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Exchange rate and economic growth nexus: The evidence of quantile regression for Nigeria

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A B S T R A C T

This paper is an attempt to ascertain the nexus between gross domestic product and real effective exchange rate of the Nigerian economy, for the period 2000 and Q2, 2022, using quarterly data observations. Data collected from the Central Bank of Nigeria, which constitutes of real effective exchange rate, real gross domestic product, consumer Price index and credit to private sector were employed for this study. All the variables were stationary after first difference, while the quantile regression analysis revealed that real economic growth has a positive relationship with real effective exchange rate, specifically at 40, 60, 70, 80 and 90 percentiles. Therefore, this study concludes that real economic growth is one of the major drivers of real effective exchange rate in Nigeria. We therefore recommend among others, that government should vigorously pursue free floating of the exchange rate, in other to increase focus on interdependency of the central bank and a greater control of inflation.

1. INTRODUCTION

Nigeria, a mono-cultural economy, has in the past and recent times experienced persistent depreciation of her currency, prompted by both global decline in oil prices and drastic fall in her balance of payments, among other macroeconomic issues. Both the monetary and fiscal sectors of the economy have employed different policies, without end in sight of exchange movements or fluctuations. It is worthy to note that even after the indirect devaluation of the naira and other economic policy measures, Nigeria has not been able to rescue the value of the naira in the past two or more decades. The adoption and implementation of the fluctuating exchange rate policies such as the Second Tier Foreign Exchange Market (SFEM), the Dutch Auction System (DAS), Modified Dutch Auction System (MDAS), Weighted Dutch Auction System (WDAS), and others, did not yield any desired results. This gave rise to Nigeria returning to fixed exchange regime in 2008. Most worrisome, the latest era of the flexible foreign exchange rate regime recently introduced by the Central Bank of Nigeria, have not been able to settle the exchange rate brouhaha in Nigeria. Consequently, the gross domestic product over the years has remained unpredictable and inconsistent, leading to the quest of ascertaining the nexus between exchange rate changes and the economic growth of the economy of Nigeria. Most studies such as Ajao & Igbekoyi (2013), Ngerebo-a & Ibe (2013), and Ubah(205) has investigated exchange rate volatility on economic growth using error correction model and autoregressive distributed lag models in the past years. This study would employed the quantile regression model and increased the scope of study from 2000 to 2022 quarter two, in other to capture the recent developments in exchange rate and economic growth, especially with the global crisis and shocks on the macroeconomic variables.

2. LITERATURE REVIEW

Purchasing power parity, is a hypothesis that claims that when two currencies' purchasing power are equal in both countries, exchange rates between them are in equilibrium. This implies that the ratio of the prices of a constant basket of goods and services in the two countries, should be same as the exchange rate between the two. For a country to revert to PPP when its domestic price level is rising (i.e., when it experiences inflation), its exchange rate must decline. The "law of one price" is the foundation of PPP. Competitive marketplaces will equalize the price of an identical good in two nations when the prices are expressed in the same currency in the absence of transportation and other transaction costs.

3. EMPIRICAL REVIEW

From empirical literature, the relationship between exchange rate and economic growth shows a mixed outcome. While some studies have found a positive relationship (see Sanginabadi & Heidari (2012); Katusiime, Agbola & Shamsuddin (2016); Katusiime et al (2016), others have found negative relationship between exchange rate changes and economic growth (see Alagidede & Ibrahim (2016); Umaru, Niyi & Davis (2018); Barguellil, Ben-Salha & Zamami (2018) and others), other studies have either found an insignificant relationship or otherwise between the two macroeconomic variables. Sanginabadi & Heidari (2012) studied "the effects of exchange rate volatility on economic growth" of Iran, with quarterly data spanning from 1988 to 2007, they employed both GARCH and ARDL approach, to measure volatility and to ascertain the relationship of the variables, respectively. They found that real exchange rate and the Iranian economic growth were significantly related. However, the ARDL long-run result suggested a negative relationship among the variables for Iran. In his study, "the impact of real exchange rate misalignment on economic performance" in the West African Monetary Zone (WAMZ) economies, using quarterly data between 2000 and 2010, Raji (2013) adopted the Generalized Method of Moments of "Dynamic Panel Estimation Method" supported with Cross Country Correlation Approach, and found that the WAMZ have irregular correlations, while the addition of "equilibrium real exchange rate" showed a regular relationship with economic performance.

