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Poverty, Governance and Economic Progression: Evidence from Nigeria

By: Idowu Oluwasayo AYODEJI [1] & Taofeeq Abiola ABDULGANIYU[2]

Abstract

Despite World Poverty Clock projection that over 42% Nigerians will be living in extreme poverty by 2030, can the current administration still deliver on his promise to remove 100 million Nigerians from poverty by 2030 with only a few months left for it in office? This study examines the effect of governance on poverty level in Nigeria using relevant and prominent variables such as exchange rates stability, inflation rates, stock prices, oil prices and COVID-19 pandemic. At 5% level of significance, results showed that governance pattern played a significant role in explaining the variations in poverty level between 2010 and 2021, as indexed by the selected macroeconomic variables. In addition, MANCOVA results showed that reduction in oil prices and the coronavirus pandemic notwithstanding, governance pattern contributed to the decline in economic performance in recent times and the decline is more evident in inflation rates and exchange rates fluctuations. In conclusion, results provided more grounds to take the World Poverty Clock forecast more seriously and to ensure that it is averted. They also have important implications for sub-Saharan Africa.

Keywords: MANCOVA, inflation rates, stock prices, exchange rates, oil prices, COVID-19

1.0 Introduction

First in the sustainable development goals is to eradicate poverty for everyone in every geographical location by 2030. Projections from the World Bank in its report titled "Piercing together the poverty puzzle" showed that the world is nowhere near achieving this important goal. It also revealed that the geographical location of poverty has now shifted to sub-Saharan Africa: estimates showed that by 2030, 87% of the people living in extreme poverty will be found in the region. Projections for the most populous nation in the region, Nigeria looks more gloomy: over 105 million out of the 247 million Nigerians will be living in poverty by 2030.

On July 2019, President Muhammadu Buhari declared that the goal for his second term in office is to remove 100 million Nigerians from extreme poverty by 2030. To show his level of commitment and progress, he announced at the last democracy day on June 12, 2021, that his administration has lifted more

[1] *Department of Mathematics, Obafemi Awolowo University, Ile-Ife, Nigeria, email: ioayodeji@oauife.edu.ng, idowu.sayo@yahoo.com*
[2] *Department of Mathematics, Obafemi Awolowo University, Ile-Ife, Nigeria.*

than 10 million Nigerians out of poverty in the last 2 years. A counter-claim due to Premium Times released on 6th April, 2022 on her website revealed that rather than lifting people out of poverty, fresh 10 million Nigerians had slipped into poverty since 2019; showing that the Nigerian case did not improve but had only got worse. The publication supported its claim using the poverty figures earlier published by the World Poverty Clock. The figures showed that a record of more than 6.5 million Nigerians fell into extreme poverty in 2020 alone, the highest to be pushed into poverty in a year since Nigeria gained independence. The present administration has adopted several strategies to combat poverty, these include the inauguration of the National Steering Committee of the National Poverty Reduction with Growth Strategy led by Professor Osinbajo, the Vice president. However, despite all these attempts estimates have shown that the country continued to sink into poverty the more. The World Bank in its report titled 'A Better Future for All Nigerians: 2022 Nigeria Poverty Assessment' noted that poverty reduction in the country has stagnated since 2015. A pertinent question to ask is, with only few months left for it in office, will the present administration be able to achieve its goal of lifting Nigerians out of poverty?

To answer this all-important question, we compare some poverty level indicators in the current dispensation with the immediate past administration; noting that if these characteristics have improved since the last dispensation then Nigeria is on its way out of poverty. Now different indicators have been employed in the economic literature to measure poverty characteristics. These usually include figures drawn from the World Development Indicators and other nation-based statistical organizations. These figures are, at best, updated quarterly, and therefore may not provide enough data to execute the task at hand. We instead turned to indices that were updated more regularly such as the stock prices, exchange rates and inflation rates, hoping that the inferences drawn from such measures can be used to assess the current state and progression of the economy.

