasticity (GARCH), and exponential GARCH models (EGARCH). Narayan and Narayan (2008), for example, employ both GARCH and EGARCH models to model oil price volatilities and contend that the GARCH performs better. In another study, Hooker (1999) employs both the bivariate and multivariate autoregressive (VAR) techniques to examine the long-term stability of the effect of oil prices on GDP and confirms the existence of a direct link between crude oil prices and output. Bercement, Ceylan, and Dogan (2009) examine the effects of oil prices on the growth output of some MENA countries and argue that the oil price increase exerts a direct influence on economic growth, except Israel, Djibouti, Morocco, Egypt, Jordan, Bahrain, and Tunisia. Using the Granger Causality approach, Guo and Kliesen (2005) analysed the impact of oil price uncertainty on the underlying economic activity in the United States and documented the negative effect of volatility crude oil price on economic growth from 1984 to 2004. In addition, the study shows the asymmetrical impact of fluctuations in oil prices on macroeconomic activities. Ghosh and Kanjilal (2014) examined the dynamic effect of oil price shocks on the macroeconomic fundamentals of India from 1991:M3 to 2009:M1 and contended that oil price shocks impact inflation and foreign exchange reserve.

Besides, Awunyo-Vitor, Samanhyia, and Bonney (2018) investigated the causal relationship between oil price variation and the economic growth of Ghana using Johansen cointegration and Granger causality tests in Ghana. The findings indicated a negative correlation between the shifts in oil prices and output growth and, as such, the change in oil prices does not have to influence the expansion of the output growth. Ogede et al. (2020) have recently explored the ARDL panel mean

group model on quarterly data from 1995 to 2018 and reported that the volatility of the oil price is negative and statistically significant with the inflation coefficient in the long-run model of the oil-exporting countries of Africa. The results show that a 1 percent increase in global oil price volatility will lead to a 0.02 percent decrease in inflation in the long term, a proxy of Africa's oil-exporting countries' consumer price index (CPI). From the foregoing discussions, not an iota of the extant studies focused on the group of net oil-exporting countries as the volatilities in oil prices amid COVID-19 continue to threaten the fiscal capacities as well as a policy framework of many African countries.

3. Sources of Data and Methodology

This study explores quarterly data for output growth, oil price, inflation, and interest rate of Nigeria, Angola, Algeria, and Gabon. Oil price data is sourced from the OPEC database, while real gross domestic product growth rate (RGDP_GR), inflation proxy with consumer price index (CPI), and interest rate (IR) were sourced from the World Bank Development Indicators. The data cover 1995Q1 to 2019Q4. All data except realized volatility (RV) are transformed into logarithmic forms to reduce the heteroskedasticity effect. Thus, the goal of this paper is to test for the causal relationship between the oil price volatility, real GDP growth, inflation, and interest rate for the selected African net oil-exporting countries. Toda–Yamamoto's (1995) and Holtz-Eakin et al's (1998) procedure of causality is employed against the conventional Granger causality test. These countries were selected based on the availability of data and their relevance in the global oil market.

Studies such as Shan and Sun (1998) and Zapata and Rambaldi (1997) have provided evidence that Toda–Yamamoto's (1995) and Holtz-Eakin et al's (1998) techniques have similar advantages in magnitude as regards the likelihood probability ratio (LR). The advantage of this approach, as referred to in Zapata and Rambaldi (1997), lies in its ability to perform better when important predictor bias is not excluded, while optimal lag lengths and appropriate sample size were used. It also limits the risk associated with possible consequences of incorrect identification of the order of integration of the series (Kelly and Mavrotas, 2001). The Toda–Yamamoto process of the causality test overcomes the issue of invalid asymptotic critical values when the causality analysis is performed in the case of non-stationary or even cointegrated series. The method uses the modified WALD test to restrict the parameters of the VAR (k) or MWALD procedure (where k is the lag length of the system). This technique has an asymptotic χ^2 distribution when a VAR) would be estimated. The significance of the MWALD statistics in the hypotheses indicates the rejection of the null hypothesis of non-Granger causality from Mt differentials to RV and vice versa. The VAR model specified in

this study focuses on using the selected macroeconomic variables to factor the relationship of the economy with oil price shocks; we defined $P_{t,2}$ as a vector of stationary economic variables:

$$P_{2,t} = \Delta RV_t, \Delta(M_t), \quad (1)$$

where ΔRV_t is the first difference of the log of real oil prices and $\Delta(M_t)$ is the first difference of the log of macroeconomic variables. Thus, the reduced form of $P_{2,t}$ can be modelled as:

$$P_{2,t} = \alpha + \beta_1 P_{2,t-1} + \dots + \beta_p P_{2,t-p} + \varepsilon_{2,t} \beta(L) P_{2,t} \phi = \alpha + \varepsilon_{2,t} \quad (2)$$

Consequently, the causality between the selected macroeconomic factors (M_t) and oil price volatility (RV_t) based on Toda and Yamamoto (1995) is tested. The RV is gauged following Andersen and Bollerslev (1998); the quarterly RV equation is specified as the sum of squared intra-year returns, which is thus given as:

$$RV_t^2 = \sqrt{\sum_{t=1}^D (\log P_{tj} - \log P_{tj-1})^2}, \quad (3)$$

where P_{tj} is the observed quarterly price of the oil at global oil, t and j are the intermediate intra-quarter time intervals. However, the study estimated the following bivariate VAR (k) model:

$$M_t = \alpha_1 + \sum_{i=1}^{c+d} \beta_{1i} M_{t-i} + \sum_{j=1}^{e+d} \gamma_{1j} RV_{t-j} + \varepsilon_{1t} \quad (4)$$

$$RV_t = \alpha_2 + \sum_{i=1}^{c+d} \beta_{2i} RV_{t-i} + \sum_{j=1}^{e+d} \gamma_{2j} M_{t-j} + \varepsilon_{2t}, \quad (4)$$

where d is the maximal order of integration order of the variables in the model, c and e are the optimal lag length of M_t and RV_t , while error terms are denoted by ε_{1t} and ε_{2t} , which is assumed to be white noise with zero mean and no autocorrelation. Arising from equations (4) and (5), there is causality from oil price volatility (RV) to macroeconomic fundamentals (M_t) if null hypothesis: $H_0: \gamma_{11} = \gamma_{12} = \dots \gamma_{1p} \neq 0$. Similarly, there is causality from macroeconomic fundamentals (M_t) to oil price volatility (RV) if null hypothesis: $H_0: \varphi_{21} = \varphi_{22} = \dots \varphi_{2p} \neq 0$.

4. Empirical Result and Discussions

The goal of this paper is to test for the causal relationship between the oil price volatility and macroeconomic fundamentals (M_t) for the net oil-exporting countries in Africa. *Table 1* presents the descriptive statistics of the selected variables. These show that the standard deviations are lower compared to the means except for the interest rate (IR). The ranges of the variables are rather large.

Table 1. *Descriptive statistics*

Variables	Mean	Maximum	Minimum	Std. Deviation
CPI	84.480	240.840	1.000	39.463
IR	17.334	160.000	2.000	33.419
RGDP_GR	106.269	265.430	1.000	16.813
lnCPI	4.168	5.484	0.000	1.051
lnIR	2.129	5.075	0.693	0.947
RV	3.738	4.796	2.188	0.700
lnRGDP_GR	4.646	5.581	0.000	0.279
Average Oil Price Volatility				
2-Period Standard Deviation Oil Price Volatility			2.43473325	
Realized Oil Price Volatility			2.176556815	

Source: authors' computation using E-views 10

Table 2 reports the Levin–Lin–Chu, Harris–Tzavalis, Hadri LM, and Im–Pesaran–Shin tests. The model with constant and time trend has been chosen for the analysis, while the null hypothesis of the existence of unit root is estimated and reported for all the variables. The time trend is found to be significant for the variables. Hence, the model with the constant trend was selected to formulate a VAR. The Harris–Tzavalis test could not be conducted for the volatility index in the panel due to serial correlation amongst panels.

Table 2. *Unit root test for panel data*

Unit Root/ Indicators	Levin–Lin–Chu		Harris–Tzavalis		Hadri LM		Im–Pesaran– Shin	
	Level	1 st Diff.	Level	1 st Diff.	Level	1 st Diff.	Level	1 st Diff.
RV	0.000	0.000	-	-	0.590	0.853	0.000	0.000
lnCPI	0.0758	0.000	0.9428	0.000	0.000	0.0000	0.7641	0.000

Unit Root/ Indicators	Levin–Lin–Chu		Harris–Tzavalis		Hadri LM		Im–Pesaran– Shin	
	Level	1 st Diff.	Level	1 st Diff.	Level	1 st Diff.	Level	1 st Diff.
lnIR	0.0253	0.000	0.0000	0.000	0.000	0.9803	-	-
lnRGDP_ GR	0.0000	0.000	0.000	0.000	0.000	0.9889	0.0446	0.000

Source: authors' computation using E-views 10

To explore the causal interactions between the selected variables, the study performs a homogenous panel causality test along with the Toda–Yamamoto causality test. The appropriate lag length is selected through the Schwarz criterion (SC) with the specification of a maximum lag of 3, and so are the later empirical tests.

4.1 Granger Causality Test in Homogenous Panel

The result of the Granger causality test in the homogenous panel is presented in *Table 3* following Holtz-Eakin et al. (1988). The dynamic panel homogenous causality test, as reported in *Table 3*, reveals a unidirectional causality initiating from interest rate to consumer price index. An equivalent trend of unidirectional causality is witnessed triggering from interest rate to oil price volatility and from consumer price index to the growth of gross domestic product (GDP). Besides, there is a bidirectional causality from the growth of gross domestic product to interest rate, from oil price volatilities to consumer price index, and gross domestic product growth in the selected net oil-exporting countries in Africa. This finding suggests that the oil price volatility significantly Granger causes the selected net oil-exporting countries in African economic growth. The finding contradicts the works of Aliyu (2009) and Soile and Babajide (2015) with regard to Nigeria.

Table 3. Homogenous panel causality test

Null Hypothesis	Causality	Chi-sq.	Prob.
LNCP1 ≠>LNIR	lnNIR → lnCPI	78.299	*0.000
LNIR ≠>LNCP1		0.596	0.440
lnRGDP_gr ≠>LNIR	lnRGDP_gr ↔ lnNIR	4.605	**0.032
LNIR ≠>lnRGDP_gr		10.165	*0.001
RV ≠>LNIR	lnNIR → RV	0.814	0.367
LNIR ≠>RV		14.065	*0.000
lnRGDP_GR ≠>LNCP1	lnCPI → lnGDP_gr	0.823	0.364
LNCP1 ≠>lnRGDP_gr		178.207	*0.000

Null Hypothesis	Causality	Chi-sq.	Prob.
RV \nrightarrow LNCPI	RV \leftrightarrow lnCPI	5.83	*0.016
LNCPI \nrightarrow RV		240.671	*0.000
RV \nrightarrow lnRGDP_gr	RV \leftrightarrow lnGDP_gr	15.136	*0.000
lnRGDP_gr \nrightarrow RV		0.790	*0.037

Source: authors' computation using E-views 10

Notes: Asterisk(s) *, **, *** represent(s) the rejection of the null hypothesis at 1% and 5% significance levels. The symbol \rightarrow denotes unidirectional causality, \leftrightarrow denotes bidirectional causality, while \nrightarrow implies does not Granger cause.

4.2 Results of Toda and Yamamoto's Causality Test

As reported in the preceding subsection, the study carried out lag selection criteria to determine the appropriate lag of these variables such that the VAR model implementation requirement will be satisfied. The residual of this model was further diagnosed for the presence of serial correlation to ensure our selected model is adequate. The results, as reported in *Table 4*, show the various Toda–Yamamoto Granger causality test results of each variable in the model by country. The null hypothesis states that there is no causality of the exogenous variable on the dependent variable. *Table 4* showed that for Algeria, there is a bidirectional causality between the real GDP growth rate and interest rate. The unidirectional causality is observed with regard to interest rate to oil price volatility and from real GDP growth rate to oil price volatility. For Angola, there is bidirectional causality from interest rate to the consumer price index. With regard to Gabon, there is unidirectional causality between oil price volatility to real GDP growth rate. For Nigeria, the findings show that no directional nexus was found from various macroeconomic fundamentals and oil price volatility. This is consistent with expectations and the realities of the Nigerian economy as reported by Aliyu (2009).

Table 4. Result of cross-sectional: Toda and Yamamoto Granger Causality test

Null Hypothesis	Algeria		Angola		Gabon		Nigeria		
	Excluded	Chi-sq.	Prob.	Chi-sq.	Prob.	Chi-sq.	Prob.	Chi-sq.	Prob.
Dependent variable: LNCPI									
lnCPI	10.18	0.3357	15.75	*0.0034	7.95	0.1687	6.77	0.1482	
lnRGDP_gr	31.11	*0.0003	1.49	0.8276	8.15	0.1481	2.09	0.7176	
RV	33.50	*0.0001	1.31	0.8598	4.22	0.5179	0.55	0.9687	

Null Hypothesis	Algeria		Angola		Gabon		Nigeria	
	Excluded	Chi-sq. Prob.	Chi-sq. Prob.	Chi-sq. Prob.	Chi-sq. Prob.	Chi-sq. Prob.	Chi-sq. Prob.	
Dependent variable: LNIR								
lnIR	5.67	0.7719	1.94	0.7462	10.81	0.0552	3.76	0.4393
lnRGDP_gr	7.71	0.5632	4.825	0.3068	8.52	0.1297	4.56	0.3349
RV	10.26	0.3293	4.99	0.2873	1.96	0.8541	8.44	0.0768
Dependent variable: LNGDP_GR								
lnIR	28.65	*0.0007	0.82	0.9362	2.17	0.8245	9.95	0.0413
lnCPI	11.85	0.2219	4.47	0.3464	3.75	0.5859	2.19	0.6997
RV	19.85	**0.0189	2.52	0.641	7.46	0.1884	4.24	0.3739
Dependent variable: RV								
lnIR	5.04	0.8312	1.83	0.7667	1.96043	0.8546	0.39	0.9831
lnCPI	4.74	0.8563	5.86	0.2095	5.12	0.4016	3.43	0.4882
lnRGDP_gr	7.33	0.6027	2.36	0.6697	26.16*	0.0001	3.82	0.4314

Source: authors' computation using E-views 10

Notes: Asterisk(s) * and ** represent(s) the rejection of the null hypothesis at 1% and 5% significance levels.