To ascertain this relationship for Uganda between 1960 and 2011 period, Katusiime, Agbola & Shamsuddin (2016) employed ARDL to determine long-run and short-run nexus of the selected variables of the study, while the GARCH technique was employed to ascertain volatility. The result indicated that exchange rate volatility in Uganda in both the short-run and long-run were positive within the period of the study. This study conducted in 2015 however, employed data ranging from 1960 to 2011, which obviously must have induced its seemingly outcome, as times change with data lapses and activities.

For Basirat, Nasirpour & Jorjorzadeh (2014) who studied "the effect of exchange rate fluctuations on economic growth", employing a panel data (using fixed effects estimate) of 18 countries for the period 1986-2010, the study amongst other findings suggested that the relationships were both positive and negative. This outcome seems inclusive and opines the need for further research. Alagidede & Ibrahim (2016) study with annual data for the period 1980-2013, adopted the GARCH and GMM and found a negative and significant relationship between the two macro variables in Ghana. The low frequency data series for this study may have affected the overall outcome. For Uganda, Katusiime et al (2016) also employed a low frequency annual time series data for the period 1960-2011. Using the GARCH and ARDL models to measure volatility and the nexus of the variables, respectively. They found a positive relationship among the variables in both the short run and significant long run relationship for Uganda. However, this study result must have been influenced by the outdated poor frequency data. Using annual data between 1970 and 2015, Phiri (2018) studied the non-linear relationship of the variables for South Africa. Like Katusiime et al (2016) he used GARCH approach to generate volatility. He also adopted the "Smooth Transition Regression (STR)" model, the study found government spending as the transition variable. He then further estimated the threshold of the transition variable which determines the regime switching behaviour. The study found that above the threshold, the relationship becomes negative but insignificant, while below the threshold, the relationship is vice versa.

Umaru, Niyi & Davis (2018) employed panel data regression analysis for the period 1980-2017 and found "a negative and significant relationship" between the variables in Ghana and Nigeria; and an "insignificant relationship" among the variables for Gambia and Sierra Leone. Barguellil, Ben-Salha & Zamami (2018) found a negative and significant relationship between economic growth and both nominal and real exchange rates. The study used a set of 45 developing and emerging economies including Nigeria, Ghana, Gambia, Sierra Leone, and Senegal for 1985-2015 period. They applied the GARCH model like previous studies for volatility generation and employed both Difference GMM and System GMM models for estimation. Achouak, Ousama & Mourad (2018) in their study using annual data spanning from 1985 to 2015 for 45 countries. Using the GARCH model, the result suggested that both the nominal and real exchange rates changes have negative impact on economic growth. They added that the effect of the changes was more harmful during flexible regime or depends on financial openness and exchange regime of the country. Studying exchange rate regimes and growth in Sri Lankan economy, Thahara, Wasima & Rinosha (2020) amongst other findings from their long-run VECM model, identified a negative correlation of exchange rate and inflation on economic growth for the period 1980 – 2017. In Nigeria, few studies exist by some scholars on this relationship with mixed results, they include, Adelowokan, Adesoye & Balogun (2015); Ubah (2015); Sabnaa, Manyob & Ugochukwu (2017); Iyeti & Utting (2017); Ehikioya (2019), amongst others.

Adelowokan, Adesoye & Balogun (2015) initiated a study ranging from 1986 to 2014, this study looks at Nigeria's investment and growth in relation to exchange rate volatility. The interactions between the variables were captured using the vector error correction approach, impulse response's function, co-integration, and Augmented Dickey Fuller (ADF) test for stationarity. The findings support the presence of an ongoing relationship between growth, inflation, interest rates, and investment as well as between exchange rates. Finally, the findings indicate that, in Nigeria, exchange rate volatility has a positive link with inflation and interest rates while having a negative impact on investment and growth. Ubah (2015) carried some empirical analysis to examine exchange rate volatility and economic growth in Nigeria, applying the Augmented Dickey-Fuller test to determine whether the variables were stationary was the first step in the empirical investigation (ADF). The cointegration test of the model came next. The results of the unit root test demonstrate that all variables were integrated at order 1, or I(1). Variables are co-integrated, according to co-integration analysis. The relationship between exchange rate volatility and economic growth was assessed using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) approach. The result demonstrates that in the Nigerian situation, economic growth is negatively responsive

to exchange rate volatility over the short term, while there is a negative association between the two variables over the long term. The outcome also suggests that Nigeria's economic growth is slowed by foreign direct investment.