The extant literature has emphasized the link between certain macroeconomic fundamentals and poverty reduction: effective macroeconomic adjustments reduce overall poverty significantly whereas inadequate ones worsen it (Demery and Squire, 1996). In particular, several studies have provided evidence to support the view that exchange rate depreciation encourages poverty reduction (Demery and Squire, 1996; Apergis and Arusha, 2018); on the other hand, some strand of literature have also maintained that depreciation does not necessarily lead to poverty reduction; for instance, Cravino and Levchenko (2016) associated Mexican peso devaluation with an increase in the cost of living, with the poor feeling the heat more than the rich. More recently, Sharif and Elham (2021) have also shown that real exchange rate depreciation has no

significant effect on poverty reduction in Iran. Thus there is currently no concensus on the link between exchange rates and poverty reduction; however, all relevant literature appears to agree to the fact that exchange rate instability aggravates poverty (Nzekwu, 2006; Omojimite and Oriavwote, 2012). In addition, stable inflation rates (Cardoso, 1992; Talukdar, 2012) and improved stock market indicators (Blau, 2017; Umar and Nayan, 2018) are two other major factors linked to poverty reduction in the literature. These variables – exchange rates stability, inflation rates and stock prices can therefore be employed as poverty indicators to examine the economic progression in Nigeria under the current administration; with the belief that if they had improved in recent times then there is hope that several millions will be lifted out of poverty as promised. It is apt to add that the study is not unaware of the current prevailing conditions and natural occurrences, hence we control for covariates such as oil prices and COVID-19 pandemic.

There are at least three important contributions of the study; first, to provide information on the poverty level in Nigeria viz-a-viz the current government's contributions; second, to give reliable and definite comparative assessment of the state of the economy under the present and immediate past administration; and lastly, to serve as guide for other sub-Saharan African countries as they all strive towards achieving the first sustainable development goal.

2.0 Literature review

This section is divided into three parts: the first reviews related literature on governance and poverty reduction; the second explores the link between selected macroeconomic fundamentals and poverty reduction while the third examines the dynamics of selected macroeconomic indices from 2015 till date.

2.1 Governance and Poverty Alleviation

Kaufmann and Kraay (2019) broadly defines governance as the manner in which power is being exercised in a country. It goes without saying that the success or otherwise of economic policies (targeted at stimulating development) depends largely on the quality of governance (OECD, 2001). Consequently, effective reform policies are expected to significantly reduce poverty whereas inadequate ones will worsen it (Demery and Squire, 1996).

Since independence in October, 1, 1960, Nigeria has underwent about 29 years of military dictatorship and 33 years of civil rule; however, despite various promises of good governance, the level of economic development experienced till date is not commensurate to her vast natural endowments.

The test of the effect of governance on poverty reduction is most closely related to the broad literature that investigates the link between governance and economic growth. Chauvet and Collier (2004) found evidence to support the motion that developing economies suffering from poor governance experience less annual economic growth in terms of gross domestic product (GDP). Quibria (2006) also reported a positive link between per capita income and certain governance indicators. In the same vein, Akanbi (2010) investigated the role of governance in encouraging investment in Nigeria. He found that good governance is a necessary ingredient for investment and significant growth. More recently, Fawaz et al. (2021) who also examined the effect of governance on economic growth in 111 developing economies found that certain governance indicators are positively associated with GDP per capita.

2.2 The link between selected macroeconomic fundamentals and poverty reduction

The selected macroeconomic variables are inflation rates, stock prices and exchange rate stability. This section will discuss their connections with poverty reduction.

Inflation rates: In its Development Update report, titled, 'The Continuing Urgency of Business Unusual', the World Bank predicted inflation of about 16% for the Nigerian economy in 2022. At this rate, additional 15 million Nigerians are expected to be pushed into poverty before the end of 2022. As of May 2022, according to the report released by the National Bureau of Statistics, the Nigerian inflation rates have exceeded 17% on year-on-year basis; hence the current level of poverty experienced in the country. The attendant effect of inflation on poverty is not peculiar to Nigeria; the Asian Development Bank Report of 2011 has it that over 64 million people in developing Asia became poor as a result of a 10% increase in domestic food prices.