5. Conclusions and Policy Implications

This study employs the Toda–Yamamoto and homogeneous panel causality techniques to gauge the nexus using time series of realized volatilities of oil prices, GDP growth, consumer price index, and interest rates from 1995 to 2019. The finding from the panel causality test suggests that the oil price volatility significantly Granger causes economic growth in the selected net oil-exporting countries in Africa. The finding contradicts the works of Aliyu (2009) and Soile and Babajide (2015) with regard to Nigeria. However, a mixed outcome was observed for the cross-sectional analyses using the Toda–Yamamoto causality test. The findings show bidirectional causality between the real GDP growth rate and interest rate. The unidirectional causality is observed with regard to interest rate to oil price volatility and from real GDP growth rate to oil price volatility. For Angola, there is bidirectional causality from interest to consumer price index, while there is unidirectional causality between oil price volatility and the real GDP growth rate in Gabon. For Nigeria, the findings show that no directional nexus was found from various macroeconomic fundamentals and oil price volatility. This is consistent with expectations and the realities of the Nigerian economy as reported by Aliyu (2009) and Awunyo-Vitor et al. (2018).

Hence, the weak regulatory regime of the oil industry, coupled with insufficient fiscal policies, further exposes selected African countries to both internal and external shocks, thus having a significant impact on macroeconomic factors, according to our findings. Fiscal policy in these countries faces challenges in the longer term, in terms of intergenerational wealth and fiscal sustainability as well as in the short term, in terms of macroeconomic stability and fiscal planning. While different models are suitable for different economies, the study suggests that more weight is given to the fiscal and monetary structures in the selected countries. As a result, a strong fiscal policy is required to sustain macroeconomic stability and robust growth both during and after the oil revenue boom. Stakeholders must also provide systemic responses to fiscal challenges by creating sound judgment about oil prices in the budget as well as establishing oil stabilization and savings funds. Moreover, market price responses to oil prices may be due to government intervention and public policy frameworks that focus on providing subsidies for fuel, food, and basic services. These policies not only determine the degree to which prices can be adjusted (especially in the short term) but also encourage consumers to buy more than they would have if such measures did not exist. As a consequence, market distortions and inefficiencies are the results of these policies. As a result, these countries must take drastic measures to overhaul their various support schemes to minimize inefficiencies and production costs. To minimize overdependence on the oil sector, the selected countries will also diversify their economies by reshaping other sectors such as agriculture and manufacturing.

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Emotional Labour and Deviant Workplace Behaviour among Health Workers

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Abstract. This paper investigates the influence of emotional labour on deviant workplace behaviour (DWB) among health workers in teaching hospitals. The data used have been collected from health workers in two government-owned teaching hospitals through a survey research design and have been analysed using descriptive and inferential statistics. The paper finds that superficial acting and deep acting are positively related to deviant workplace behaviour among health workers in teaching hospitals, and honest acting has negative but significant contributions to deviant workplace behaviour. The paper concludes that in order for teaching hospitals to achieve person–job fit, health workers in training should be exposed to the reality that they would be required to master their emotions to succeed in their practice. It is therefore recommended that the management of teaching hospitals as well as government organizations should ensure that rules and policies are enforced to curb certain deviant behaviours, which could otherwise easily become norms if taken for granted.

Keywords: deviance, emotions, health workers, hospitals, workplace

JEL Classification: D2, D23

1 Introduction

It is common knowledge that emotions that people show have a lot to do with the kind of interactions that happen between them (Iyayi, 2011). Emotions in the workplace are no longer seen as private issues as any emotional display of an employee is regarded as a “public performance”. Whatever happens in the

organization happens in the public and becomes part of a social context created together by employees and customers. It is therefore pertinent to explore how emotions are managed in the workplace to improve work outcomes. What is next is to determine how organizations and their employees manage this integral part of organizational life to achieve effectiveness. Lazanyi (2010) posited that in a bid to put their employees on the right track, work organizations would develop directives and disseminate myths and stories or compel them to produce the desired emotional displays. The outcome of this emotion management is referred to as emotional labour. Three strategies for performing emotional labour have been identified and documented in the literature: superficial acting, in which employees simulate and display certain emotions as different from the emotions they feel: “by changing their outward appearances, facial expression, voice tone, or gestures, when exhibiting required emotions” (Chu, 2002: 18); further, there is deep acting, in which “employees influence what they feel in order to express the reaction they are required to display” (Virk and Malhotra, 2016: 164), and honest acting, which is the natural emotional response to a particular circumstance that meets the emotional demands of the organization (Lazanyi, 2010). Our concern is to explore how emotion management impacts employees’ work outcomes. As noted earlier, organizations and their employees manage emotions as an important strategy to achieve organizational effectiveness. However, achieving effectiveness is not always the case as efforts put into managing feelings often lead to and predispose the actors to dysfunctional behaviours in the workplace. In this study, this range of behaviours is called deviant workplace behaviour (Robinson and Bennett, 1995).

Deviant workplace behaviour is a common problem in today’s organizations. It is common knowledge that organizations in the current economy face many obstacles in their bid to achieve a competitive advantage. What may not be well-known is the threat to the success of the organization posed by the very people who make up the organization. Hussain (2015) observed that organizations bring together different employees, who aspire for a common goal as they work in a group. This groupwork provides a platform for interaction and the display of a variety of behaviours. According to Hussain (2015: 1), “sometimes the impacts of these behaviours leave a positive effect on others’ wellbeing and sometimes they harm in a manner that [the] lives of employees become surrounded by negativity and other harmful consequences”. Employees’ deviant workplace behaviour has been described in various ways such as anti-social behaviour, counter-productive behaviour, workplace aggression, organizational incivility, and workplace misbehaviour (Appelbaum et al., 2007). By whatever name it is called, “if the behaviour is not mentioned in the formal job definition, it is beyond the existing role expectations and it violates organisational norms, such behaviour is regarded as deviant” (Yildiz, et al., 2015: 414). Two types of deviant behaviours are identified: positive deviance (in which employees honourably violate organizational norms by going beyond their

job requirements to add value to their organizations) and negative deviance (in which employees commit acts that undesirably affect their organizations and/or co-workers) (Appelbaum et al., 2007). In this study, we are concerned with the negative dimension of deviant behaviour in the workplace. The interest in negative deviant behaviour is as a result of its undesirable consequences for organizations and their employees.

Although health workers are among the employees most involved in emotional labour (Lee and Ji, 2018), not much has been done to explore the possible negative consequences of emotional labour and deviant workplace behaviour among health workers. This study, therefore, was intended to fill these gaps. On the basis of this, the following research question is asked: how are emotional labour outcomes of superficial acting, deep acting, and honest acting related to deviant workplace behaviour? Drawing from the research question, the research aim is to determine how emotional labour outcomes of superficial acting, deep acting, and honest acting are related to deviant workplace behaviour.

The remainder of this paper is organized as follows. Section 2 focuses on reviewing the existing literature on DWB (i.e. deviant workplace behaviour), the typology of DWB, emotional labour in the workplace, and the theoretical framework. Section 3 discusses the methods and procedures employed in gathering data. Sections 4 and 5 comprise the results and discussion of the findings respectively. Finally, Section 6 contains conclusions, managerial implications, and suggestions for future research.

2 Literature Review

Deviant Workplace Behaviour

Generally, concerning workplace behaviour, deviance is a concept relating to several human conducts which are inconsistent with the rules, regulations, and the expected behaviour of persons within an organization (Peterson, 2002). Workplace deviance may also be seen as the deliberate or intentional desire to cause harm to an organization (Omar et al., 2011) or when employees do not conform to the policies, values, and culture of the organization, which compromises its standards, welfare, and vision (Bennett and Robinson, 2000). Warren (2003) conceptualized the construct more neutrally and simply as a departure from norms. However, it was Robinson and Bennett (1995: 556) who provided a profound definition of workplace deviance to mean “voluntary behaviour that violates significant organisational norms, and in so doing, threatens the well-being of an organisation, its members, or both”. This conceptualization was based on investigations of Robinson and Bennett (1995) and Bennett and Robinson (2000), who have been widely cited in further

research by other scientists (Appelbaum et al., 2007). Therefore, this study adopts the construct of deviant workplace behaviour as defined by Robinson and Bennett (1995). From these definitions, particular emphasis is given to organizational norms as prescribed by formal and informal organizational policies, procedures, and rules. This is so because for any behaviour to be termed deviant, it must be defined in terms of set standards by a social group (Robinson and Bennett, 1995).

The Typology of Deviant Workplace Behaviour

Classifications of deviant workplace behaviour were long proposed by a few authors before Robinson and Bennett (1995). For example, Mangione and Quinn (1975) were those who first introduced the concepts of property deviance and production deviance, in the context of which they distinguished between serious and non-serious organizational rule breaking. The framework that was based on property deviance and production deviance was initially set up by Hollinger and Clark (1982), while Redeker (1989) published a list of punishable offences in the workplace.

However, Robinson and Bennett (1995) developed a multidimensional scaling technique to analyse the various negative deviant workplace behaviours, which vary along two dimensions: organizational deviance versus interpersonal deviance and minor versus serious deviance. Organizational deviance covers a range of negative behaviours targeted at the organization itself; interpersonal deviance is about negative behaviours that are directed at co-workers. On the other hand, the minor versus serious dimension of deviance relates to the gravity or intensity of the effect of the behaviour whether targeted at co-workers or at the organization itself. Robinson and Bennett (1995: 557) contended that the frameworks mentioned above did not organize and incorporate diverse behaviours into an expression pattern of interpersonal nature such as physical aggression and sexual harassment. The need to capture the social aspects of an organization with a history of workplace deviance was brought to the fore by Robinson and Bennett (1995), who went on to provide that in their framework: a typology of DWB, and they discussed it as follows.

Production Deviance. This refers to behaviours that go against the formerly agreed norms, defining the least quality and quantity of work to be achieved (Rogojan, 2009: 14). Behaviours that fall under production deviance include employees' absenteeism, lateness to work, leaving workplace before closing hour, spending too much time on breaks, unproductive utilization of organizational resources, and abuse of substance in the workplace (Rogojan, 2009).

Property Deviance. It covers behaviours targeted at the organization, and they are relatively more harmful (Hussain, 2015). It refers to employees destroying or misusing the property of an organization. It might be the sabotage of equipment, stealing organizational property, and so on. These acts bring direct costs to the

organization since work cannot continue until the damaged equipment are replaced (Norsilan et al., 2014).

Political Deviance. Robinson and Bennett (1995) described it as an insignificant interpersonal deviant behaviour involving social dealings, which positions others at a disadvantage politically or personally. Robinson and Bennett (1995) observed that incivility in the workplace, nepotism, excessive gossip about colleagues, and unhealthy competition are forms of political deviance. As noted by Rogoan (2009), those who suffer from this type of behaviour tend to be dissatisfied with their jobs; they are more likely to be depressed and are subsequently more likely to resign.

Personal Aggression. Rogoan (2009) argues that personal aggression manifests in employees in the form of being hostile, unsympathetic, and antagonistic to others in the workplace. Examples include harassing others sexually, verbal and non-verbal abuse, thwarting the efforts of co-workers, and so on. Rogoan (2009) found that employees are less committed to their organization if they suffer from physical and emotional trauma caused by the aggression of a co-worker. Perpetrators might be ostracized. The full lists of Robinson and Bennett's dimensions, categories, and the associated items can be seen below (Robinson and Bennett, 1995).

Emotional Labour in the Workplace

Emotional labour has remained a subject of interest to many researchers and writers, being defined as “the effort required on the part of the individual to express organisationally required emotions, independent of the subjective feelings of the individual” (Iyayi, 2011) and “the forced emotion management in work for a wage” (Tsang, 2011: 312). Grandey (2000) noted that emotional labour usually involves enhancing, faking, or suppressing emotions to change the emotional look; and they are commonly displayed to comply with organizational rules.

Three emotional labour strategies are outlined as surface, or superficial acting, deep acting, and effective, or honest acting (Chu et al., 2012). Although these strategies are termed differently by other authors (Lazanyi, 2010; Kundu and Gaba, 2017), it is these three (superficial acting, deep acting, and honest acting) that are adopted in this study. This is because, unlike other configurations, the strategies provide a clear distinction among them, both in meaning and in expression. These strategies are discussed here.

Superficial Acting. This is a situation where employees simulate emotions that are not actually felt, by varying their external manifestations, facial expressions, voice tone, or gestures when demonstrating the necessary emotions (Chu, 2002). For example, a customer service desk staff member in the Nigerian “new generation” banks is expected to put on a smile to cheerfully receive a customer even if s/he is actually down. In this way, employees feign emotions that are not experienced. This emotional labour strategy focuses on the customer's response, and it only

modifies the visible expressions on the surface (Kim et al., 2017) as the employees put on a façade as if the emotions were truly felt (Kumar et al., 2010). In this way, Henning-Thurau et al. (2006) contended that surface acting lacks authenticity because it only constitutes the expression of feigned emotions.

