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Macroeconomic Aggregates and Exchange Rate in Nigeria

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Abstract

The effect of currency rates on Nigerian macroeconomic aggregates is examined in this study. Using annual time series data from 1990 to 2022, the study investigates potential direct and indirect relationships between GDP growth and real exchange rates. Two methods are used to derive the relationship: a vector-autoregressive model and a simultaneous equations model inside a fully described (but constrained) macroeconomic model. The estimation results demonstrate that there isn't any proof of a significant correlation between GDP growth and exchange rate fluctuations. As an alternative, Nigeria's economic growth has been directly impacted by monetary and fiscal policy as well as other economic factors, most notably the expansion of oil exports. These elements tend to maintain an overvaluation trend of the real exchange rate, which has proven detrimental to growth. The analysis concludes that while currency rate management needs to be improved, it is insufficient to boost Nigeria's economy. It is necessary to implement a comprehensive program of economic reform, which should include a complementing tight monetary policy. Overall, the findings provide useful information.

Keywords:
Exchange rate, Macro-economy, Simultaneous equations, Nigeria

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Background to the Study

The price of one currency represented in terms of another is known as the exchange rate. It is an essential macroeconomic metric that is used to assess an economy's overall health. It continues to be a crucial pricing variable in all economies, fulfilling the dual functions of upholding global competitiveness and acting as a nominal anchor for domestic prices, Mordi (2006). There are two main conventions used to define the exchange rate: the direct technique and the indirect way. The price of home currency expressed in terms of one unit of foreign currency is the exchange rate, according to the direct convention, whereas the price of foreign money expressed as one unit of native currency under the indirect convention. The relationship between macroeconomic performance in emerging nations and exchange rate management has drawn a lot of discussion and attention (Umoru et al. 2024). The degree to which the exchange rate fluctuates in response to both internal and external shocks is the main topic of discussion. There seems to be agreement that depreciation or devaluation could increase local production by energizing the net export component. This is demonstrated by the rise in local industries' global competitiveness, which causes consumers to shift their spending from expensive foreign items to affordable home goods. Guitan (1976) and Dornbusch (1988) provide examples of how currency depreciation can effectively promote trade balance, but it also depends on the domestic economy's ability to fulfill the increased demand by producing more items and reorienting demand in the right direction and amount. Overall, changes in exchange rates are probably going to have an impact on economic performance. Therefore, it is essential to assess how exchange rate changes affect price inflation and output growth.

Because structural changes like cutting imports or increasing non-oil exports inevitably imply a decline of the nominal exchange rate, exchange rate policies in developing nations are frequently delicate and contentious (Umoru et al. 2024). These domestic changes are seen as detrimental to the economy because of their immediate effects on demand and prices. Paradoxically, developing countries that rely on imports for both production and consumption rarely discuss the distortions that arise from an overvalued exchange rate regime (Umoru et al. 2023a). From the early post-independence era, when Nigeria maintained a fixed parity with the British pound, through the oil boom of the 1970s, to the 1986 floating of the currency in the wake of the economies near collapse between 1982 and 1985, Nigeria's exchange rate policy has seen significant changes. The political and economic factors that shaped exchange rate policy during each of these eras had a significant impact on real income, inflation, the balance of payments, and the structural development of the economy Umoru et al. 2023b)

A few econometric studies on the determination of exchange rates and changes in Nigerian output movements have been attempted; these include Egwaikhde (1994), Odusola and Akinlo (2001), and Ekpo (2003). Nevertheless, a lot of these older investigations relied on a single equation regression methodology. This study differs from earlier ones conducted in Nigeria in that it uses a simultaneous equation modeling approach and its structural form, in which changes in production are caused by a number of basic disruptions, including monetary, interest rate, income, and official and parallel

exchange rates. Four sections comprise the remaining portion of the paper. The relevant literature is reviewed in Section 2. Section 3 discusses Nigeria's exchange rate policies. Section 4 presents the empirical model and estimation, while Section 5 wraps up and summarizes the work.