Cardoso (1992) highlighted two channels through which inflation increases poverty; first is through inflation tax as it may affect the savings of people in the middle class to the extent that it pushes them below the poverty line; secondly, when inflation surges and nominal wages could not keep up, a decrease in the real wages is inevitable. Powers (1995) reported that consumption-based poverty grew worse with rising inflation. In a related development, Brazil recorded a persistent increase in Gini coefficient in the 1980s when inflation rose and a decrease when inflation was stabilized within 1994 and 1996 (Rezende, 1998). In a study conducted on India, Datt and Ravallion (1996) reported that increased poverty rates were associated with increased inflation. Shiller (1996) in a survey conducted on 677 people in Brazil, Germany and the

United States showed that the major reason citizens dislike inflation is that it reduces the standard of living. Using data from 115 countries spanning 27 years, Talukdar (2012) reported, by and large, a positive association between inflation and poverty.

Exchange rates and exchange rates fluctuations: Bulk of the literature in this section identified economic growth as the major channel through which poverty responds to changes in exchange rates (Omojimite and Oriavwote, 2012). Several of these studies insist that exchange rate depreciation encourages poverty reduction (Demery and Squire, 1996; Apergis and Arusha, 2018); however, some strand of literature have also maintained that depreciation does not necessarily lead to poverty reduction. For instance, Cravino and Levchenko (2016) using data on household consumption found that Mexican peso devaluation (occasioned by the 'Tequila Crisis') was associated with an increase in the cost of living, with the poor feeling the heat more than the rich. More recently, Sharif and Elham (2021) have also shown that real exchange rate depreciation has no significant effect on poverty reduction in Iran. In addition, some studies have also provided evidence that real exchange rate depreciations inhibit growth (Cottani et al., 1990; Bahmani-Oskooee et al., 2002) which have been positively associated with poverty reduction (Fosu, 2010). In the midst of all these, one fact that all relevant literature seems to agree on is that exchange rate instability does not favour the poor (Nzekwu, 2006; Omojimite and Oriavwote, 2012). Nzekwu (2006) noted that exchange rate fluctuations may stall investment growth rates, increase the borrowing rates of private firms which in turn may adversely affect the demand for labour, increase the prices of consumables, and encourage round-tripping behaviour in some financial sectors which may provide avenue for corruption. It is worth adding that Sharif and Elham (2021) provided empirical evidence in the case of Iran to support the fact that exchange rate volatility aggravates poverty.

Stock prices: As far back as the nineties, the extant literature has provided evidences to support the motion that financial development impacts significantly on economic growth, standard of living and poverty level (Goldsmith, 1969; McKinnon, 1973; Levine, 1991). More recent evidence can also be found in Rewilak (2017). There are also studies tailored towards investigating the effect of stock market development, in particular, on poverty reduction. For instance, Lazar et al. (2006) also showed that the size of capital market as indexed by the market capitalization ratio and concentration can be exploited to alleviate poverty in India. Moreover, in a cross-country analysis comprising of 91 samples, Blau (2017) also demonstrated that stock market liquidity reduces poverty. In addition, a study carried out at IFC with a World Bank research grant

also alluded to the fact that stock market development is crucial to growth in poor countries than the industrialized ones.

2.3 Inflation, stock and exchange rates movements in Nigeria post-2015

In 2014, prior to the inauguration of the current administration, inflation rates ranged between 7.7% and 8.5%. A year after inauguration, inflation rates averaged 9%. According to the National Bureau of Statistics (NBS), inflation had skyrocketed in recent times reaching its all-high in four years. As at March 2021, inflation rates stood at 18.17%, representing an 0.82% increase from the February figures. The sudden upsurge in inflation rates had been traced to food prices (Olawoyin, 2021). According to NBS, food inflation rose to 20.57% year-on-year in the first month of 2021; its highest in 11 years.