Deep Acting. Deep acting is said to be the felt emotions that seek to align expected displays with the integral experience and behaviours by regulating the expressions (Kiran and Khan, 2014). Deep acting necessitated individuals to tailor their feelings to expressing the reaction required them to exhibit. Virk and Malhotra (2016) have observed that not only does deep acting require the manifest behaviour to be suppressed, but it also expects that the inner feelings are controlled accordingly for they attempt to feel the emotions they want to display (Humphrey et al., 2008). A case in point for deep acting would be when a healthcare provider, who is indignant at a patient's disregard for instructions, suddenly works on his/her feelings to show how much s/he shares the patient's pains and hence displays a friendly gesture, just to be able to serve the patient (Pandey and Singh, 2016; Akanni and Adeniji, 2016). It has been said that because deep acting is not only about outer expression, which employees evoke by recalling past joyful circumstances to create appropriate emotion, the strategy appears authentic to the audience because it requires putting one's self in another's shoes (Kim et al., 2017).

Honest Acting. Effective acting, which is a third type or strategy of emotional labour, has been seen as a situation in which one's spontaneous emotional response to a particular circumstance meets the emotional requirements of one's organization (Lazanyi, 2010). Chu (2002) asserted that the work of Hochschild (2003) ignored the situation in which employees spontaneously and genuinely experience and express the expected emotion without having to exert any effort. Kiran and Khan (2014) have said that this type of emotion is where the felt emotion aligns with the displayed emotion as well as with the one expected by the organization. Companies are no longer content with surface acting, they now seek effective acting from their employees, as the rate of competition increases, to enhance the authenticity of the service performance and reduce the possibility of breaking the display rules (Chu, 2002). As submitted by Lazanyi (2010), if the individual's genuine emotions are in agreement with what the work organization expects, neither emotional dissonance nor negative side-effects will develop.

Theoretical Framework

This study is built on the self-determination theory (SDT). The theory was developed by Edward Deci and Richard Ryan in 1970 to explain human motivation. They described motivation in this context as things that move people to act. The theory is built on a positive human tendency for growth and is facilitated by three core needs, namely: autonomy, competence, and relatedness. Self-determination promotes a

sense of control in making choices and gets employees motivated to take actions that reflect their emotions. SDT focuses on the extent to which people's behaviour in the workplace is self-motivated and self-determined. Previous studies have discussed human behaviour factors that serve as antecedents of deviant workplace behaviours. These factors can be categorized as individual factors, organizational factors, and work-related factors.

Organizational factors. One of the key factors identified in the literature as the cause of DWB is perceived injustice among employees. Other organizational factors responsible for DWB include organizational frustration, lack of control over the work environment, weak sanctions for violation of rules, and perceived unfavourable organizational changes such as layoff. Organizational justice relates to the perception of fairness among employees in the workplace. It has been empirically established that employees' motivation and performance are determined by their perception of fairness in the organization (Setiawati and Ariani, 2020). For instance, employees that feel abused or unjustly treated have a higher tendency of engaging in deviant behaviour that is targeted towards the given organization in general and sometimes towards the offending managers or colleagues. Transparency in the ways things are done in the workplace could help in minimizing DWB. Also, respectful and constructive feedback to subordinates that feel abused and maltreated by their superiors can help to limit employees' sensitivity and negative reactions.

Individual factors. The individual factors responsible for DWB include personality traits, negative affectivity, and emotional intelligence, among others. Personality traits such as surgency have been empirically established to promote interpersonal deviance in the form of bullying and working for selfish interests (Abdullah and Marican, 2016); low agreeableness, which is the inability to get along with others, has been found to promote uncaring and unsympathetic attitudes to others; adjustment in the form of emotional instability also promotes anxiety, anger, and depression, while individuals that have low conscientiousness are prone to exhibit behaviours that are counterproductive. Unwillingness to experience change in behaviour has also been found to significantly promote employees' deviant behaviour in the workplace (Abdullah and Marican, 2016).

Work-related factors. Abusive supervision and job stress are some of the work-related factors that can promote DWB among employees. Abusive supervision as a sustained demonstration of non-face-to-face, verbal, and non-verbal but hurtful attacks against subordinates by their supervisors (Ambrose and Ganegoda, 2020) can manifest in the form of public derogation. This kind of behaviour is capable of negatively affecting employees' health and well-being, thereby promoting DWB among them. Emotional exhaustion, depression, and anxiety are possible negative organizational outcomes of abusive supervision. In a similar vein, job stress which arises when job demands exceed employee capacity can result in behavioural outcomes such as absenteeism, smoking, abuse of substances, and so on.

In summary, most of the studies in this area were done in the developed countries of Europe, America, and Asia. In Nigeria, while we acknowledge the recent growing interest of researchers in the phenomenon of deviance, very few studies done on the public service generally and on health institutions in particular have been documented so far.

3 Methodology

Sample and Collection of Data

Data were collected from health workers in two teaching hospitals (University of Benin Teaching Hospital and Irrua Specialist Teaching Hospital) in Nigeria. The choice of the samples is based on the status of the teaching hospitals in terms of the variety of the care services they render and the expected number of employees who work there. Four hundred health workers (doctors, nurses, pharmacists, laboratory scientists, medical record managers) were randomly selected from the two hospitals. The rationale for investigating health workers is that they are often expected to go out of their way in making the concerns of patients and their relatives a priority (Logan, 2016). However, this expectation appears to be unrealistic as it is observed that there is an emerging unwholesome behaviour – theft of supplies and medicines, sabotage, acting rudely, habitual lateness to work, buck-passing, and loafing, among others – among health workers in public health institutions (Olabimitan and Alausa, 2014).

Collection of data was done through the use of structured questionnaire, which was administered within four weeks. This period is similar to the time spent by De Clercq et al. (2019) on administering their instrument. Concerning information disclosure through questionnaire completion, respondents were reluctant, as expected, to freely give adequate information about their negative behaviour in the workplace. This was not so much a surprise, considering the nature of variables (emotions and negative behaviours) for the study. To mitigate these limitations, the following steps were taken: inclusion of a statement of assurance of anonymity in the data gathering instrument, the construction/adaptation of the survey questions to reflect impersonal, third-person contemplation, and collaboration with the executives of relevant workers' associations in the hospitals to reach the target respondents.

Operational Definitions of Constructs

The items are presented in terms of dependent and independent variables, as used in previous studies.

Table 1. *Operational measures*

S/N	Item	Operational Definition and Source	Scale	Number of Questions	Reliability Values
Emotional labour constructs					
1	Superficial Acting	Employees simulating emotions that are not actually felt, by changing their outward appearances, facial expression, voice tone, or gestures when exhibiting required emotions (Chu, 2002).	Likert-type, five-point scale	4	0.800
2	Deep Acting	Individuals influencing what they feel to express the reaction or take on the role they are required to play (Virk and Malhotra, 2016)	Likert-type, five-point scale	2	0.786
3	Honest acting	Spontaneous emotional response to a particular circumstance meets the emotional requirements of the organization (Lazanyi, 2010; Kiran and Khan, 2014).	Likert-type, five-point scale	2	0.807
Deviant workplace behaviour dimensions					
4	Production deviance	Norm-breaking behaviour directed at the organization with the intention to reduce work output (Robinson and Bennett, 1995; Al-Fayyad, 2015).	Likert-type, five-point scale	5	0.967
5	Property deviance	Norm-breaking behaviour directed at the organization and its property (Robinson and Bennett, 1995; Al-Fayyad, 2015).	Likert-type, five-point scale	6	0.959
6	Political deviance	Norm-breaking behaviour directed at co-workers to undermine their interests (Robinson and Bennett, 1995; Al-Fayyad, 2015).	Likert-type, five-point scale	5	0.985
7	Personal aggression	Norm-breaking behaviour that harms co-workers and affects their properties (Robinson and Bennett, 1995; Al-Fayyad, 2015).	Likert-type, five-point scale	6	0.948

Estimation Techniques

Descriptive statistics, such as frequency distribution and mean, were used to describe the demographic attributes of the respondents, while bivariate analysis using correlation coefficient was used to estimate the relationship between emotional labour and deviant workplace behaviour (Bechtoldt et al., 2007; Hwa and Amin, 2016). Data obtained were compressed accordingly. Four instances, four items or questions were used to measure superficial acting. The average of the responses to the four items was taken to form a single column to represent the variable which is used in conducting the bivariate analysis. The same procedure was implemented for other constructs or variables.

4 Results

Out of the four hundred (400) copies of the questionnaire administered to health workers (doctors, nurses, pharmacists, laboratory scientists, medical record managers) in the two hospitals, 327 copies were found to be valid and usable.

Respondents' Demographic Characteristics

Results show that 110 (33.6%) of the respondents were male, while 217 (66.4%) were female. This shows that most of the health workers examined were female. The age distribution showed that the majority of the respondents (131, 40.1%) were between 26 and 35 years old. This is followed by respondents within the age range of 36–45 years. This category accounts for 28.4%. Some 60 (18.3%) of the respondents were 25 years old or less. Only 13.1% of the respondents were between 46 and 55 years. The respondents' work experience in the health sector shows that 134 (41%) of the respondents have worked five years or less. 126 (38.5%) of the respondents have worked between six and ten years, while 39 (11.9%) of them have worked between eleven and fifteen years. Only 28 (8.6%) of the respondents have worked for sixteen years or more. The age range of most of the respondents is between 26 and 45 years, while the average years of respondents' work experience are between 6 and 10. This shows that the majority of the respondents are experienced. It can be asserted that the respondents who filled in the questionnaire were knowledgeable in the activities of teaching hospitals.

Descriptive Statistics and Correlation Analyses

Mean, standard deviation, and Pearson correlation coefficients were computed on the data for all the variables in the study. The results are shown in *Table 2*.

Table 2. Mean, standard deviation, and Pearson's correlation coefficients

Variables	SUA	DEA	HOA	PRD	PRO	POL	PER
Superficial Acting (SUA)	1						
Deep Acting (DEA)	0.554**	1					
Honest acting (HOA)	0.046	0.270**	1				
Production Deviance (PRD)	0.151**	0.109*	-0.154**	1			
Property Deviance (PRO)	0.259**	0.154**	-0.113*	0.629**	1		
Political Deviance (POL)	0.217**	0.297**	-0.159**	0.551**	0.571**	1	
Personal Aggression (PER)	0.398**	0.334**	-0.083	0.300**	0.428**	0.586**	1
Mean	2.587	3.569	4.384	2.983	2.749	3.24	3.071
Standard Deviation	1.016	1.087	0.713	0.917	0.962	0.675	1.006

Note: $N = 327$, * = $P < 5\%$; ** = $p < 1\%$

Table 2 shows the Pearson's correlation coefficients between each pair of variables. Bryman and Cramer (1997) posit that "the Pearson's correlation coefficient (r) should not exceed 0.80; otherwise the independent variables that show a relationship above 0.80 may be suspected of having multi-collinearity". The results in *Table 2* show that none of the correlation coefficients reaches 0.80; hence, it can be inferred that multicollinearity is not present in the model. *Table 2* shows that surface acting and deep acting are positively and significantly related to all the four dimensions of deviant workplace behaviour. However, effective acting has a negative but significant relationship with all the four dimensions of deviant workplace behaviour.

5 Discussion of Findings

The study found that superficial acting and deep acting have a positive relationship with property deviance among health workers, whereas honest acting was found to have negative relationship with property deviance among them. These results are

generally consistent with several previous related studies. For instance, Alias et al. (2013) found that when employees are emotionally strained due to the management of observable expressions, they become more susceptible to developing negative behaviours. In the same way, Grandey (2000) observed that in service performance superficial acting would negatively impact customer service. Faked emotions, or superficial acting seems to have a “leakage” through which observers can detect the deception. As suggested by Hochschild (2003), the job demand for superficial acting brings about stressful experiences for the employee. Generally, individuals would not want to feel fake, and the suppression of true emotions to express fake emotions requires a great deal of effort with its attendant negative outcomes, chiefly engaging in deviant workplace behaviour such as aggression towards co-workers and patients in the case of health institutions. Moreover, Morris and Feldman (1996) found a link between the suppression of the emotion acted superficially and a variety of deviant workplace behaviours such as drug use, alcohol abuse, and absenteeism.

However, the finding slightly differs from that of Chu (2002), who revealed that the consequences of emotional labour were both positive and negative. It is positive if performed well to bring about customer satisfaction, customer loyalty, and the eventual organizational performance. The negative outcome of superficial acting, apart from its toll on the health conditions of the “actors”, includes financial losses, sabotage, and aggression, among others. Most times, publicly owned institutions, such as the teaching hospitals, are less rigid in their application of rules and regulations, and most importantly they are not established primarily for profit maximization.

A significant and positive relationship was found between deep acting and deviant workplace behaviour (political deviance and personal aggression). This confirms some previous findings (Fox and Spector, 1999; Lee and Ok, 2014), which indicated that the emotional labour of deep acting was positively associated with service sabotage as employees who work hard to feel the emotions they are expected to express are likely to engage in deviant behaviours. This is because the constant emotional consumption in the course of the “labour” is a drain on their psychological and emotional energy. The emotionally depleted employees are most likely to reduce or withhold personal involvement, and this depersonalization of service is likely to make them frustrated and then prompt them to engage in service misbehaviours to compensate for the loss in personal resourcefulness, as explained by the conservation of resources theory (Ahmed and Omar, 2013). By the same token, in a related study that investigated nurses’ burnout and counter-productive work behaviour in a Nigerian sample, Ugwu et al. (2017) found that burnout not only positively but also significantly predicted counterproductive work behaviour. These findings are also consistent with those of Kiran and Khan (2014) that deep acting results in stress and job burnout leading to all kinds of workplace

misbehaviour and with that of Grandey (2000) that emotion management of deep acting enhances the individual's physiological arousal, which in turn may force employees to withdraw from work, and that individuals with negative emotions will be more affected by workplace stressors and will more likely be involved in emotional labour and engaged in deviant behaviours.