Sabnaa, Manyob & Ugochukwu (2017) used the GARCH (1,1) model to estimate the volatility of the naira's exchange rate against the US dollar and discovered persisting volatility in the rate. The Generalized Method of Moments (GMM) was used in the study to estimate the relationship between volatility and economic growth in Nigeria, and the results revealed that both volatility and FDI had a negative and significant impact on the economy of Nigeria. Iyeti & Utting (2017) used Johansen Co-integration estimation techniques to examine the variables' effects in both the short and long runs. All the variables are found to be stationary using the ADF test. The parsimonious model findings indicate that OREV and EXR have a positive relationship with GDP. The result further reveals the existence of two equations at the 5% level in the trace and Max-Eigen statistics. This suggests that in the long run, exchange rate volatility and oil revenue increase GDP. Ehikioya (2019) investigates the impact of exchange rate volatility on the Nigerian economy using time series data from January 1980 to December 2017, with Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model and the system Generalized Method of Moments (GMM) techniques. The Johansen co-integration test was used to establish the link between the study's variables, and the Augmented Dickey-Fuller and Philips-Perron tests were employed to assess whether a unit root existed. The estimations' findings provide proof that exchange rate volatility endures over the course of the study period and significantly and adversely affects Nigeria's economic growth. In summary the results of the review above show mixed outcome, consequently, this study employed the quantile regression model and increased the scope of the study from 2000 to 2022 quarter two, to capture the recent developments in exchange rate and economic growth in Nigeria. Given the global financial and economic crisis, and shocks on macroeconomic variables in almost all nations presently, this study seems a worthwhile venture, as it will contribute both in literature and monetary policy management.

4. MODEL SPECIFICATION

Purchasing power parity is a well-liked macroeconomic study metric to contrast economic productivity and living standards between nations (PPP). This means economic productivity is linked to the exchange rate. Therefore, real gross domestic product is the component of exchange rate, it can then be further estimated as

$$REER = F(RGDP, CPI, TBR, CPS) \quad \ldots \quad (1)$$

Expressing equation (1) in econometric form, we obtain equation (2). Where REER represents Real Effective Exchange Rate, RGDP is Real Gross Domestic Product, CPI is consumer price index, TBR is used to proxy interest rate and cps is used to proxy credit to private sector.

$$REER_t = \varphi_0 + \varphi_1 LRGDP_t + \varphi_2 CIP_t + \varphi_3 TBR_t + \varphi_3 CPS_t \, \xi_t \quad (2)$$

Quality circles also have the reciprocal responsibility of presenting the plan and goals of their activities or work, target achievement charts, time and budget requirements on a periodic or consistent basis, not only to the senior management personnel or the financial personnel but also to all the employees of the organization which instils confidence and solidarity among all. Although uninterrupted supply of resources and support of the management of an organization definitely brings a positive change in quality of work life, the real success of the quality circle process lies in the strict implementation of its findings and leading to a breakthrough in research and development cell of the organization. (Sanjay & O'Shaughnessy, 1998). Some notable dimensions or features of quality circles are premised on the related activities of the circle. These include strategic-based quality circles and functional based quality circles.

4.1 Quantile regression

To calculate the relationship of real effective exchange rate and economic growth in Nigeria, we used the quantile regression model

created by Koenker and Bassett in 1978. With the help of this method, it is possible to consider impacts at various quantiles in the distribution of the dependent variables. In this way, it becomes obvious how the dependent and independent variables relate to one another. This approach enables potential comparisons across the model's range (Peng et al. 2019)

5. PRELIMINARY ANALYSIS

Table 1 below shows the descriptive statistics of exchange rate, gross domestic product, inflation, treasury bank rate and credit to private sector. the mean value of the gross domestic product was the highest with a value of 13499428, followed by credit to private sector with a value of 12842789 and the least mean value was real effective exchange rate, which has a mean value of 86.44. Credit to private sector had the highest maximum value of 39233606, followed by gross domestic product which had a maximum value of 20329062, and the least maximum value is the real effective exchange rate with a value 109.33. Real Gross Domestic Product showed to have the highest median value, which is 14109972 also followed by the Credit to private sector with a value of 10667420. Real effective exchange rate also had the least value of median which is 87.08. This paper would concentrate more on the median since the quantile regression pay more emphasis on the median than the mean.

Table 1. Descriptive statistics

	REER	CPI	RGDP	CPS
Mean	86.44078	151.8933	13499428	12842789
Median	87.08	119.0934	14109972	10667420
Maximum	109.33	455.3541	20329062	39233606
Minimum	63.93	30.0578	6642108	478189.6
Std. Dev.	11.91426	109.027	3838285	10720444
Skewness	0.088083	1.017235	-0.17593	0.522372
Kurtosis	2.063252	3.10194	1.71825	2.200785
Jarque-Bera	3.406991	15.56047	6.625064	6.488382
Probability	0.182046	0.000418	0.036424	0.039
Sum	7779.67	13670.4	1.21E+09	1.16E+09
Sum Sq. Dev.	12633.51	1057934	1.31E+15	1.02E+16
Observations	90	90	90	90

Source: authors computation

The unit root test in table 2, shows that at level, Reer, rgdp, cpi and cps all showed not to be stationary at level because, all the probability value were greater than 0.05. While at first difference they were all stationary at first difference because their probability values were all lower than 0.05.