Further, six months after inaguration in 2015, a dollar exchanged for NGN197; however, since then, the naira has endured several devaluations with two of such happening in 2020 alone. Recently, the Nafex rate was adopted with the justification that it would harmonize the multiple exchange rates. This new move also devalued the naira by 7.6% (Olawoyin, 2021). Currently, the exchange rate stood at NGN410.25 to a dollar. We note that devaluation implies that naira will have a lesser value. Now for a country that imports almost everythihg, the effect on salary earners may be devastating as it may lower the purchasing power of their wages and consequently push most of them into poverty. Excessive devaluations may also take its toll on businesses as it may increase the cost of production forcing several small businesses to close down and consequently aggravating the unemployment rate.

The Nigerian stock market is also not immuned to the current realities as it reported a loss to the tune of NGN528bn in just three days in April 4, 2019 (Sobowale, 2019). Several pundits have examined the current happenings in the country, especially in the stock market, and have attributed it to the sudden upsurge in the inflation rates (Ojoye, 2018; Olawoyin, 2021). On the other hand, others such as Ademuwagun (2021) and Emejo (2022) are of the opinion that the current realities in the financial markets are as a result of the reduction in crude oil prices and the COVID-19 pandemic.

3.0 Data and Methodology

Datasets involved monthly exchange rates (USD/NGN) and inflation rates (computed from the consumer price index) from May 2010 to March 2021. They were extracted from the website of the Central Bank of

Nigeria. Closing stock prices were downloaded from investing.com. Bonny light oil prices were also obtained from the website of the Central Bank of Nigeria. The data were first-differenced to ensure stationarity. COVID-19 values were generated such that the variable COVID was assigned value 1 if COVID was present in a certain month and 0 otherwise. According to the Nigerian Centre for Disease Control (NCDC), Nigeria reported its first coronavirus case in February 27, 2020. Thus from February 2020 till March 2021, the COVID variable was assigned value 1, and value 0 in the preceding months. Exchange rate fluctuations were measured using the exponential generalized autoregressive conditional heteroscedasticity technique proposed by Nelson (1991). More details are provided in the Appendix.

3.1 The Multivariate Analysis of Covariance

In simple terms, multivariate analysis of covariance (MANCOVA) applies the multivariate analysis of variance (MANOVA) treatment to data while partialling out the effect of the covariates (Rencher, 1998). In this study, MANCOVA tests whether average economic performances based on a combination of macroeconomic variables (while controlling for the effects of oil prices and COVID-19) differ by government. In other words, it seeks to test whether the poverty level, as indexed by certain selected variables, differ under Buhari relative to the immediate past administration.

Consider the following observation vector:

$$y = \begin{pmatrix} exchange\ rates\ volatility \\ \text{inf}\ lation\ rates \\ stock\ prices \end{pmatrix}, \qquad (1)$$

The model for each observation vector is

$$y_{ij} = \mu + \alpha_i + \beta Z_{ij} + \varepsilon_{ij}; i = 1,2,\ j = 1,2,\cdots,n_i, \qquad (2)$$

where $i = 1$ represents the immediate past administration's characteristics and $i = 2$ represents the current administration's. n_i represents the sample sizes for each dispensation or the total number of months data were available for each administration; μ represents the overall mean, α a measure of the effect of each administration on the observation vector, β is a 3×2 matrix of regression coefficients of (the three

dependent variables exchange rates volatility, inflation rates and stock prices denoted) y on (the two covariates oil prices and COVID-19 denoted) Z (Rencher, 1998) and ε the random error term assumed to be independently and identically normally distributed with 0 mean and variance Σ. Thus, for instance, y_{11} represents the combined macroeconomic variables exchange rate fluctuation, inflation rate and stock price during Jonathan's first month in office while y_{23} represents the combined macroeconomic variables during Buhari's third month in power. The grand mean is calculated as:

$$\bar{y} = \frac{1}{\sum_{i=1}^{2} n_i} \sum_{i=1}^{2} \sum_{j=1}^{n_i} y_{ij} \quad . \tag{3}$$