Another important finding concerns the relationship between honest acting and deviance. Not surprisingly, our finding shows a negative relationship between honest acting and all deviant workplace behaviour constructs. First, it should be noted that honest acting is the expression of genuine emotions, in which one's spontaneous emotional response to a particular situation meets the emotional requirements of his/her organization. The finding here corroborates Chu's (2002) that since genuineness is a product of fusing the private self and the public self, employees usually invest their true selves in their jobs. As they have good interactions with customers, the genuineness of their emotions would lead to positive job outcomes. This is also in line with Hochschild's (2003) observation that service employees who tend to genuinely enact emotional labour usually meet customers' and organizations' expectations.

We can be certain that this finding, apart from confirming previous results, fulfils any common sense condition. The employee who honestly displays felt emotions towards customers would naturally not engage in any form of misbehaviour to hurt either customers or the organization. On many occasions, personal experiences and those of others show that health workers frequently empathize with patients genuinely. What normally follows is a very caring and concerned show through service delivery. This genuineness excludes any form of deviation targeted either at the individual or at the organization.

6 Conclusions and Recommendations

This study has shown that health workers, in their bid to provide the needed services to patients, are involved in emotion management, called emotional labour, on a daily basis through the various strategies of superficial acting, deep acting, and honest acting. The study has further shown that deviant workplace behaviours among health workers in teaching hospitals are pervasive and are in response to organizationally accepted ways of emotional expressions. Drawing from the findings, it is concluded that a clear relationship exists between emotion management and deviant workplace behaviour among health workers in teaching hospitals. It also shows that organizations in Nigeria (service organizations in particular) are faced with deviant workplace behaviour, majorly as a consequence of "working" to produce and display organizationally required emotions while relating to customers.

Managerial Implications

Practically, the value of this study is that researchers and practitioners in the field of organizational behaviour are provided with information relating to emotional labour and deviant workplace behaviour in organizations generally and in health institutions in particular, rather than depend on perception. On the other hand, it provides government, managers of health institutions, and other policy-makers with the necessary information for the formulation of tailor-made policies for the management of all kinds of negative deviant behaviours arising from employees' emotion management in health institutions.

The management of teaching hospitals as well as government organizations should ensure that rules and policies are enforced to curb certain deviant behaviours, which are rapidly becoming norms if taken for granted.

There is a need to achieve a person–job fit for health workers of all categories. To achieve this, health workers in training should be exposed to the reality that they would be required to master their emotions in order to succeed in their practice. In doing this, authorities of various institutions – backed by government policy – where health workers are trained should include emotion management in their training manual as well as provide counselling to address emotional burden borne by employees in order to reduce incidences of DWB.

Research Limitations and Suggestions for Future Studies

The limitations of this study were the chosen scope of the study and respondents' level of willingness to disclose information. Although the study was concerned with deviant workplace behaviour among health workers in teaching hospitals, only health workers in the two government-owned teaching hospitals in Edo State, Nigeria, were included in the study, based on which generalized conclusions are reported. It is therefore noted that the scope of future studies on the subject matter should be expanded to include other health institutions, other than teaching hospitals, and should cover other parts of the country as well. Secondly, the health implications of emotional labour for the “actors” were not part of the study scope. Other researches in the future should look at the psychological and physiological effects of emotional labour on the employees involved.

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Environmental Responsiveness and Firm Value: Evidence from Nigeria

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Abstract: This paper examines the effects of environmental responsiveness on firm value in Nigeria and provides an insight into the feasibility of corporate entities engaging with the United Nations' sustainable development agenda, without compromising their wealth creation agenda. Secondary data were gathered from annual reports and audited accounts of 83 quoted non-financial firms for three years covering the period of 2016–2018. Thereafter, a regression analysis using the Ohlson value relevant model for price valuation was done. Results of the empirical analysis confirm the positive influence of value relevance of book values, earnings per share, alongside environmental responsiveness and firm size on the firm value of Nigerian firms, while leverage is inversely related. Remarkably too, firms with higher values tend towards being environmentally responsive. Impliedly, there is an empirical evidence of reverse causality between firm value and environmental responsiveness.

Keywords: book value, eco-efficiency, equity, firm value, ISO14001, sustainable development

JEL Classification: M14, G19

1. Introduction

The quest for sustainable business practices has necessitated firms to seek alternatives in improving their operational processes (Bebbington and Unerman, 2018; Boiral and Henri, 2012; Huppés and Ishikawa, 2009; Le Blanc, 2015; Waal and Thijssens, 2019). The industrial and economic development across nations and regions is largely accompanied by harmful environmental degradation (Huppés and Ishikawa, 2009). While regulatory bodies and government institutions are leading the vanguard for sustainability by way of issuing standards and policies, it has become necessary for firms to adjust and comply with the various regulations and policies on environmental management (Moses et al., 2019). In effect, firms are beginning to adopt various manufacturing techniques that will not only improve their processes but will also minimize the ecological impact of their operations. Since firms are now incurring additional costs to reduce their environmental footprints, it becomes necessary to ascertain whether their response to environmental issues by way of investment in environmental-friendly processes and the adoption of green technologies is creating or adding value as expected. Further, the agreement of world leaders to pursue sustainable development through a win-win approach had heightened the alertness of entities to ensure eco-efficient practices (Boons et al., 2013; Schramade, 2017). Particularly, the progress recorded by the United Nations (UN) in the aspect of environmental sustainability has been relatively low as corporate entities still struggle finding the appropriate means to reduce their environmental impact (Bebbington and Unerman, 2018); this arguably may have informed the inclusion of goals 12 (responsible consumption and production) and 13 (climate action) in the United Nations' Sustainability Development Goals (SDGs), which emphasized efficient production and sustainable climate condition respectively. Based on the foregoing, our study focused on the implication of environmental responsiveness¹ on firm value, particularly as there is disparity in the submissions of scholars as to its effect on corporate entities' earnings and value (Al-Najjar and Anfimiadou, 2012; Dowell et al., 2000; Ingram and Frazier, 2013; Peck and Sinding, 2003; PwC, 2016; Walley and Whitehead, 1994). In specific, we address the following research questions: (1) What is the effect of environmental responsiveness on firm value in Nigeria? (2) What is the prospect of the UN win-win agenda on corporate value in Nigeria? Our study focuses on Nigeria for several reasons. First, the Nigerian economy ranks as one of the most industrialized and largest economies in Africa with a population of over 200 million and a GDP of \$448.12 billion (The World Bank, 2020). However, despite the growing adoption of sustainable business practices in Africa, the discourse on its effects on corporate earnings is relatively absent in the literature (Iredele et al., 2019; Moses et al., 2020).

1 The terms environmental responsiveness, eco-efficient business practices, and eco-efficiency are used interchangeably in this study.

Second, while the discussion on eco-efficient practices seems to be thriving in developed economies, less has been done in this context in emerging economies (Iredele et al., 2019; Moses et al., 2020), leaving the policymakers and businesses in this jurisdiction with poor bases for environmental decisions. Consequently, this study extends the scope of previous research (Al-Najjar and Anfimiadou, 2012; Sinkin et al., 2008) by investigating the effect of environmental responsiveness on firm value in developing economies. Applying Ohlson's value relevant model for price valuation, this study provides additional empirical support towards understanding the nexus between environmental responsiveness and corporate value in Nigeria.

Specifically, our study contributes in the following ways. Firstly, it supplements the existing evidence on environmental management on firm value from developing economies (Che-Ahmad and Osazuwa, 2015), with specific focus on Africa, which is yet to be documented in the literature. Secondly, this study – based on our research – is the first to provide an assessment of the UN “win-win” agenda by examining the influence of eco-efficient practices on firm value in the post-2015 development agenda era. This assessment is important in terms of the strategic role of corporate entities in the actualization of the 2030 Agenda (Rosati and Faria, 2018; Scheyvens et al., 2016). Lastly, our study extends the proxies of eco-efficient business practices by including signatories to the UN Global Compact as environmentally responsive firms. Overall, our empirical results show that environmental responsiveness positively affects firm value. First, we affirm that investment in green technology and the adoption of eco-friendly production process do not affect shareholders' wealth negatively, rather they reduce firm exposure to litigation risks and promote environmental friendliness. Second, our findings suggest that if firms truly commit to the sustainable development goals (SDGs), specifically goals 12 (responsible consumption and production) and 13 (climate action), the UN campaign against environmental degradation may be accomplished soonest.

The remaining of the paper is structured as follows: Section 2 is dedicated to literature review, discussing previous studies and the theoretical framework for the present study; Section 3 discusses the methodology, while results and discussions are contained in Section 4. Section 5 is devoted to conclusions and recommendations.

2. Literature Review

Review of Previous Studies

Environmental responsiveness has its origin in the World Business Council for Sustainable Development (WBCSD) 1992 publication titled *Changing Course* as

well as in the 1992 Earth Summit. The WBCSD conceptualized environmental responsiveness as a “delivery of competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing environmental impacts of goods and resource intensity throughout the entire life-cycle to a level at least in line with the Earth’s estimated carrying capacity”. Sinkin et al. (2008) described it as the management control process that seeks to maximize the effectiveness of business processes while curtailing their footprint on the environment. Huppel and Ishikawa (2005) conceived it as an approach adopted by the management to reduce environmental intensity, improve environmental productivity, and at the same time minimize the costs and creating value. It can be inferred from the above that environmental responsiveness is an aspect of sustainable development that seeks an equilibrium between the economic operations and environmental actions of firms, without any of the two at a disadvantage. For the purposes of this study, we conceptualize environmental responsiveness as the commitment to environmental preservation through the institution of an environmental management system (EMS) and the adoption of environmentally-friendly production techniques.

Although there has been a previous inquiry into environmental activities and firms’ financial performance (Cordeiro and Sarkis, 1997), it is not until 1991 that environmental responsiveness began to be viewed as a means of creating value. This view was premised on the statement of the WBCSD that environmental responsiveness is a “management philosophy” that aims to increase profit while minimizing environmental degradation (WBCSD, 2000). As a follow-up to this assertion, several studies (Cormier and Magnan, 2007; Hart and Dowell, 2011; Hassel et al., 2005; Sinkin et al., 2008) have been conducted to test this claim and position it appropriately. However, studies on environmental management and firm value can be classified into two groups, the event studies being the earliest and then the regression analysis studies (Al-Najjar and Anfimiadou, 2012). Prominent among the event studies are Blacconiere and Northcut (1997) and Jacobs et al. (2010); further analyses of these studies reveal uniform findings and suggest that environmental responsiveness positively affects firm value. Nevertheless, the opinion of scholars on the nexus between green practices and economic performance is inconclusive in the research literature. Wagner et al. (2002) argued that the divergent opinions may be attributed to multiple factors, which include: small sample size and paucity of sound theoretical underpinnings. A relatable example is the inconsistency of authors in the operationalization of firms’ environmental responsiveness. In the category of regression analysis studies reporting positive impact is the study of Sinkin et al. (2008) that considers eco-efficiency and firm value using a sample of fortune 500 companies. The study considers an entity to be eco-friendly based on two criteria: an ISO 14001 certification and the publication of Corporate Environmental Report (CER) or sustainability reports at least in the past five years. The study adopts Ohlson’s (1995) value relevance model to test the

authors' hypothesis; results show that firms with eco-efficient business strategies valued more than those without eco-efficient strategies. Similar to this study is the study of Al-Najjar and Anfimiadou (2012), examining the relationship between environmental policies and corporate value in the United Kingdom for the period of 1999–2008. The study, however, broadens the definition of environmental responsiveness of firms by considering not only the ISO 14001 certification and CER publication as criteria but also including indexation in the Business in Environment (BiE) and FTSE₄Good directories. These organizations have the reputation of indexing businesses with high environmental performance; hence, firms indexed in their directories are considered to be environmentally responsive. Following the model of Sinkin et al. (2008) in testing the hypothesis, the result shows that eco-friendly firms' prices are higher than of those lacking environmental strategies. While the above statements may have originated from developed economies, Che-Ahmad and Osazuwa (2015) test the same hypothesis as in Al-Najjar and Anfimiadou (2012), using a sample of Malaysian firms and adopting the same methodology; the result of the study is consistent with the former one. Using Swedish listed firms, Hassel et al. (2005) also report that environmental information is value relevant since it has the likelihood of affecting the expected future profits of quoted companies. Providing evidence from Indonesia, Safitri and Gamayuni (2019) examined the effect of the relationship between research and development (R&D) investment and environmental investment on eco-efficiency and firm value; results show that R&D investment has a positive significant correlation with eco-efficiency and corporate value. While these studies may have provided a good insight into the nexus between eco-efficiency and corporate value, the validity of their assertions has been criticized, especially when entities have the tendencies to greenwash stakeholders by mentioning only favourable environmental impacts in their corporate environmental reports or sustainability reports, and, on the other hand, holding an ISO 14001 certification may be a matter of institutional pressure and not necessarily legitimacy (Phan and Baird, 2015).

There are studies with similar findings to those of Al-Najjar and Anfimiadou (2012) and Sinkin et al. (2008). However, they differ with respect to proxies adopted to measure corporate environmental responsiveness. In their study on Dutch firms, Guenster et al. (2011) examined the economic value of corporate eco-efficiency. Covering the period from 1997 to 2004, the study identified eco-efficient firms by using a robust database of corporate-level eco-efficiency index developed by a third party (Innovest Strategic Value Advisors). The authors questioned the appropriateness of this third-party directory due to its comprehensiveness, especially as it had obtained information from more than 20 sources, both quantitative and qualitative, and because of its inclusion of both ex-post (historical) and ex-ante (future) attributes of corporate eco-efficiency. Despite the author's argument as to the robustness of the measure, the major drawback is its low

acceptability in the empirical literature. Other studies have also considered the level of GHG emission in assessing the environmental consciousness of corporate entities (Pogutz and Russo, 2009).