Theoretical Literature

The optimal currency area (OCA) hypothesis, which was created by Mundell (1961) and McKinnon (1963), is the oldest and most prominent theoretical basis for the selection of exchange rate regimes. The trade and business cycle stability are the main topics of this literature. Its foundations are the ideas of labor market mobility, openness level, and shock symmetry. Nevertheless, the OCA theory is unable to provide a clear recommendation for the ideal exchange rate regime because the relationships between the nominal exchange rate regime and macroeconomic performance both reinforce and offset one another. By eliminating exchange rate uncertainty and, consequently, the cost of hedging, a fixed exchange rate regime, for instance, can boost trade and production growth. It can also stimulate investment by lowering the currency premium from interest rates. On the other side, by halting, postponing, or slowing the required relative price adjustment process, it can also lower trade and output growth.

Subsequent ideas concentrated on the stabilization of financial markets and speculative financial behavior, especially in emerging nations. The theory states that by preventing competitive depreciation, fostering the growth of financial markets, and offering a nominal anchor and the frequently required credibility for monetary policy, a fixed regime can boost trade and output growth (Frankel, 2003). However, the theory also contends that a set regime frequently results in speculative attacks and can postpone the required relative price changes. Thus, according to Calvo and Reinhart (2002), many developing and emerging economies have a "fear of floating." However, their fixed regimes also frequently end in crashes when there is a "sudden stop" of foreign investment (Calvo, 2003), and capital flight ensues, as was the case in the crises in East Asia, Latin America, and some sub-Saharan African nations.

Not surprisingly, there is little theoretical consensus on this question of regime choice and subsequent economic growth in the development economics literature as well. While the role of a nominal anchor is often emphasized, factors ranging from market depth (or the lack of it), political economy, institutions and so on often lead to inclusive suggestions as to which exchange rate regime is appropriate for a developing country (Frankel et al (2001), Montiel (2003), Montiel and Ostry (1991)) The literature in development economics acknowledges the importance of the effects of the level of development to the relationship between regime and growth (see Berg et al (2002), Borensztein and Lee (2002), Frankel (1999), Lin (2001), McKinnon and Schnabl (2003), and Mussa et al (2000) among others).

Empirical Literature

Using a regression approach, Morley (1992) examined the impact of real exchange rates on output for twenty-eight devaluation events in developing nations. He noted that after

controls were put in place for variables including terms of trade, import growth, the money supply, and the fiscal balance that may simultaneously cause devaluation and lower output, the output decreased as the real exchange rate declined. For Mexico, Rogers and Wang (1995) found comparable outcomes. The majority of changes in Mexican output in a five-variable VAR model (output, government spending, inflation, the real exchange rate, and money growth) were caused by "own" shocks. Nonetheless, they pointed out that a decrease in output was caused by exchange rate depreciations.

Copelman and Wermer (1996) used the same methodology but slightly different variables and found that positive shocks to the rate of exchange rate depreciation greatly limited the availability of credit, which had an adverse effect on output. Remarkably, they discovered that shocks to the real exchange rate had no impact on output, suggesting that the contractionary consequences of devaluation are more closely linked to the nominal exchange rate's pace of change than to the real exchange rate's rate of change. Additionally, they discovered that "own" shocks to real credit had no impact on output, suggesting that depreciation had an adverse effect on output via processes other than a decrease in credit availability.

In an effort to break down the fluctuations in Peruvian output, Rodriguez and Diaz (1995) calculated a six-variable VAR, which included output growth, real wage growth, inflation, monetary growth, exchange rate depreciation, and the Solow residuals. They found that while "own" shocks accounted for the majority of output growth, rising exchange rate depreciation also had a negative impact. In an effort to explain the variation in inflation in Kenya, Ndung'u (1993) calculated a six-variable VAR, which included the money supply, domestic price level, exchange rate index, foreign price index, real output, and interest rate. He noted that the exchange rate and inflation rate mutually explained one another. In the study's expanded form, a similar finding was also made (Ndung'u 1997).

Gidigbi, Babarinde and Lawan (2018) examined the impact of currency rate volatility pass-through on price inflation in Nigeria. The study employed 30 years of annualized data for its estimation since it adjusted and generated data for additional variables from the sourced data, using annualized time series data from 1981 to 2015. Utilizing the Vector Error Correction Model (VECM), the relationship between the specified key variables was estimated. All of the model's variables were significant in Granger producing inflation over the long term, according to VECM estimate. At the one percent significance level, the long-term ECM shows a correction of deviance in a single period, which is statistically significant. The study did not find any correlation in the short term between the volatility of currency rates and inflation, imports, government spending, foreign direct investment, or trade openness. In the short term, however, there was a positive correlation between inflation and the money supply. Variance decomposition clearly demonstrates that factors other than exchange rate volatility that are significant contributors to changes in inflation were incorporated in the model. The study advises Nigerian federal government organizations, particularly the Federal Ministry of Finance

(FMF) and the Central Bank of Nigeria (CBN), to keep long-term inflation targeting a component of their monetary policy framework. In order to control inflation, the CBN should begin focusing on trade openness and foreign direct investment. The paper refutes the widespread belief that short-term inflation was justified by exchange rate volatility.