While the mean for each group is calculated as:

$$\bar{y}_{i.} = \frac{1}{n_{i.}} \sum_{j=1}^{n_i} y_{ij} \tag{4}$$

The null hypotheses to be tested are:

$$H_{01} : \alpha_1 = \alpha_2 . \tag{5}$$

and

$$H_{02} : \beta = 0 . \tag{6}$$

If H_{01} were true then there is no significant difference in the average poverty level during both tenures based on the combination of the observation vectors, low oil prices and COVID-19 pandemic notwithstanding. If H_{02} were true, then reduction in oil prices and COVID-19 pandemic had no significant effect on the Nigerian economy. More details on sources of variations and degrees of freedom are available in Chatfield and Collins (1980). MANCOVA proceeds by computing the Wilk's lambda and the corresponding F value. This is then compared with the F-distribution table under appropriate degrees of freedom and a decision is taken.

MANCOVA computations have been made easier with the introduction of common statistical softwares such as SPSS and R. This study was carried out using the SPSS.

4.0 Results and Discussion

Results will be presented and discussed under two subsections: descriptive and inferential parts.

4.1 Descriptive Statistics

Table 4.1 below contained summary statistics for the three selected indices while Figure 4.1 displayed the raw plots. From Table 4.1 below, we observed that the average inflation and exchange rates were higher in recent times compared to the immediate past administration, but reverse is the case for stock prices. This is also visible in Figure 4.1. Higher exchange rates imply that the value of Nigerian naira has declined in recent times. Although exchange rate depreciation is expected to encourage export and economic growth (Nzekwu, 2006), however; Omojimite and Oriavwote (2012) have proven that this is true in the case of Nigeria, an import-based economy, which is bedeviled with high cost of importations and infrastructural facilities. In addition, Olawoyin (2021) have argued that exchange rate depreciations would impact on local trade, investment, and consequently the economy in a negative way. Further, higher average inflation rates imply that consumers were, on the average, buying goods at higher prices post-2015. In addition, the computed mean for stock prices under the previous administration was also higher than that of the current one; this implies that companies listed on the exchange seemed to thrive better, on the average, before 2015. This is not surprising since naira was stronger pre-2015 and inflation rates were lower.

In Figure 4.1, we note in passing that the stock market appeared to be doing relatively well at the early stage in the current regime until January 2018 when the stock values nose-dived. Further, the standard deviations of the macroeconomic variables were uniformly lower during previous administration compared to post-2015. This indicated that the variables behaved more unpredictably after power changed hands. We note, in passing, that fluctuations in commodity prices, exchange rates and stock prices are not a good recipe for investment. The content of the joint report by the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) and the National Bureau of Statistics (NBS) confirms this as it noted that the nano, micro, small and medium scale enterprises experienced a 4.53% drop in quantity between 2017 and 2020 (Emejo, 2022).

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Table 4.1: Summary Statistics (May 2010 – March 2021)

Statistics	Exchange rates		Inflation rates		Stock prices	
	Pre-2015	Post-2015	Pre-2015	Post-2015	Pre-2015	Post-2015
Mean	0.764262	2.628571	1.079567	2.870519	128.806066	67.639429
Std. dev.	2.6282094	9.9034022	0.7051229	1.2378424	1.66×10^3	2.12×10^3
Samples	61	70	61	70	61	70