Another cohort of studies has also examined the impact of environmental responsiveness on other variables such as firm performance, stock returns, and firm growth. Using a survey research design, Hojnik et al. (2017) inquired into eco-innovation and firm efficiency in Slovenia. The study categorized eco-innovation into three variants, namely: process eco-innovation, product eco-innovation, and organizational eco-innovation; the sample was also classified into more innovative and less innovative organizations. The hypothesis testing result shows that process eco-innovations which involve the use of cleaner production and low energy consumption positively affect firm efficiency. Providing evidence from 28 European countries, Jové-Llopis and Segarra-Blasco (2018) examined the effect of eco-efficiency actions on SMEs growth. Findings suggest that not all eco-business strategies translate to firm growth, especially in the short term. However, the study noted that firms with cleaner production processes perform better. While most of these studies report a positive relationship between eco-efficiency and corporate value, findings may not be generalized, especially in countries like Nigeria, where corporate entities' compliance with environmental policies is low and minimal (Moses et al. 2019), which is coupled with critics' statement (Walley and Whitehead, 1994) that engagement with environmental concerns leads to higher operating costs for the entities. Further, the majority of these studies are conducted before the UN SDGs launch in 2015 and mostly in developed economies. Hence, to bridge these existing gaps, this study focuses on investigating environmental responsiveness and firm value in the Nigerian context.

Theoretical Framework and Hypothesis Development

This study anchors on the propositions of Resource-Based Theory (RBT) and Legitimacy Theory (LT). The resource-based theory argues that an organization can achieve competitive advantage if it employs resources that are difficult to imitate by its competitors. As argued by Hart and Dowell (2011), using resources that can prevent pollution, reduce the required input, and simplify the production process can increase efficiency, reduce compliance costs and liabilities, and ultimately facilitate competitive advantage. The argument explains why investment in green technology may positively drive corporate earnings and value. The legitimacy theory (LT) further provides insight into why corporate entities adopt green practices. The theory posits that in order for an organization to continue to operate it must act in accordance with the society's values and norms (Dowling and Pfeffer, 1975). Since the relationship between a firm and the society yields mutual benefits, it has been argued that the willingness of an entity to disclose its corporate environmental

reports can be influenced by both internal and external advantages (Hassel et al., 2005). At the internal level, businesses can take advantage of minimized material costs and top-quality products. Externally, environmentally responsive entities may profit from government regulations on the environment as well as from better access to capital. Porter and Van Der Linde (1995) and Spicer (1978) posit that eco-efficient business strategies can enhance business reputation and increase stakeholders' trust in the firm, which may positively affect the perception of the firm in the financial markets. Further, the previous findings of studies from other climes suggest that eco-responsive entities have a higher market value than those that are not eco-responsive (Al-Najjar and Anfimiadou, 2012; Che-Ahmad and Osazuwa, 2015; Guenster et al., 2011; Sinkin et al., 2008). Based on the foregoing discussion, the study tests the following hypothesis:

H₀: The adoption of eco-efficient business strategies is positively correlated to firm value.

3. Methodology

Population and Selection of Sample

The population for this study consists of 105 non-financial firms (excluding financial sector firms) listed on the Nigeria Stock Exchange (NSE) as at 31 December 2018. Of these, 87 firms made up the initial sample size, having published and made available their annual reports and having audited accounts for three years (2016–2018). This period was selected in order to strictly account for the post-2015 United Nations win-win sustainable development agenda. However, four firms – namely MTN, Global Spectrum, Medview, and Notore – were later dropped as they were quoted between years 2016 and 2017, whence they did not have market share prices for the selected years. This brings down the final sample size for the study to 83 firms, representing 79% of the total population. A sample selection procedure of this nature, where selected firms span across the 12 sectors, based on the new NSE classification, that is, stratified (with each sector used as a stratum) random sampling, is believed to eliminate the incidence of selectivity bias among firms. Previous studies suggest that firms listed in the capital market are likely to be the avant-garde in the adoption of cutting-edge environmentally-friendly processes and policies (Hassel et al., 2005; Sinkin et al., 2008).

For the purpose of gathering data for environmental responsiveness (ER), the study adopts the criteria of Sinkin et al. (2008), that is, only firms with an ISO 14001 certification and published Corporate Environmental Reports

(CERs) or sustainability reports, at least for the past five years, are categorized as environmentally responsive firms. These criteria were premised on the wide recognition of ISO 14001 and environmental reports as a reflection of corporate adoption of green practices (Cormier and Magnan, 2007; Sinclair and Walton, 2003). However, to incorporate responses to the United Nation's concern for environmental protection and to satisfy the need to provide a glimpse of how corporate involvement in environmental protection actions affects firm value, the study further classifies firms that are signatories to the United Nations Global Compact (UNGC) as environmentally responsive. The UNGC is a voluntary United Nations treaty to encourage entities across the globe to embrace sustainable and socially responsible policies and to report on their implementation. It is a principle-based model for commercial enterprises, highlighting ten principles in the areas of human rights, labour, the ecosystem, and anti-corruption. The UNGC has over 13,000 signatories and other stakeholders in over 170 countries. A key focus of the UNGC and its signatories includes supporting actions towards the actualization of the SDGs (UNGC, 2020).

The Research Model

The study adopts the value relevance model (Ohlson, 1995) as modified by Sinkin et al. (2008) in examining how eco-efficiency influences firm value. The basic model is expressed in equation 1.

$$P_{it} = a_0 + a_1BV_{it} + a_2EPS_{it} + \beta_0V + \mu_{it} \quad (1)$$

According to the basic Ohlson (1995) model, other information is value relevant if they provide information regarding future earnings. Specifically, if such information is positively associated and significantly related with future earnings, then it adds to the market value of the firm. Accordingly, Sinkin et al. (2008) extended the model by introducing eco-responsiveness (ER) as an additional variable since it provides information that could assist in explaining increased future earnings. For the purposes of this study, the following control variables were added: leverage, return on assets, and firm size. Hence, our final model is as shown in equation 2.

$$P_{it} = a_0 + a_1BV_{it} + a_2EPS_{it} + \beta_1ER_{it} + \beta_2LEV_{it} + \beta_2ROA_{it} + \beta_3SIZE_{it} + \mu_{it} \quad (2),$$

where P_{it} is market price of firm i at date t , α_0 is the constant variable, BV_{it} represents the book value of equity per share at time t , while ER_{it} is the environmental responsiveness indicator. EPS_{it} is the earnings per share for period $(t - 1, t)$, and LEV_{it} represents long-term debt to total assets ratio. ROA_{it} is return on assets measured as net income/total assets. $SIZE_{it}$ is firm size, measured as natural logarithm of total assets, and, lastly, μ_{it} is the error term.

The variable of interest (ER) is a binary variable that assumes the value of 1 for environmentally responsive firms and is otherwise 0. Besides, the natural logarithm of the dependent variable was computed in order to reduce its magnitude as well as range.

4. Results and Discussion

This section provides results from data gathered and analysed. It is subdivided into descriptive and inferential statistics. Thereafter come discussions by way of connecting past scholarly works with the current study.

Descriptive Statistics

Table 1. *Summary of descriptive statistics*

Variables	Mean	Standard Deviation	Min.	Max.
Price	40.189	160.613	0.2	1,555.99
Book Value	9.625	17.303	-10.341	93.659
EPS	2.190	14.375	-79.73	171.12
ER	0.321	0.468	0	1
LEV	0.794	4.018	-11.4453	53.635
ROA	0.0005	0.158	-0.827	0.639
SIZE	74,900,000	221,000,000	200,859	1,720,000,000

Source: authors' computation using Stata software (2020)

Table 1 presents the summarized descriptive statistics of variables used in this study. The average market price for selected firms is ₦40.19 ranging from ₦0.20 (Chams plc in 2018) to ₦1,555.99 (Nestle plc in 2017), with a standard deviation of 160.61. Consequent upon the large range noticeable in the dependent variable (market price), the natural log was computed for regression purposes to reduce the magnitude of the variable. The book value has a mean value of ₦9.63 with a standard deviation of 17.30. It ranges from a minimum value of -₦10.34 (John Holt in 2017) to a maximum value

of ₦93.66 (Mobil/11plc in 2018). The mean of EPS is ₦2.19 ranging from –₦79.73 to ₦171.12 (for Seplat plc in 2016 and 2017 respectively), with a standard deviation of 14.37. The variable of interest, that is, environmental responsiveness (ER), has a mean value of 0.32, indicating that 32% (27) of the selected firms appear to be eco-friendly, while 68% (56) are not eco-friendly. This may be a result of the voluntary nature of regulations presently governing environmental practices in Nigeria. In comparison, Nigerian firms are relatively more environmentally friendly than Malaysian firms as 16% was reported by Che-Ahmad and Osazuwa (2015). Furthermore, the control variables, that is, leverage, ROA, and firm size, display mean values of 0.7940, 0.0005, and ₦74.9 billion respectively. Impliedly, Nigerian firms are highly levered (leverage = 79%) but less profitable (ROA = 0.05%). This is contrary to Malaysian firms, which are reported to be relatively lowly levered (leverage = 24%) but more profitable (ROA = 3.08%).

Multivariate Analysis

Correlation Analysis

Table 2. *Correlation matrix*

Variables	lnMP/sh	Book Value	EPS	ER	LEV	ROA	SIZE
lnMP/sh	1						
Book Value	0.369	1					
EPS	0.523	0.241	1				
ER	0.270	0.294	0.143	1			
LEV	-0.019	-0.025	-0.004	0.057	1		
ROA	0.201	0.273	0.227	0.176	0.048	1	
SIZE	0.201	0.545	0.076	0.440	0.084	0.221	1

Source: authors' computation using Stata software (2020)

Table 2 presents the correlation matrix for the various variables used in this study. The correlation matrix shows the association between the explained variable and the explanatory variables as well as the relationships among explanatory variables. As shown in the table, except for leverage (-0.019), which displays a negative association, all other explanatory variables exhibit positive relationship with firm value (price). In addition, there is no multicollinearity amongst the explanatory variables as none of the correlation values are in excess

of 0.65. The maximum is the positive relationship between firm size and book value (0.5451).

The variance inflation factor (VIF) further confirms the assumption of the absence of multicollinearity, as shown in *Table 2*. *Table 3* presents the VIF of the explanatory variables alongside values for their reciprocals (tolerance error).

Table 3. *Variance inflation factor (VIF)*

Variables	VIF	1/VIF
LnTA	1.67	0.5985
Book Value	1.57	0.6377
ER	1.29	0.7757
ROA	1.10	0.9097
EPS	1.06	0.9444
LEV	1.01	0.9897
Mean VIF	1.28	

Source: authors' computation using Stata software (2020)

As shown in *Table 3*, the mean of VIF is 1.28, while individual values for each of the predictor variables range from a minimum of 1.01 (leverage) to a maximum value of 1.67 (LnTA). There is none that is greater than 2.50 (rule of thumb for weaker models) and 10.00 (rule of thumb for strong models). In addition, the reciprocals of VIF for all variables are all close to 1.

Regression Analysis

Table 4 presents the multivariate regression analysis from the estimation of the model specified for the study. It comprises the pooled, fixed, and random effects alongside values for adjusted R² and results of formal comparison tests used to determine the appropriate model for this study. The Breusch and Pagan Langrangian multiplier (L-M) test (48.02) compares regression estimates of pooled and random effects, while the Hausman test (16.18) compares regression estimates of fixed effects with that of random effects. While the p-value for the former is significant (p < 0.05), the p-value for the latter is non-significant (p > 0.05). Therefore, both tests support the random effects as the appropriate model for this study; hence, it becomes the basis the study is hinged upon. This is not surprising as data inspection depicts large cross-sectional units (large ‘i’) and a small time dimension (small ‘t’) indicative of a random effects method as the preferred and expected option.

Table 4. *Multivariate regression estimates*

	Pooled				Random Effects				Fixed Effects				
	Coeff.	S. E.	t		Coeff.	S. E.	z		Coeff.	S. E.	t		
DV = lnMP													
Book value	0.036	0.007	4.84*		0.034	0.008	4.03*		0.013	0.014	0.96		
EPS_1	0.018	0.007	2.57*		0.003	0.003	0.80		0.000	0.003	0.08		
ER	1.105	0.258	4.29*		0.544	0.266	2.05*		-0.354	0.344	-1.03		
LEV	-0.039	0.024	-1.69***		-0.029	0.015	-2.04*		-0.022	0.014	-1.62		
ROA	1.307	0.760	1.72***		0.347	0.502	0.69		-0.002	0.493	-0.00		
LnTA	0.209	0.070	2.99*		0.284	0.087	3.25*		-0.243	0.373	-0.65		
Cons	-2.683	1.077	-2.49		-3.663	1.362	-2.69		5.395	5.999	0.90		
Ajusted R ²	0.507				0.508				0.168				
F value	29.23 (0.000)				80.38 (0.000)				0.523				
L-M test	48.02 (0.000)												
Hausman					16.18 (0.128)								

Source: authors' computation using Stata software (2020)

The adjusted R² is in 51% implying that the totality of explanatory variables account for 51% of the variations in the firm value (market price per share) of Nigerian firms, while the F-value is 80.38 with a p-value of 0.0000 ($p < 0.05$), indicating that the model is statistically significant. Furthermore, except for leverage (LEV), all other independent variables exhibit positive influence on firm value. Specifically, book value ($t = 4.03, p < 0.05$), environmental responsiveness ($t = 2.05, p < 0.05$), and firm size ($t = 3.25, p < 0.05$) display positive and significant relationship, while leverage shows a negative and statistically significant ($t = -2.04, p < 0.05$) association with market price. This implies that the higher the book value, the more environmentally friendly and the larger a firm appears, the higher the market value, while the higher the debt ratio by Nigerian firms, the less the market value. Consequently, book values, investment in environment-related activities, and assets are value relevant in the market valuation of Nigerian firms. Although the lag of EPS (EPS_1) also appears to show positive influence, it is statistically insignificant ($t = 0.80, p > 0.05$).