Akpan and Atan (2010) looks into how changes in currency rates affect Nigeria's real output growth. The research investigates the potential direct and indirect association between exchange rates and GDP growth using quarterly series covering the years 1986 to 2010. Two methods were used to derive the relationship: one uses a simultaneous equations model inside a tiny but fully described macroeconomic model. It was investigated to use the Generalized Method of Moments (GMM) approach. According to the estimation results, there wasn't much proof that shifts in the exchange rate and increases in output were strongly correlated. Rather, monetary factors have a direct impact on Nigeria's economic growth. These elements tend to maintain a real exchange rate structure that has not been helpful for expansion. The analysis concludes that while currency rate management needs to be improved, it is insufficient to boost Nigeria's economy. In order to support the chosen exchange rate policy, a comprehensive program of economic reform is needed.

Odusola and Akinola's paper (2001) focused on Nigeria's output, inflation, and exchange rate. By using a structural VAR model, the estimations' evidence showed that there are conflicting findings about the effects of production depreciation on exchange rates. It was discovered that inflation had significant destabilizing effects on output, indicating that monetary authorities should be crucial in creating an atmosphere that supports growth. The authors concluded that significant factors influencing changes in the official foreign exchange rate included prices, the parallel exchange rate, and loan rates.

Another study by Mireille (2007) contends that a significant obstacle to Nigeria's and the Benin Republic's recovery has been the overvaluation of currency rates. Furthermore, the author argues that devaluation combined with targeted policies and an increase in the local price of tradable commodities could boost economic performance and restore exchange rate equilibrium. Aliyu et al. (2009) looked at exchange rate pass-through in Nigeria from 1986 to 2007 in a related study. The estimation procedure uses a vector Error Correction Model estimate and a quarterly dataset. In part contradicting the conventional wisdom in the literature that exchange rate pass-through is always significantly higher in developing countries than developed countries, the authors found that exchange rate pass-through in Nigeria during the period under consideration was low and declined along the price chain. The authors concluded that pass through would probably rise over time and that monetary policy has to be adjusted to account for the impact.

Nigeria's Exchange Rate Policies

Selecting a suitable exchange rate and guaranteeing its stability are the goals of an exchange rate policy. Many strategies and choices have been applied over the years to

acquire efficiency in the foreign exchange market in an attempt to accomplish these goals. Nigeria's exchange rate arrangements have changed throughout time, moving from a fixed system in the 1960s to a pegged system in the 1970s to the mid-1980s, and then, starting in 1986, with the deregulation and implementation of the structural adjustment program (SAP), to various forms of a floating regime. Since the SAP, Nigeria's floating exchange rate system has mostly consisted of a managed system with no clear commitment to maintaining any particular parity. The Dutch Auction System (DAS) was reintroduced on July 22, 2002, in response to the variations of the flexible exchange rate mechanism—the AFEM, which was adopted in 1995, and the IFEM, which was introduced in 1999—failing to guarantee exchange rate stability. The DAS was intended to accomplish three goals: lower the premium on the parallel market, protect the diminishing external reserves, and bring the naira's exchange rate closer to reality. The DAS reduced the widening premium, minimized authorized dealers' speculative inclinations, preserved external reserves, and stabilized the value of the naira. Since 2003, the foreign exchange market has remained comparatively stable until recently when volatility set in again.

According to Mordi (2006), the following factors made it easier for the DAS to be reintroduced in 2002: the external reserve position, which allowed the CBN to guarantee adequate market funding; a decrease in inflationary pressures; the CBN's instrument autonomy and its quick deployment of monetary control instruments in support of the DAS; and the bi-weekly auctions, which replaced the previous fortnightly auctions and ensured a steady supply of foreign exchange. On February 20, 2006, the CBN launched the Wholesale Dutch Auction System (WDAS) with the goals of achieving convergence, further liberalizing the market, and reducing the arbitrage premium between the official inter-bank and bureau de change parts of the markets. In order to develop a fair exchange rate for the naira, this was intended to deepen the foreign currency market and consolidate the gains of the retail Dutch Auction System. The authorized dealers were allowed to deal in foreign exchange on their own accounts under this system, with the intention of selling it to their customers.