Table 2. Unit root test

	Level			
	REER	LRGDP	LCPI	LCPS
t-stat	2.89	2.89	2.9	2.89
Prob	0.43	0.64	1	1
	First Difference			
	Reer	rgdp	cpi	cps
t-stat	2.89	2.89	2.9	2.89
Prob	0	0	0	0

Source: authors computation

5.1 Quantile regression analysis

The paper set out to analyze the relationship of exchange rate and economic growth using quantile regression. The results of the quantile regression estimations for the model are depicted in the appendix but Table 3 shows the result of only economic growth and exchange rate. The estimated coefficient of the explanatory variable was based on the 0.15 and 0.95 range for economic growth in Nigeria. The nexus of economic growth and exchange rate is positive in all

quantiles. The positive relationship was significant at 0.4, 0.6, 0.7, 0.8 and 0.9 quantiles. The result implies that economic growth is important for real effective exchange rate. It shows that as more variable of economic growth is accounted for the more positive relationship it has with real effective exchange rate in Nigeria.

Table 3. Quantile regression

	Quantile	Coefficient	Std. Error	t-Statistic	Prob.
LRGDP	0.1	9.947854	8.201931	1.212867	0.2285
	0.2	16.66565	9.63974	1.728848	0.0875
	0.3	14.45693	9.512731	1.519745	0.1323
	0.4	20.82037	9.684094	2.149956	0.0344
	0.5	18.46402	9.391895	1.965952	0.0526
	0.6	29.57273	10.36589	2.852889	0.0054
	0.7	30.72599	11.93317	2.574838	0.0118
	0.8	45.86183	11.60209	3.952893	0.0002
	0.9	46.02295	10.69397	4.303635	0

Source: authors computation

6. IMPLICATIONS OF THE STUDY

Based on our findings, by implication real economic growth do not impact negatively and significantly on exchange rate movements in Nigeria in the short run. However, as the quantile increases, real economic growth is shown to significantly increase the real effective exchange rate movements in Nigeria. Therefore, to minimize exchange rate fluctuations or movements in Nigeria, real economic growth must be expanded among other variables, and must be properly aligned or shaped. The outcome of this study agrees with Chipili (2012) which among other findings, revealed that monetary factors had greater outcome than the real factors in mitigating exchange rate volatility or movements in Zambia. Our study is also in partial agreement with Ngerebo-a & Ibe (2013) who confirmed a long-run equilibrium relationship for exchange rate and gross domestic product, external debt, balance of payment, this could be related to the increase in relationship at 0.95 percentage quantile. This study also partially agrees with Ajao & Igbekoyi (2013) who employed the GARCH (1,1) and the ECM techniques for the period 1981- 2008 and found that a long-run relationship exists between some selected variables, and exchange rate volatility. But their study identified interest rate and lagged exchange rates as core drivers for the period of their study. Further, our finding depicts a novel for Nigeria as it deviates from the earlier studies, having employed the real exchange rate as the dependent variable, using the quantile regression methodology and increasing the sample period from 2000Q1 to 2022Q2.

Specifically, we identified that, real economic growth negatively and significantly affects the movements of exchange rate and is considered one of the major variables to mitigate exchange rate movement in Nigeria.

7. CONCLUSION AND RECOMMENDATION

This study concludes that real economic growth is very important variable that affects real exchange rate movements in Nigeria. This is because real economic growth affects the exchange rate significantly because of the increasing quantile it has on the median of exchange rate. In view of the findings, the following recommendations are made:

• Since exchange rate stability exhibits a positive nexus with economic growth, the fiscal and monetary authorities may consider adopting and implementing free-floating exchange rate policy to enable the currency flow easily without any management, this would allow the monetary authority to be able to concentrate more on independence of the central bank and managing of inflation.

• Increase in export could be a way of enhancing the exchange rate and this could be done by floating the exchange rate more and this would in turn attract investors and thereby boost the external reserve and current account balance.

• Since economic growth is increasing real effective exchange rate which is bad. The fiscal authorities should make sure consumption is reduced to minimum level, in other to enhance export in the current account, and thereby sustaining the exchange rate.

Disclaimer: views expressed in this paper are solely the authors' not the CBN.

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