Heteroscedasticity Test and Sensitivity Analysis

(a) Heteroscedasticity Test

Table 5. *The Breusch–Pagan/Cook–Weisberg test for heteroscedasticity*

Hypothesis, H ₀	Constant variance
Variables:	Fitted values of lnMP
Chi ² (1)	2.14
Prob > Chi ²	0.1431

Source: authors’ computation using Stata software (2020)

Homoscedasticity, otherwise known as constant variance, is a major assumption and condition to be satisfied during regression analysis. This study conducts such test using the Breusch–Pagan/Cook–Weisberg test for heteroscedasticity. The results are presented in *Table 5*. As can be seen in the table, the Breusch–Pagan/Cook–Weisberg test for heteroscedasticity has an average value of 2.14 with a p-value of 0.1431. Judging from these values, the null hypothesis is not rejected, while the alternative hypothesis is not accepted as the p-value ($p > 0.05$) appears insignificant, and hence there is constant variance. Therefore, there is an absence of heteroscedasticity as far as this study is concerned.

(b) Sensitivity Analysis

As a robustness check and sensitivity analysis, a robust random effects model was estimated; estimates are as shown in *Table 6*. Overall, the estimates reflect that, as

shown in *Table 4*, except for the lag of EPS (EPS_1), which was hitherto positive but insignificant ($t = 0.80$, $p > 0.01$), the lag of EPS (EPS_1) is now positive and significant ($t = 2.55$, $p < 0.01$). Similarly, the environmental responsiveness variable (ER) becomes insignificant but still positive ($t = 1.42$, $p > 0.01$). The adjusted R^2 , which was 0.5088 (51%), remains unchanged.

Table 6. *Random-effects GLS regression estimates (robust)*

DV = lnMP/sh	Coeff.	Robust Std. Error (RSE)	Z
Book value	0.0342	0.0089	3.84*
EPS_1	0.0025	0.0010	2.55*
ER	0.5439	0.3837	1.42
LEV	-0.0295	0.0066	-4.46*
ROA	0.3477	0.3850	0.90
LnTA	0.2844	0.1177	2.42*
Cons	-3.6628	1.8401	-1.99
Ajusted R ²	0.5088		
Wald chi2 (6)	108.73 (0.0000)		

Source: authors' computation using Stata software (2020)

Further Empirical Analysis: Endogeneity and Reverse Causality

Arising from the possibilities of the above regression estimates, from being biased against the problem of endogeneity among explanatory variables as well as the incident of reverse causality, where firm value may also influence environmental responsiveness, and vice versa, this section provides results of two-stage least squares regression in *Table 7*, which was adopted to address these two problems. The Hausman test ($\text{chi2} (6) = 0.23$, $p > \text{chi2} = 0.9998$) supports two-stage least squares regression as opposed to the three-stage least squares regression.

The two-stage least squares regression estimates, as shown in *Table 7*, clearly indicate that environmental responsiveness significantly and positively influences firm value, even after controlling for endogeneity. This result further lends credence to the above estimates, as reported in *Table 4*. Remarkably too, firms with higher values tend towards being environmentally responsive. Impliedly, there is empirical evidence of reverse causality between firm value and environmental responsiveness. Though not the real focus of this paper, but this later result of reverse causality is plausible as high-valued Nigerian firms are environmentally responsive. A large chunk of existing literature is yet to consider this area; hence these findings obtained from empirical analysis and pointing to the existence of

reverse causality between firm value and environmental responsiveness appear to be a wake-up call to scholars, especially from emerging nations, to inquire more into this two-way relationship.

Table 7. *Two-stage least squares regression estimates*

Dependent variables	lnMP			ER		
	Coeff.	S. E.	t	Coeff.	S. E.	t
Book value	0.0279	0.0167	1.67***	-0.0032	0.0035	-0.92
EPS_1	0.0372	0.0254	1.47***	0.0006	0.0055	0.11
ER/lnMP	4.5767	1.2957	3.53*	0.1064	0.0400	2.67*
LEV	-0.0346	0.0661	-0.52	0.0013	0.0135	0.10
ROA	0.4475	3.6612	0.12	-0.3968	0.7245	-0.55
LnTA	-0.1463	0.2322	-0.63	0.0826	0.0368	2.25*
Cons	1.6813	3.3789	0.50	-1.0829	0.5631	-1.92*

Source: authors' computation using Stata software (2020)

Discussion of Findings

Based on a sample of 83 quoted non-financial firms in Nigeria, this study provides an empirical insight into the nexus between eco-responsiveness and firm value in the post-2015 sustainable development agenda era. Overall, results show that environmental responsiveness positively affects firm value. Firstly, our findings resonate with Ohlson's (1995) model, which posits that an information is value relevant provided it enhances corporate future profits. Accordingly, we observed that firm value is positively affected by the variable ER, implying that firms investing in eco-friendly equipment and minimizing their operational impact on the environment can increase their future value more than those that are not environmentally responsive. These observations are consistent with the findings of Al-Najjar and Anfimiadou (2012), Che-Ahmad and Osazuwa (2015), Derwall et al. (2005), Guenster et al. (2011), and Sinkin et al. (2008), who also investigated the effects of eco-business strategies on firm value in the US, the UK, and Malaysia. Further, and similar to extant literature, the study controlled for profitability (ROA) and leverage in the extended Ohlson's (1995) value relevance model. Results show that profitability has a positive but insignificant relationship with firm value, which is a slight departure from the outcome of Che-Ahmad and Osazuwa (2015), who reported a positive but significant relationship between the control variable and firm value. Nevertheless, the results confirm the negative

influence of leverage on firm value. This is also consistent with findings by Al-Najjar and Anfimiadou (2012), Che-Ahmad and Osazuwa (2015), and Sinkin et al. (2008). Evidence provided by these results also support the argument of Dowell et al. (2000) and Peck and Sinding (2003) that there is a likelihood of firms' increase in value as well as of reducing their risk profile when they adopt eco-friendly policies.

Extending the scope of our findings, our result provides a glimpse into the prospect of the United Nations' win-win agenda, which is to ensure the profitability of firms on the one hand and the protection of the environment on the other. We interpret the positive relationship between environmental responsiveness and firm value to be an indication that corporate involvement in environmental protection does not hamper shareholders' value but rather ensures a levelled playing ground between corporate activities and physical environment. This position corroborates the argument of Peck and Sinding (2003). Thus, we argue that if firms truly commit themselves to sustainable development goals (SDGs), specifically goals 12 (responsible consumption and production) and 13 (climate action), the UN campaign against environmental degradation may be accomplished soonest. This observation is also in agreement with the predictions of Bebbington and Unerman (2018) and Moses et al. (2019).

Lastly, our findings also unveil some environmental management practices concerning particularly the level of corporate commitment to green practices. As shown in *Table 1*, the mean value of environmental responsiveness (ER) stood at 32%, indicating that only 27 firms in our sample are environmentally responsive. This resonates weakly with environmental laws and regulation in Nigeria and shows the apathy of corporate entities towards compliance. This observation also aligns with the findings of Iredele et al. (2019) and Moses et al. (2019), who conducted an appraisal of the environmental laws and regulations in Nigeria.

5. Conclusions and Recommendations

Our study seeks to establish the nexus between environmental responsiveness and firm value in Nigeria. This was intended to extend the existing literature on eco-efficient business practices (Al-Najjar and Anfimiadou, 2012; Che-Ahmad and Osazuwa, 2015; Sinkin et al., 2008) and to provide extant evidence from emerging economies such as Nigeria. Further, we have attempted to take a glimpse into the prospect of the United Nations' win-win agenda by including firms who are signatories to the UN Global compact as environmentally responsive; this inclusion stands for a novel contribution of our study in the operationalization of environmental responsiveness. Our findings reveal that environmental responsiveness positively affects firms' value.

The outcome of this study has implications for both corporate managers and national policymakers. At the corporate level, the positive relationship between environmental responsiveness and firm value is an indicator for corporate managers that investment in green technology and the adoption of eco-friendly production processes do not have an adverse effect on shareholders' wealth, rather they reduce firm exposure to litigation risk on the one hand and promote environmental friendliness on the other. Hence, it does not account for any conflict of interest but rather it creates an avenue to achieve a competitive advantage since stakeholders are becoming interested in corporate environmental practices (Bui et al., 2019). At the national level, our findings exposed the weakness in corporate environmental laws and entities' apathy towards compliance. We therefore recommend that the government should revisit the various regulations on environmental protection and ensure strict implementation and compliance.

As with most studies, this study also has its inherent limitations. First, it is the sample size: though encompassing the majority of the firms (79%) listed on the Nigerian stock exchange, it excludes those in the financial sector, hence limiting findings of this study to all firms quoted on the NSE. In addition, our operationalization of eco-efficiency may not suffice to account for corporate involvement in environmental protection activities. Hence, we encourage future studies to explore these areas, perhaps by exploring other measures of environmental responsiveness.

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Appendices

Appendix 1. *List of firms used in the study alongside industry classification (final sample)*

S/No	Name of Firm	Industry
1	11 Plc (formerly Mobil)	Oil & Gas
2	ABC Transport	Services
3	Academy Press	Services
4	Afromedia	Services
5	Aluminium Extrusion Industries	Industrial Goods
6	Anino International	Oil & Gas
7	Arдова (Formerly Forte Oil)	Oil & Gas
8	Austin Laz & Company	Industrial Goods
9	Berger Paints	Industrial Goods
10	Beta Glass Co	Industrial Goods
11	BOC Gases Nigeria	Industrial Goods
12	C & I Leasing	Services
13	Cadbury Nigeria	Consumer Goods
14	CAP	Industrial Goods
15	Champion Breweries	Consumer Goods
16	Chams	ICT
17	Chellarams	Conglomerates
18	Conoil	Oil & Gas
19	Courteville Business Solutions	ICT
20	Cutix	Industrial Goods
21	CWG	ICT
22	Daar Communications	Services
23	Dangote Cement	Industrial Goods
24	Dangote Sugar Refinery	Consumer Goods
25	Ekocorp	Healthcare
26	Ellah Lakes	Agriculture
27	Eterna	Oil & Gas
28	E-Tranzact International	ICT

S/No	Name of Firm	Industry
29	Fidson Healthcare	Healthcare
30	Flour Mills Of Nigeria	Consumer Goods
31	FTN Cocoa Processors	Agriculture
32	GlaxoSmithKline Nigeria	Healthcare
33	Greif Nigeria	Industrial Goods
34	Guinness	Consumer Goods
35	Honeywell Flour Mill	Consumer Goods
36	Ikeja Hotel	Services
37	Interlinked Technologies	Services
38	International Breweries	Consumer Goods
39	Japaul Oil & Maritime Services	Oil & Gas
40	John Holt	Conglomerates
41	Julius Berger Nigeria	Building Construction
42	Lafarge Africa	Industrial Goods
43	Learn Africa	Services
44	Livestock Feeds	Agriculture
45	May & Baker Nigeria	Healthcare
46	McNichols	Consumer Goods
47	Meyer	Industrial Goods
48	Morison Industries	Healthcare
49	MRS Oil Nigeria	Oil & Gas
50	Multiverse Mining and Exploration	Industrial Goods
51	Nascon Allied Industries	Consumer Goods
52	NCR (Nigeria)	ICT
53	Neimeth International Pharmaceuticals	Healthcare
54	Nestle Nigeria	Consumer Goods
55	Nigerian Aviation Handling	Services
56	Nigerian Breweries	Consumer Goods
57	Nigerian Enamelware	Consumer Goods
58	Northern Nigeria Flour Mills	Consumer Goods
59	Oando	Oil & Gas

S/No	Name of Firm	Industry
60	Omatek Ventures	ICT
61	Pharma-Deko	Healthcare
62	Portland Paints & Products Nigeria	Industrial Goods
63	Premier Paints	Industrial Goods
64	Presco	Agriculture
65	PZ Cussons Nigeria	Consumer Goods
66	R T Briscoe	Services
67	Rak Unity Petroleum	Oil & Gas
68	Red Star Express	Services
69	SCOA Nigeria	Conglomerates
70	Seplat Petroleum Development	Oil & Gas
71	Studio Press (Nigeria)	Services
72	Tantalizers	Services
73	Initiates	Services
74	Thomas Wyatt Nigeria	Industrial Goods
75	Total Nigeria	Oil & Gas
76	Tourist Company Of Nigeria	Services
77	Transcorp Hotels	Services
78	Trans-Nationwide Express	Services
79	UAC of Nigeria	Conglomerates
80	Unilever Nigeria	Consumer Goods
81	Union Diagnostic & Clinical Services	Healthcare
82	University Press	Services
83	Vitafoam Nigeria	Consumer Goods



Corporate Board of Directors' Attributes and Audit Fees

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Abstract. This study examines the effect of corporate board of directors' attributes on audit fees for Nigerian listed Deposit Money Banks (DBMS). The study adopts an *ex post facto* research design and uses data on 10 deposit money banks sampled via purposive sampling technique using data spanning from 2012 to 2018. Results based on Generalized Method of Moment show that corporate board of directors' proxies do not significantly influence audit fees of Nigerian deposit money banks. However, firm size and profitability are found to affect external audit fee significantly. The study therefore concludes that corporate boards of directors' attributes do not individually significantly affect audit fees in Nigerian listed Deposit Money Banks. Arising from the findings, it is recommended that corporate governance practices should be strengthened so as to aid external audit.