Empirical Model and Estimation

Nigeria is regarded as a small, open emerging economy for the purposes of the analysis, subject to changes in global markets. The impact of the money supply, inflation, and exchange rate on the real output growth of the manufacturing sector is examined using a simultaneous equations model. A basic structural model of the Nigerian economy is estimated based on the country's economic structure in order to capture the interconnections. This model contains formulas for the inflation rate, real income growth, exchange rate fluctuations, and changes in government revenue. The nominal exchange rate is defined as the nominal exchange rate modified by the ratio of the foreign price level (US CPI, as a proxy for the price of tradables) and the domestic price level (Nigerian CPI, as a proxy for the price of non-tradables) in order to get at the real exchange rate. The purchasing power parity requirement is met by this definition.

Model

The study model is based on Khan and Knight's (1991) structural macroeconomic model. It contains every fundamental component of the International Monetary Fund's financial programming system. The addition of imports and the currency rate as open economy variables improves the original Khan-Knight model. Determining the relationship between growth and exchange rate while accounting for other significant influences on both variables is the fundamental principle.

These are shown in the appropriate order.

The Formula for Inflation:

The specification considers the monetarist viewpoint and states that real production, predicted inflation, money supply, and exchange rate are all functionally related to inflation, so that;

$$LnINF_t = \beta_0 + \beta_1 InMs_t + \beta_2 LnYr + \beta_3 inf_{t-1} + \beta_4 ex_t + \varepsilon_t \quad 1$$

Where *ex* is the exchange rate, ε is the error term, *Yr* is real output as measured by real GDP, *inft-1* is a proxy for projected inflation, and *inf* represents the inflation rate.

Equation of Income

Real GDP is expressed in the income equation as a function of fiscal and monetary factors in such a way that;

$$LnYr_t = \partial_0 + \partial_1 InMs_t + \partial_2 LnInex + \partial_3 Inex_{t-1} + \partial_4 Ininf_t + \partial_5 Inyr_{t-1} + \varepsilon_t \quad 2$$

The variables are as previously specified.

Equation of Exchange Rate

The relationship between fiscal and monetary variables and the exchange rate is modeled as follows:

$$LnEx_t = \alpha_0 + \alpha_1 LnYr_t + \alpha_2 Lninf_t + \alpha_3 Lnex_{t-1} + \alpha_4 LnIMs_t + \varepsilon_t \quad 3$$

Where all other variables are as previously defined, and IM stands for imports.

Equation of Government Revenue

In theory, fluctuations in exchange rates might affect certain components of revenue and spending as well as the overall level of prices. A decline in the value of the currency, for example, results in higher interest rates and capital repayments on external debt, which rises total government spending. Thus, the relationship that follows is derived.

$$LnGOR_t = \gamma_0 + \gamma_1 LnYr_t + \gamma_2 LnGRR + \gamma_3 LnGOR_{t-1} + \varepsilon_t \quad 4$$

GRR stands for government retained revenue, and GOR is for actual total government revenue.

Estimation

Two-stage least squares (2SLS) were used to estimate the system. In order to reduce the issue of simultaneous equation bias, this strategy is investigated. The series underwent unit root tests (Augmented Dickey-Fuller and Sargan Bhargava Durbin-Watson tests) to establish stationarity prior to the estimation. The majority of the series were differenced before being utilized in the estimation because they were not stationary at levels. The presence of a long-term link between the dependent and independent variables was then determined using a co-integration analysis. The error correction technique came after that. According to the integration process's results, there would be a better fit with an error correction specification than there would be without one. The calculated behavioral equations' findings are shown below:

INF t = -0.074 + 0.426Mst -1.976 Yr + 0.167 inft-1 + 0.040ext - 0.2817ECMt-1
(2.073) (2.645) (3.672) (1.952) (2.436) (2.31) R2 = 0.54

Yrt = -0.074 + 0.298Mst - 0.150ext + 0.342ex t-1 – 0.214inft + 0.345Yr t-1- 0.125ECMt-1
(1.354) (1.243) (1.145) (1.257) (2.349) (3.421) (2.130) R2 = 0.62