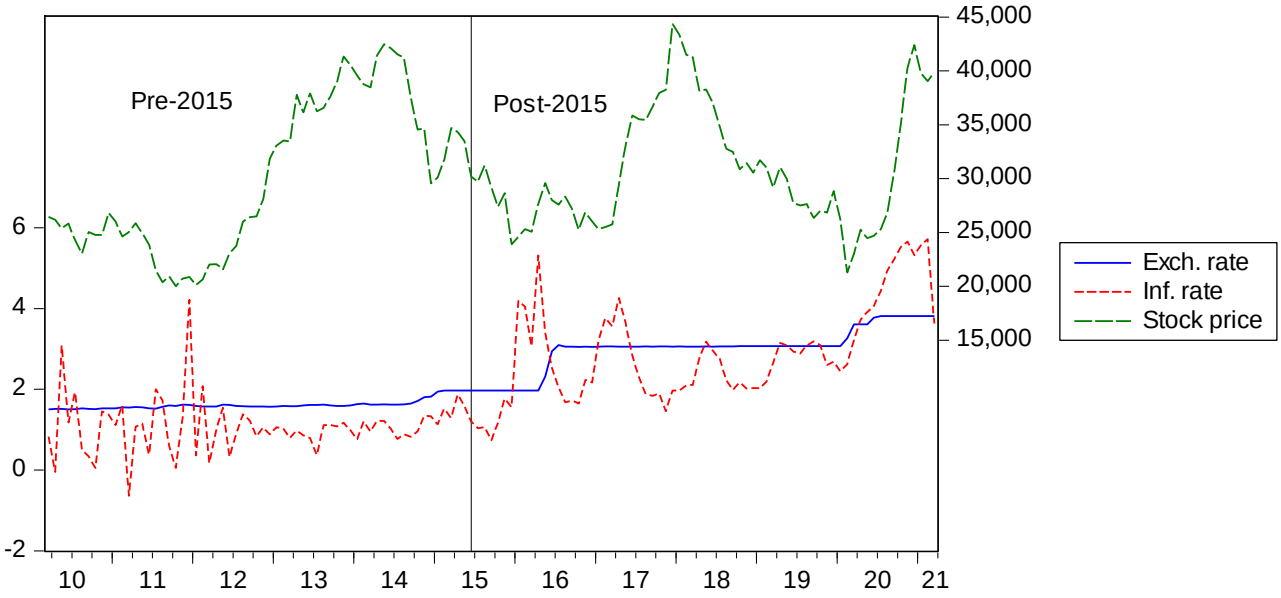

Figure 4.1: Line plot of selected macroeconomic variables (May 2010 and March 2021).

4.2 Inferential part - MANCOVA

At the start up, we applied the multivariate analysis of variance (MANOVA), ignoring the covariates (oil prices and COVID-19). Table 4.2 referred to the MANOVA output. Clearly, all the statistics agreed with *p=0.00* that the combined response inflation rates, exchange rates volatility and stock prices recorded between May 2010 and March 2021 were significantly different during the two tenures. This is a clear indication that governance played a significant role in explaining the variations in poverty level within 2010 and 2021, as indexed by the selected macroeconomic variables.

Table 4.2: MANOVA Computations

Effect	Statistics	Value	F-value	Significance
Governance	Pillai's Trace	.470	37.536	.000
	Wilks' Lambda	.530	37.536	.000
	Hotelling's Trace	.887	37.536	.000
	Roy's Largest Root	.887	37.536	.000

Further investigation was conducted to determine which of the three indices was responsible for the significant-difference conclusion obtained in the MANOVA computations. Table 4.3 below presents the test of between-subject effects conducted using one-way ANOVA on each of the indices. It is obvious that the significant difference was more visible in the inflation rates and exchange rates fluctuations. Thus in line with what was earlier observed in Table 4.1, we can conclude that inflation rates experienced significant upsurge while exchange rates also fluctuated more after 2015.