Keywords: board size, board independence, board diligence, audit fee and GMM

JEL Classification: G38; M42

Introduction

This study examines whether corporate board of directors' attributes drive audit fees in Nigerian Deposit Money Banks (DBMs). The choice of financial sector by the study is informed by its contributions to the whole economy. The significance of the financial sector in any economy cannot be overemphasized. The sector is known to serve as the lubricant, which facilitates the smooth running of any

economy (Yaqub and Omobitan, 2012). The linkage between the financial sector and economic growth has been a subject of discussion for a long time (Kurawa and Garba, 2014); it is, however, established that the sector is expected to galvanize economies by mobilizing funds from surplus to deficit ends, manage the payment systems and facilitate the effectiveness of monetary policies (Yaqub and Omobitan, 2012). Relying on his findings from a study focusing on sub-Saharan African countries, Ndebbio (2004) establishes that a developed financial sector triggers sustainable economic growth. Using England's economy as an example, Hicks (1969) also affirms that a well-developed financial sector engenders sustainable economic growth.

Undoubtedly, the Nigerian financial sector presents an ideal model of the financial sector of a developing economy. This is so given that the country's financial sector, like any other developing economy's financial sector, has a less-developed capital market, which indicates the nation's inability to fully tap into the huge opportunities of capital accretion internally and into the huge potentials of foreign direct investments that a developed capital market offers. The limitation of most developing economies in this regard is mainly responsible for their low capital formation, unemployment, poor gross domestic product, low per capita income, and, finally, poor standard of living in general. Studies focusing on factors that could further strengthen the financial sectors of these climates will expectedly provide insights on what to do to address some of the economic plagues confronting these economies, and, therefore, these will prove to be a worthwhile endeavour.

Businesses around the world need to be able to attract funding from investors in order to expand and grow (Mallin, 2011). Investors, however, require a certain level of assurances concerning the safety of their funds as well as the expected returns thereon. These assurances are usually and traditionally derived from disclosures made about business status in companies' annual financial statements, duly attested by an independent person (auditor).

While corporate governance, of which the board of directors is an integral part, remains on the front burner of all business entities owing to its numerous benefits – particularly on strengthening corporate harmony –, external audit remains one of its key mechanisms. The contribution of external audit to the various stakeholders of business organizations in terms of deepening their confidence in relation to the safety of their interests (financial and non-financial) and investments is the reason it maintains a vantage position within the corporate governance domain. As the need for financial statements' integrity increases, companies are under pressure to ensure quality audits. A quality audit carried out by reputable audit firms, however, constitutes part of firms' operating costs, which in effect reduces companies' bottom line in terms of profitability. One of the ways the cost of external audit can be reduced, however, is by reducing the number of areas of concern and internal control deficiency that the audit firm needs to verify.

Poor bank governance negatively affects the economy and the society. Strong corporate governance mechanisms and external audit are of significant relevance to shareholders and customers as well as to regulators for the protection of their reputation and to ensure public confidence (Jizi and Nehme, 2018). Separation of ownership from management further reiterates the need for the professional examination of financial statements to ensure that they show a true and fair view of the entity's financial affairs. Audits, therefore, play a unique role in reducing agency problem by serving as the tool for aligning the interests of the agents with that of the principals (Jensen and Mecling, 1976). Audits strengthen the quality of financial reporting and thus assist in reducing information asymmetry and guarantee equal treatment of all shareholders in a way that mitigates agency problems (Desender, Aguilera, Crespi, and Garcia-Cestona, 2013). Audit fee is regarded by Liu (2017) as economic remuneration paid to auditors as a reward for audit services, which serves as an agency fee. He argues further that the fee paid is the combination of the total cost of audit through the overall audit work, the risk compensation, and the profit demand.

It is reasoned in the literature that effective CG practices should ordinarily strengthen internal control effectiveness, in effect, minimize the areas of concern for the external auditor and possibly reduce the cost of such audit exercise; CG and audit fees have in recent time attracted researchers' interest, and many empirical investigations have been attempted in this regard. The unending debate on the topic has, however, been sustained as a result of corporate scandals of the world's most reckoned with entities such as Adelphia, WorldCom, Enron, and Parmalat (Farooq, Kazim, Usman, and Latif, 2018; Ilaboya and Obaretin, 2015). Besides these debates, these corporate scandals have also raised the concern of the stakeholders about the issue of the effectiveness of corporate governance and external audit as control tools for mitigating the pervasiveness of agency problems.

Additionally, the Nigerian banking sector has witnessed a series of corporate scandals that have generated the failure of many banks, arising from weak corporate governance and failure of external audit to provide the necessary assurance service. In line with this, a series of reforms aimed at improving the corporate governance structure have been introduced by the appropriate banks' regulatory bodies in Nigeria. Despite the reforms, the issue of corporate governance failure still persists. For instance, the failure of Skye Bank in this context is significantly linked to corporate governance failure.

Corporate board of directors refers to one of the corporate governance structures designed to run and direct the affairs of an entity in order to safeguard the interests of the business stakeholders. Larcker and Tayan (2011) view corporate governance itself as a control process designed by an entity to prevent its agents from actions considered detrimental to the achievement of its desired goals, and by so doing ensure its going concern. The importance of strong corporate governance was

further brought to the front burner after the failure of some world-class entities such as Adelphia, WorldCom, Enron, and Parmalat (Farooq et al., 2018). In the Nigerian banking sector, for instance, a series of corporate failures involving banks such as Oceanic Bank, Intercontinental Bank, Savannah Bank, Afribank, etc. has been significantly linked to the failure of governance structure and external audit. This development further directed the attention of banks' regulators to the issue of corporate governance, which has thus driven the Central Bank of Nigeria and Security and Exchange Commission to develop a corporate code of conduct for DBMs and discount houses in a bid to ensure the proper discharge of directors' responsibility for financial transparency and accountability. According to Dabor and Dabor (2015), corporate governance is regarded as one of the tools for enhancing financial reporting quality and its reliability. Zaman, Hudaib, and Haniffa (2011) argued that board of directors and audit committee effectiveness is likely to protect auditors' independence and reduce the probability of issuing inaccurate audit opinions on top management's policies.

Though external audit has been established as one of the key mechanisms of CG, discussions on the significance of their nexus is yet to be laid to rest. Two paradigms exist in literature as regards the association between CG and audit fees. The first line of thought is synthesised from substitution theory, while the second line of argument rests on signalling theory. The two paradigms, however, due to their different theoretical underpinnings, produce conflicting empirical outcomes (Wu, 2012). On the one hand, substitution theory argues that effective corporate governance practices are a substitute for external audit service. Accordingly, strong internal control practices are associated with lower agency costs and risk for audit firms, which in turn suggest lower audit effort and, hence, lower audit fees (Wu, 2012). On the other hand, the signal sent by deficient corporate governance practices to external auditors warrants managers to engage the services of high-quality audit firms, which in effect leads to high audit fees (Wu, 2012).

To the best of our knowledge, studies on corporate board of directors' attributes and audit fees are scanty and call for empirical investigation focusing on the key roles played by corporate governance and external audit, towards ensuring the proper functioning of banks as well as transparency, accountability, and protection of shareholders' interest. As gleaned from extant studies, most studies on corporate board of directors' attributes and external audit in Nigerian banks have mainly focused on corporate governance and audit firm choice (see: Soyemi, 2020; Ilaoya, 2014; Ejeagbasi, Nweze, Ezech, and Nze, 2015) and the determinants of audit fees (Ezinand, 2020; Monsuru, 2014). Some studies have examined the influence of CG on external auditors' reporting lag (see: Soyemi, Sanyaolu, and Salawu, 2019; Ilaoya and Iyafekhe, 2014; Salau and Ayoib, 2016). With a view to expanding the horizon of the extant effort, therefore, this study examines in its dynamic form the relationship between CG and audit fees, focusing specifically on the financial

sector, a critical sector in any economy. The main objective is to investigate in its dynamic form, using data covering a period of seven years (2012–2018), the nexus between the corporate board of directors' attributes and the external audit fees of Nigerian DBMs as to whether it plays a substitutive or complementary role in influencing external audit fees.

In this study, three critical aspects of corporate board of directors' attributes are operationalized. These are board size, board independence, and board diligence (measured in terms of frequency of meetings). In line with the variables, three hypotheses are also developed regarding the corporate board of directors' attributes and audit fees. *Our empirical findings show that boards of larger size and frequent meetings are associated with higher audit fees, while highly independent boards show positive effect on audit fees, implying that board independence increases audit fees.*

We adopted the approach of Jizi and Nehme (2018) by examining the effect of corporate board of directors' attributes on audit fees, and we also highlight the policy implications of the study's findings for the deposit money banks and their regulatory authorities.

The practical implications of our finding imply that good governance is an essential component of quality audit as the later tends to yield good financial reporting quality, which in turn assists in reducing asymmetry information and supports the efficient functioning of the financial market. The study provides insights into policies that are interested in enhancing the financial aspect of corporate governance in order to achieve an improved financial reporting. Therefore, the study can provide a useful tool for practitioners and policy makers with regard to the critical roles of effective corporate governance mechanisms, which in turn can help in reducing market imperfections that hinder the efficient functioning of financial market, specifically of the banking sector.

The remaining of this paper is structured as follows. Section 2 focuses on the review of literature. Section 3 addresses methodology. Results and the discussion of findings are presented in Section 4, while Section 5 concludes and makes recommendations and suggestions for further investigations.

2. Conceptual Review

Board Size and Audit Fee

The effect of board size on board monitoring and control has generated controversy in literature. Basically, two strands of argument exist concerning board size, board monitoring, and control effectiveness. Some scholars have argued that small board size brings better governance as they believe that small firms are better able to

monitor and control their activities considering the better communication and level of interaction they enjoy (Ozkan, 2007). By contrast, Lipton and Lorsch (1992) and Jensen (1993) argued for a larger board, indicating that it helps in better monitoring, considering the diverse expertise and the varied experience of the board members. Their argument is that larger boards are more motivated to ensure the credibility of financial reporting and thus opt for quality audit firms that may charge high audit fees. Studies such as Bozec and Dia (2017), Jizi and Nehme (2018), and Karim et al. (2015) have documented the direct influence of board size on AF. We, therefore, hypothesise that board size has no significant positive effect on external audit fees of Nigerian listed DBMs.

Board Independence and Audit Fees

Non-executive directors are saddled with the responsibility of monitoring top managers so as to protect the interest of the shareholders against the management's opportunistic behaviour (Farooq et al., 2018). Directors with non-executive status are considered highly essential as they act as check and balance on the management due to their non-involvement in the daily business affairs of the entity. The level of independence they enjoy further propels them towards taking independent courses of actions that are considered beneficial to the protection and maximization of shareholders' wealth. In support of this argument, prior studies have reported the positive effect of board independence on audit fees as board independence may entail audit quality so as to improve assurance and confidence (Bozec and Dia, 2017; Jizi and Nehme, 2018). With a view to investigating this in the domain of the current study, we hypothesise that board independence has no significant positive effect on external audit fees of Nigerian listed DBMs.

Board Diligence and Audit Fees

Board diligence in this study refers to the extent of board activities in terms of the frequency of their meetings in a fiscal year. Lara et al. (2009) regarded board diligence as a strong measure of board monitoring as it depicts the extent of board monitoring and control functions. The frequency of board meetings is considered by Lipton and Lorsch (1992) to be associated with the better performance of duties in a diligent manner, which is considered beneficial to the interest of the shareholders. In support of the argument, Vifeas (1999) indicated that the frequency of board meetings is related to the effectiveness of board oversight. According to Farooq et al. (2018), board diligence may enhance the credibility of the financial statement. Carcello and Neal (2000) expressed this succinctly by stating that a high level of board diligence may warrant the service of high-quality auditor so as to attain high level of assurance, which may ultimately lead to high audit fees.

This study, however, consequently hypothesises that board diligence has no significant positive effect on external audit fees of Nigerian listed DBMs.

Theoretical Review

Studies of CG and external audit have hovered around some theories prominent among which are: agency theory, signalling theory, and lending credibility theory.

The agency theory was developed by Jensen and Meckling (1976) to capture the agency crisis between the agents and the principals as a result of ownership being separated from management. Shareholders employ managers to run the affairs of their entity. Agency crisis sets in due to shareholders' inability to directly monitor the behaviour of the managers (Jensen and Meckling, 1976). To further provide a control mechanism, shareholders incur agency cost such as audit fee. The auditor as shareholders' agent acts in such capacity by conducting an independent examination on the financial statements prepared by the management before the final presentation to the shareholders. This assists in reducing asymmetric information and thus lends more credence to the financial reports. In an entity with a pervasive agency crisis, more audit time, resources, and efforts will be required. This invariably increases audit fees (Leventis et al., 2005). The signalling theory opines that the outcome of the external audit services sends signal to the market about the credibility of the financial statement. The fees paid to the auditor are therefore a significant factor in determining the level of the audit quality. A high-quality audit, of course, sends positive signals to the market. This implies that users of such financial statements tend to ascribe more credibility to such financial statements. It could therefore be argued that the overall purpose of external audit is to attest to the credibility of financial statements so as to enhance the confidence of its users.

This study, therefore, significantly relies on agency theory, which postulates that in order to reduce agency problems, shareholders incur agency costs such as audit fees so as to monitor the management with a view to reducing the agency costs that they are exposed to.