Ext = -1.107 + 0.652Yrt + 0.452inft + 0.674ext-1 0.165Imst + 1.135ECMt-1
(0.942) (1.240) (2.34) (2.654) (2.18) (1.970) R2 = 0.61

GORt = 0.012 - 0.813Yrt + 0.765GER + 0.326GORt-1 – 0.134ECMt-1
(2.260) (2.967) (5.980) (6.625) (0.716) R2 = (0. 48)

Equation 1 (the inflation equation) serves as the starting point for the results' interpretation. According to the results above, real output (as a supply variable), the expansion of the money supply, inflation expectations, and exchange rates have been the main drivers of inflation. In fact, the lagged exchange rate coefficient is quite substantial, suggesting that inflation is driven higher by exchange rate depreciation. The ECM coefficient shows that there is 0.3 feedback between money supply and inflation.

It's important to notice that, despite the calculated coefficient not being statistically significant, income growth and the real exchange rate were adversely correlated according to the income equation. This deviates from what is typically anticipated, which is a reduction in growth accompanied with real exchange depreciation. The aforementioned result is replicated in equation 3. One argument is that the exchange rate has been under pressure due to slower income growth. However, it's important to remember that the real exchange rate, imports, and income growth all have the right signs on their corresponding coefficients according to the exchange rate equation. Thus, the real exchange rate and real income growth have a negative direct relationship within the framework of the model.

Equation 4 reports the outcome of the government revenue equation. The outcome demonstrates that government revenue plays a major role in setting government spending and that it also reacts strongly to economic growth as measured by real GDP.

With a 0.76 elasticity of government spending, it is relatively high. Wagner's law of growing state activities, which states that government spending tends to increase as the economy grows, provides a reasonable explanation. The findings are generally instructive. While some outcomes support theoretical predictions, others do not. Nonetheless, the model is quite dynamic and well-liked due to the usage of lags, natural logarithms, and error correction mechanisms.

Co-Integration Test Results

The results of the simultaneous equations that were previously shown give some idea of the direct and indirect relationships between changes in the exchange rate and growth. They articulated the short-term dynamics of the link between real income growth and real exchange rates. Whether the two variables are related over the long term is not addressed by these findings or the paper's main conclusions. A Johansen cointegration test based on the VAR model of the real income and real exchange rate is used to address this problem. Since these two variables have no direct theoretical relationship, the VAR model's structure must be interpreted as a statistical relationship. The best VAR structure appears to have one lag for each variable, according to estimates of VAR models of real exchange rate and real income with varying numbers of lags (from 1-4) and comparing the value of the Akaike Information Criterion (AIC) statistics:

$$Yr_t = \varphi_1\theta_{11}Yr_{t-1} + \theta_{12}ex_{t-1} + \mu_1$$
$$ex_t = \varphi_1\theta_{21}Yr_{t-1} + \theta_{22}ex_{t-1} + \mu_2$$

Then cointegration is tested using the Johansen method for the VAR model with one lag. In this instance, the likelihood ratio test indicates no cointegration. His outcome agrees with the previous research. There is no discernible relationship between real income and real exchange rates. The long-term association between the variables is, at most, mediocre. These outcomes agree with previous research. There is no statistical relationship between the real income and the real exchange rate. The two variables have, at most, a modest long-run association.

Conclusion and Recommendations

The economic relationships between Nigeria's exchange rate, inflation, government revenue, and income growth have been empirically estimated by this study. A system of equations that represented the relationships between the variables mentioned above was used to achieve the goal. Cointegration and a two-stage least squares estimation method was used in the estimate strategy. The estimation's findings show that there isn't a direct correlation between inflation and exchange rates that is statistically significant. Nonetheless, there are a number of indirect connections between both, including those involving money and output. The outcome of the vector auto regression indicates that there is no significant cointegration between real income and real exchange rate. The income and exchange rate may not diverge over time, but their relationship is shaky and indirect in the near term. All of these findings support the notion that there isn't much data pointing to a significant correlation between GDP growth and exchange rate

fluctuations. As opposed to this, Nigeria's economic growth has been directly impacted by monetary and fiscal variables, especially the rise in government spending and revenue. Growth has not been favored by the real exchange rate overvaluation pattern that these factors have tended to maintain. The analysis concludes that while currency rate management needs to be improved, it is insufficient to boost Nigeria's economy. Economic reform on a large scale is necessary. In addition to other things, this should involve implementing a tight monetary policy to support the chosen exchange rate strategy.

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