Table 4.3: Test of between-subject effects

	Sum of squares	df	Mean square	F	Significance
Inflation rates	104.550	1	104.550	99.493	.000
Stock prices	121951.118	1	121951.118	.033	.856
Exch. volatility	93.998	1	93.998	7.017	.009

Adding the covariates oil prices and COVID-19 pandemic into the mix, we observed that though the two covariates were highly significant for both tenures, they did not diminish the "governance effect" on the composite variables. This implies that reduction in the oil prices and the coronavirus pandemic notwithstanding, the combined response inflation rates, exchange rates fluctuations and stock prices recorded between May 2010 and March 2021 were significantly different during the two regimes. Thus we can conclude that reduction in the oil prices and the coronavirus pandemic notwithstanding, governance pattern contributed to the decline in economic performance in recent times and the decline is more evident in the inflation rates and exchange rates fluctuations. In other words, reduction in the oil prices and the coronavirus pandemic notwithstanding, governance pattern contributed to the current level of poverty (as indexed by

selected macroeconomic variables) in Nigeria.

Table 4.4: MANCOVA Computations

Effect	Statistics	Value	F-value	Significance
Governance	Pillai's Trace	.425	30.853	.000
	Wilks' Lambda	.575	30.853	.000
	Hotelling's Trace	.740	30.853	.000
	Roy's Largest Root	.740	30.853	.000
Oil prices	Pillai's Trace	.118	5.583	.001
	Wilks' Lambda	.882	5.583	.001
	Hotelling's Trace	.134	5.583	.001
	Roy's Largest Root	.134	5.583	.001
COVID-19	Pillai's Trace	.345	21.920	.000
	Wilks' Lambda	.655	21.920	.000
	Hotelling's Trace	.526	21.920	.000
	Roy's Largest Root	.526	21.920	.000

5.0 Conclusions and Recommendations

The study examines the effect of governance on poverty level in Nigeria using some selected macroeconomic variables. The multivariate analysis of covariance technique was employed. Major research findings include; (i) governance played a significant role in explaining the variations in poverty level within 2010 and 2021, as indexed by the selected macroeconomic variables; (ii) inflation rates experienced significant upsurge while exchange rates also fluctuated more after 2015; (iii) governance pattern contributed to the decline in economic performance in recent times and the decline is more evident in the inflation rates and exchange rates fluctuations. In other words, low oil prices and the coronavirus pandemic notwithstanding, governance pattern contributed to the current level of poverty (as indexed by selected macroeconomic variables) in Nigeria.

There is no doubt that this outcome provided more grounds to take the World Poverty Clock projection seriously and to ensure that it is averted. The study has made it clear that if the current administration must remove 100 million from poverty by 2030, there is need for consumer-friendly policies in order to crash the inflation rates so that the financial markets can experience positive growth; and consequently, the hardship that citizens are facing can be alleviated. It is true that there are no policies without attending consequences; however, adequate provision must have been made to cushion the effect on the masses before

such policies are introduced. In particular, certain policies on items that affect consumers' day-to-day runnings such as the cooking gas, pump prices and consumables should be reviewed to effectively crash the inflation rates.

Further, all relevant avenues must be explored to ensure that Nigeria changes from an import-oriented to an exporting economy as this is the only way to ensure exchange rates stability. If Nigeria is no longer import-dependent then external shocks would not easily distort the economic movements within the country. In addition, it is important to tackle the issue of insecurity decisively and provide better infrastructure so as to create a better environment for businesses, especially nano, small and medium scale, to thrive. It is true that the government cannot do all these alone hence the need to woo the private sector with investment-friendly policies.

Finally, the study has established that a nation which desires to meet the poverty eradication goal by 2030 should ensure to keep inflation rates at a single-digit level. High inflation rates are not peculiar to Nigeria rather it is a common 'disease' in the sub-Saharan African countries. Ayodeji (2021), for instance reported that only 8 countries in SSA have made some significant improvement in inflation rates within 2004 and 2019. It is sad to note that not much progress has been made till date: Lovablevibes.co (2022) reported that the Zimbabwean economy had experienced free-fall since October 2018 due to high inflation rates and low level of investor confidence. Thus there is need for all hands to be on deck in ensuring that inflation rates are kept at the barest minimum in the sub-Saharan African region to ensure that the region is not left behind in the quest to achieve the sustainable development goal.