Empirical Review

Applying regression analysis on the data of 19 randomly selected banks in Nigeria, Akhidime (2015) found a positive influence of non-executive directors, while independent directors and directors sharing ownership on audit quality were found to have a negative effect on audit quality. Using regression analysis on the data of 11 Nigerian listed DBMs from 2007 to 2014, Ejeagbasi et al. (2015) found that CEO function separation, board size, and audit committee composition significantly and directly influence audit quality, while board independence was found to have negative and insignificant effect.

Farooq et al. (2018) analysed the impact of CG on audit fee using 5 years data of Pakistani quoted companies. Findings obtained from the regression analysis show that surrogates for corporate governance have positive influence on external audit fees.

Kikhia (2014) found from his investigation on a sample of 112 Jordanian non-financial firms from 2010 to 2012 that board independence, expertise, and size exert positive significant influence on audit fees.

In an investigation on the effect of overconfident managers on audit fees with board characteristics as moderating variables, Mitra, Jaggi, and Al-Hayale (2019) found that there was a significant and direct influence of overconfident managers on audit quality. It was also found that board characteristics directly influence the nexus of overconfidence of managers and audit fees.

Focusing on small firms in America and New Zealand, Ananthanarayanan (2018) established that short-term incentive total compensation influences audit risk, thus increasing audit risk. It was further established that good corporate governance is associated with audit quality, which in turn warrants higher audit fees.

Kee (2015) examined the influence of audit committees on Malaysian Public Companies using 4,570 firms from the period from 2003 to 2012. The study found no significant influence of audit committee attributes on audit fees.

Using data on 379 of Malaysian quoted firms from 1999 to 2002, Effiezal, Mazlina, and Kieran (2011) found evidence for the significant positive effect of CG on audit fees.

In a study using regression analysis and carried out in Nigeria based on the data obtained from the annual reports of 15 DBMs from 2009 to 2018, Ezinando (2020) found evidence to suggest that audit fees are not positively and significantly determined by client size, client complexity, and the independence of audit committee. Kim, Emma-Riikka, and Per (2018) established that there was a significantly negative effect of alumnus chair of the audit committee on audit fees. However, it was found to have positive influence on non-audit fees as a proportion of total fees charged by an external auditor. Using panel regression analysis on a sample of quoted Canadian companies from 2002 to 2008, Bozec and Dia (2017) investigated the effect of board characteristics on audit fees with ownership structure as moderator. The result of the regression analysis reveals that board independence (BI) when moderated with high ownership concentration has a significant positive effect on audit fees.

Jizi and Nehme (2018) used regression analysis involving fixed effect on a sample of US national commercial banks with 664 firm year observations for seven years. Findings reveal that board size, the CEO/chair dual role, and audit committee financial experts positively influence audit fees. Karim, Robin, and Suh (2015) reported an indirect association between audit fees and overlapping of audit committees and that board classification is directly associated with audit fees.

3. Methodology

3.1 Sample

The sample of the study is made up of purposively selected 10 listed DBMs. As at 31 December 2018, 15 DBMs were listed on the Nigerian stock exchange. The selected 10 banks represent 67% of the entire list. The purposive sampling technique is adopted in this study, and the applicable research design is *ex post facto*. The choice of this research design is informed by the fact that the data of the study relate to past event, and as such it cannot be manipulated by the researcher.

3.2. Source of Data

Data for the selected 10 banks were sourced from their financial statements from the period of 2012–2018. The financial statements were obtained from the website of the selected banks and from the Nigerian stock exchange yearly fact books.

3.3. Measurement of Variables

Audit fee is the only dependent variable of the study, which represents the total fee paid to the external auditor or the external audit exercise, as reported in their FS for the period under consideration. For ease of measurement, this study also used natural logarithm of total audit fee as used by prior researchers such as Farooq et al. (2018), Ghafran and O'Sullivan (2017), and Jizi and Nehme (2018). We use three variables to proxy the corporate board of directors' attributes. The first variable is board size, which is the total number of directors on the board. The second variable is board independence proxied by the proportion of non-executive directors to total directors on the board. The third variable is board diligence, a measure of total board activities in terms of the frequency of board of directors' meetings for the years under coverage.

In addition, the studied firm's size measured by logarithm of total assets and profitability is measured in terms of natural logarithm of profit before tax as control variables. This approach is in line with that of Jizi and Nehme (2018).

3.4 Method of Data Analysis

The study analysed the data by using inferential statistics by adopting descriptive and correlation analysis as well as generalized method of moment with the aid of EViews 9. The generalized method of moment is the preferred approach when the number of observations (N) is greater than times series (T).

3.5. Model Specification

We specify the econometric model as follows:

$$AUF_{it} = \beta_0 + \beta_1 AUF_{it-1} + \beta_2 BS_{it} + \beta_3 BI_{it} + \beta_4 BD_{it} + \beta_5 ROA_{it} + \beta_6 FSZ_{it} + e_{it}, \quad (2)$$

where AUF_{it} denotes the audit fee of firm i in period t , AUF_{it-1} denotes the previous year's audit fee, BS_{it} denotes board size of firm i in period t , BI_{it} denotes the board independence of firm i in period t , BD_{it} denotes board diligence of firm i in period t , ROA_{it} denotes return on asset of firm i in period t , FSZ_{it} denotes firm size of firm i in period t , and e_{it} is a stochastic error term.

4. Data Analysis, Presentation and Interpretation of Results

Table 1. Descriptive statistics

	LAUDIT_ FEE	BS	BI	BD	ROA	FZS
Mean	12.219	14.243	0.581	6.229	0.018	21.039
Median	12.207	15.000	0.571	5.5000	0.015	21.092
Maximum	13.508	20.000	0.895	11.000	0.120	22.440
Minimum	11.290	7.000	0.455	4.000	-0.056	17.876
Std. dev.	0.597	2.820	0.089	2.001	0.022	0.918
Skewness	-0.067	-0.336	1.628	0.895	1.002	-0.673
Kurtosis	1.983	2.982	6.134	2.944	10.199	3.454
Jarque–Bera	3.068	1.315	59.565	9.364	162.872	5.716
Probability	0.216	0.5180	0.000	0.009	0.000	0.0574
Sum	855.295	997.000	40.654	436.000	1.257	1430.677
Sum Sq. dev.	24.569	548.871	0.552	276.343	0.033	56.482
Observations	70	70	70	70	70	70

Source: authors' computation (2020) using EViews 9

Table 1 shows the descriptive statistics of the data; the shown audit fees have a mean of 12.220 with corresponding minimum and maximum values of 11.290 and 13.510 respectively. The Jarque–Bera statistics of 3.068(0.2157) implies that the variables are not normally distributed. This may be due to the panel nature of the

data. Board size is averaged 14.240 with a minimum of 7.000 and a maximum of 20.000. The Jarque–Bera statistics of board size of 1.315(0.518) shows that the variable is not well distributed. Board independence has an average value of 0.581, implying that 58% of the directors are independent. It further shows a minimum value of 0.455 and a maximum of 0.85. The Jarque–Bera statistics of 59.565(0.000) means that the variable is normally distributed. Board diligence is averaged 6.229 with a minimum of 4.000 and a maximum of 11.000. The Jarque–Bera statistics of 9.364 (0.009) shows that the variable is normally distributed. Profitability (measured by ROA) is averaged 0.018 with a corresponding mean of -0.056 and a maximum of 0.120. The Jarque–Bera statistics of 162.872 (0.000) shows that the variable is normally distributed. Finally, size is averaged 21.039 with a minimum value of 17.876 and a maximum of 22.440. The Jarque–Bera statistics of 5.716(0.057) means that the variable is normally distributed.

Table 2 below displays the correlation analysis, which shows the association between the variables. Board size has a negative correlation of 0.040; board independence, board diligence, profitability, and size have a positive relationship of 0.041, 0.046, 0.454, and 0.856 respectively.

Table 2. *Correlation matrices*

	AUDF	BS	BI	BD	ROA	SIZE
AUDF	1.000					
BS	-0.040	1.000				
BI	0.041	-0.063	1.000			
BD	0.046	0.161	0.088	1.000		
ROA	0.454	0.016	-0.022	-0.150	1.000	
FZS	0.856	0.126	0.111	0.219	0.171	1.000

Source: authors' computation (2020) using EVIEWS 9

Table 3 displays the results of the GMM (i.e. Generalized Method of Moment). BS is negative and insignificant. This result is in tandem with our expectations. The implication of the finding is that larger boards may have less agency problems and thus require lower audit quality and effort, which invariably reduces audit fees. Board independence has a positive but insignificant influence on audit fees. Independent directors are more concerned with financial reporting quality and may therefore demand a high-quality audit firm, which may be associated with high audit fees. Board meetings have a negative but insignificant effect on audit

fees of Nigerian DBMs. This implies that board activities reduce audit fees. This means that board meeting frequency will facilitate financial reporting reliability and credibility, which will in turn lead to lower work input and less effort, hence lower AUF. Profitability is positive and significant, which implies that profitable banks may want to disclose more information, which in turn increases audit effort and time and thus increase audit fee. Firm size has a positive coefficient, and it is also highly significant. This implies that larger firms are more complex and require more audit attention due to the number of branches that the auditor needs to visit; this in turn increases audit fees. The main finding is that profitability and size are the significant determinants of the audit fees of Nigerian DBMs.

Table 3. GMM analysis for corporate board of directors' attributes and audit fees

Regressors	Pooled OLS Estimation		Fixed Effect		Random Effect	
	Coeff.	p-val	Coeff.	p-val	Coeff.	p-val
Constant	-0.269	0.551	-2.005	0.352	-0.273	0.589
AUDF(-1)	0.840	0.000	0.700	0.000	0.827	0.000
BS	-0.006	0.274	-0.005	0.526	-0.007	0.234
BI	0.011	0.948	0.335	0.311	0.033	0.861
BM	-0.005	0.580	0.003	0.775	-0.004	0.644
ROA	2.104	0.052	1.570	0.295	2.119	0.064
FZS	0.113	0.033	0.264	0.077	0.121	0.037
R-square	0.972		0.977		0.963	
Adj. R-square	0.968		0.969		0.959	
J-stat	51.000		42.000		51.000	
Prob J-stat	0.000		0.000		0.000	
Durbin Watson	2.035		2.334		2.007	
Instrument rank			17		8	
Hausman Test	5.318	6	0.504			

Source: authors' computation (2020) using EViews 9

5. Discussion and Conclusions

The main objective of the investigation is to examine the effect of corporate board of directors' attributes on audit fees of Nigerian quoted DBMs. Data of 10 selected DBMs for seven years from 2012 to 2018 were obtained from their annual financial reports. Using (GMM), we found that the main corporate board of directors' variable that increases external audit fee is board independence, while board size and board diligence reduce it. However, the study could not find any of this variable exerting significant effect on audit fees. Our result as to board size having a positive coefficient is in tandem with that of Bozec and Dia (2017) and Jizi and Nehme (2018), who revealed the positive influence of board independence on audit fees. We found board size and board diligence to have a negative influence on audit fees. These findings are in line with our expectation, as a board may be made up of directors with diverse experiences, including the one related to financial expertise, which may lead the preparation of high-quality financial reports that require less audit services and thus reduce audit fees. As to board diligence, the frequency of meetings may suggest quality financial reporting, which also reduces audit fees. This is in tandem with the finding of Farooq et al. (2018). As to the significant direct effect of profitability on audit fee, it is concluded that profitable companies may want to disclose more information about their companies, which invariably increases efforts and by implication audit fees. Results also reveal that firm size positively and significantly influences audit fees. This is so as larger banks are considered to be more complex and to have more branches that the auditor needs to visit. This increases audit efforts and thus warrants higher audit fees.

Most studies on CG and audit fees have mainly focused on developed countries, while the few ones conducted in developing countries, such as Nigeria, have not focused on the banking sector. Arising from this gap, the study examines the corporate board of directors – an integral part of corporate governance – and external audit fees of Nigerian listed deposit money banks. The study found that boards that are dominated by non-executive directors demand high audit quality, which warrants high audit fees. The quest for audit quality by non-executive directors may be due to the fact that the non-executive directors act as a monitoring tool for aligning shareholders' interest with that of the managers. Therefore, in a bid to ensure this alignment of interests, increased controls and audit are required. This in turn may necessitate the engagement of top-rated external audit firms with the associated high audit fees.

Findings from the study provide evidence that Nigerian deposit money banks can protect shareholders' interest through board independence by having more non-executive directors. As our finding suggests that board independence does not only provide effective monitoring tools of top management, but it also ensures that a high-quality auditor is engaged in a bid to improve financial statement reporting quality and credibility.

On the relationship between board size and board diligence with audit fees, our study provides evidence to suggest that larger board size and higher frequency of board meetings can reduce agency costs such as external audit fees. This implies a substitution effect between board size and board diligence, two major variables of corporate board of directors' attributes on external audit fees.

Findings from our study indicate that firms with larger board size and board diligence have a tendency of enjoying lower external audit fees. Consequently, in order to have lower external audit costs, DMBs are encouraged to consider larger board size and motivated board members with high level of diligence.

Despite the contributions of this study to the extant body of knowledge, specifically relating to the literature on firms' corporate board of directors, attributes and external audit fees, it is worth mentioning that our study is not without limitations. First, our study examined corporate board of directors' attributes and audit fees of Nigerian DBMs. In order to have broadened perspectives on these concepts, there is a need to explore further sectors as well such as telecommunication, agriculture, oil and gas, manufacturing, etc. Second, the inclusion of other CG variables (such as ownership structure, audit committee attributes, and audit firm size) into the model adopted for the study is likely to produce a more robust study and stimulating findings.

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