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Appendix: Exchange rate fluctuations

In order to model volatility, the conventional practice is first to conduct an ARCH LM test to ascertain that the data exhibit some heteroscedastic nature. The results of the tests conducted at lags 1 through 5 are placed in Table A1 below. It is evident that the Nigerian exchange rates exhibit some elements of non-constant variations and therefore is a good candidate for ARCH modeling.

Table A1: Results of ARCH Test for Exchange Rates

Lag	Statistic	Significance
1	11.12038	0.0009
2	12.11038	0.0023
3	12.07783	0.0071
4	12.05835	0.0169
5	11.96990	0.0352

Going forward, the next step is to carry out the actual test. We employed the exponential GARCH, a variant of the ARCH test which is most commonly-used in applications due to its parsimonious nature and its ability to capture leverage effect in addition to modeling heteroscedasticity. Details on estimation and usage of the model can be found in Nelson (1991). The maximum likelihood estimates of the EGARCH parameters were computed using Eviews 8.0. The result of the modeling is summarized in the Figure A1 showing the conditional standard deviation extracted using EGARCH. Clearly, EGARCH modeling confirmed what was earlier observed in the standard deviations contained in Table 4.1 above that exchange rates experienced significant fluctuations post-2015.

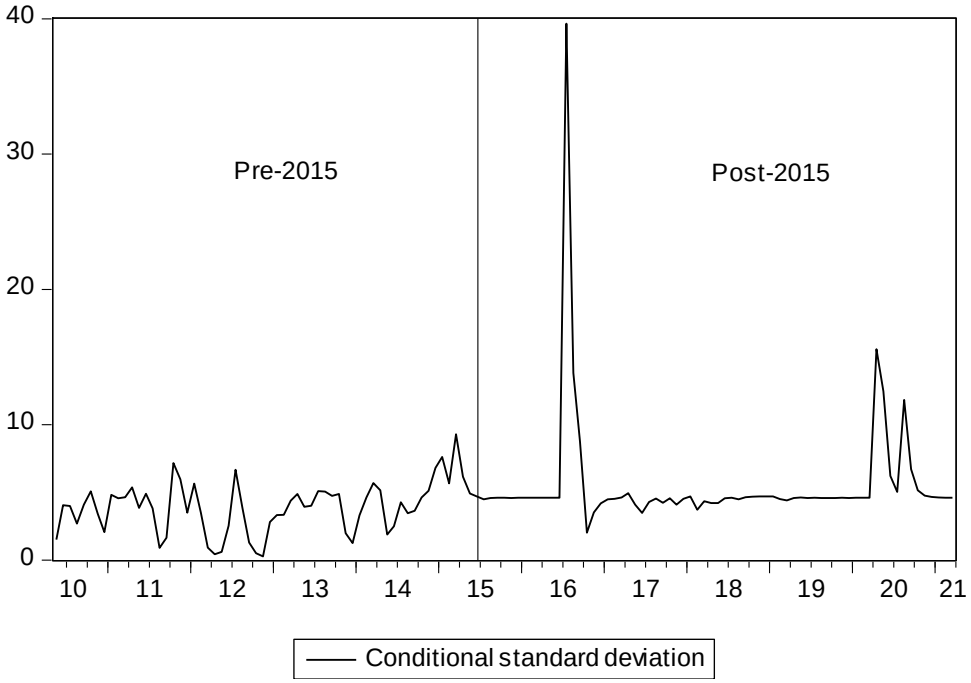

Figure A1: Conditional volatility for exchange rates

Data on conditional standard deviation displayed here were included in MANOVA for further analysis.