EXCHANGE RATE DYNAMICS AND REGIMES IN NIGERIA: NEW EVIDENCE FROM A MODIFIED STICKY PRICE MODEL

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Abstract

The study utilized a modified sticky price model to examine Naira-to-Dollar exchange rate movements. Monthly data from 1986 to 2022, which smoothed out the effect of the fixed regime, was estimated using the dynamic ordinary least square (DOLS) method. The results of the extended sticky price model suggested significant positive relationships between exchange rates and variables such as oil prices, reserves, fiscal factors, and manufacturing output, while negative relationships were observed with interest rate differentials and money supply differentials. Given the positive relationship between foreign reserves, oil prices, and the Naira exchange rate, efforts should be made to build foreign reserves during periods of high oil prices. The government should sustain the Sovereign Wealth Fund (SWF) and allocate a portion of oil revenues directly to foreign reserves when oil prices exceed the specified budgetary benchmark. This will help provide a buffer against external shocks and as a means for sterilization

Keywords: Central Bank Policies, Exchange Rate Management, sterilization.

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1.0 Introduction

The achievement of relative exchange rate stability has become a significant challenge for the Nigerian monetary authority (Falana, 2019). Since 1974, the Central Bank of Nigeria (CBN) has employed various strategies to manage the Naira, adapting to changes in the economy, pegging the Naira initially to maintain positive trade balance and control inflation. However, global economic challenges, particularly the oil price shocks of the 1970s and 1980s, rendered this system unsustainable (Ajibola, Udoette, Muhammad, and Anigwe, 2020). These fiscal strains compelled the CBN to adopt a more flexible regime, leading to the introduction of the Second-Tier Foreign Exchange Market (SFEM) in 1986. This transition was part of the Structural Adjustment Program (SAP), designed to liberalize Nigeria's economy and allow the Naira to be market driven (Obadan, 2007). Despite the market liberalization, managing the exchange rate remained a challenge for the CBN as volatility persisted, particularly due to global oil price fluctuations and the dynamic and complex economic climate of Nigeria. The monetary authority currently operates a managed float system where market forces largely determine the exchange rate, but with systematic intervention. However, ensuring relative stability with market flexibility has proven difficult especially with the presence of a parallel market, speculative trading, and declining foreign reserves.

The CBN's dilemma is further complicated by the varying effectiveness of monetary and fiscal policies under different exchange rate regimes. Under a fixed regime, monetary policy is less effective due to capital movements that counteract the policy's intended effects, particularly in the face of declining foreign reserves. In contrast, under a flexible regime, fiscal policy becomes less effective, while monetary policy gains more traction (Ajibola *et al.,* 2020). Moreover, the inherent volatility of exchange rates under a floating system often necessitates the adoption of complementary monetary policy strategies, such as money supply control and inflation targeting, each of which introduces its own set of challenges. The complexity of this situation is heightened by Nigeria's increasing debt, much of which is denominated in foreign currencies, particularly the U.S. dollar. A depreciation in the Naira exacerbates the burden of debt repayment, amplifying the risks associated with a flexible exchange rate regime.

The volatility risk was further compounded by the introduction of the Bureau de Change (BDC), in 1989, to facilitate foreign exchange transactions at the retail level. The creation of dual exchange rate markets and the introduction of BDCs in 1989 created a multiplicity of problems. Furthermore, future challenges are likely to be posed by the absence of a standardized Naira rate, coupled with the lack of stringent legislation to discourage defaulting Bureau de Change operators. Therefore, the key issue for the Central Bank of Nigeria (CBN) is not merely the choice between various exchange rate regimes (ERR) or monetary policy options. Given the wealth of economic and empirical literature available, the focus should instead be on understanding and mitigating the underlying factors contributing to exchange rate volatility. The complexity of Nigeria's economy, which is deeply interconnected with that of the United States through bilateral trade and other economic linkages, further complicates exchange rate management. Shifts in both the Nigerian and U.S. economies such as changes in foreign money supplies, output gaps, expected interest rates, price levels, crude oil prices, manufacturing output, government expenditures, and reserves amplify the challenges. The CBN seems to navigate domestic monetary and fiscal dynamics without a close watch on international economic shifts, risk and uncertainties, particularly those affecting the United state which may have a significant impact on Nigeria's exchange rate.

To this end, the objective of this paper is to examine exchange rate dynamics in Nigeria using a modified sticky price model, while also analyzing the policies and regimes implemented by the Central Bank of Nigeria (CBN) and the behavior of key performance variables during the periods. The study is organized into five sections. Section one introduces the study. The subsequent sections are structured as follows: Section two reviews the relevant literature; section three outlines the methodology used to achieve the study's objectives; section four presents the empirical analysis and interprets the results; and section five concludes with a summary and final conclusions.

2.0 Literature Review

2.1: Conceptual Literature

Exchange rate management (ERM) remains central to monetary authorities and crucial to governments all over the world. ERM entails the use of appropriate foreign exchange regimes and policies to influence the exchange rate to maintain the external value of the domestic currency, achieve a positive balance of payments, and guarantee price stability (CBN 2022).

Exchange rate regimes can be broadly classified into three categories. The first is the free-floating regime, where the exchange rate is determined entirely by market forces with no government or central bank intervention. The second is the fixed regime, where the exchange rate is anchored at a specific value, and authorities intervene to keep it steady. Lastly, there are mixed or fixed parity regimes, which offer limited flexibility, allowing the exchange rate to fluctuate within a controlled range while still being subject to intervention when needed. A regime is considered a "peg" if the exchange rate has fluctuated by no more than 2% above or below its set value over a two-year period. Pegs can be further divided into soft pegs, which include systems like the crawling peg, crawling bands, or target zones, and hard pegs, which encompass currency boards, dollarization, or monetary unions. However, regime is categorized as non-peg when the exchange rate variation surpasses the interval of oscillation of 2% above or below the original value (Terra, 2015). The IMF classifies exchange rate regimes into eight categories and this classification is adjusted based on available information on various countries' exchange rates and monetary policies/ intentions. Over the years, the CBN has experimented with both market-based and fixed exchange rate regimes (Umoru, 2013).

Exchange rate regimes play a crucial role in shaping exchange rate dynamics. Understanding these dynamics is essential for policymakers, investors, and businesses engaged in international trade and finance. The variability in the value of one currency relative to another over a certain period may be high, low, rapid and unpredictable. A market-based regime that allows exchange rates to float freely may result in high volatility, presenting both opportunities and risks. Exchange rate volatility may provide opportunities for traders and investors to profit from currency speculation and arbitrage. Investors and traders might profit from currency speculation, but the accompanying unpredictability can create uncertainty for businesses, increasing transaction costs and complicating long-term investment decisions. On the other hand, a fixed regime may promote more stability, though it often requires significant reserves and policy interventions to maintain the peg.

are the domestic and foreign interest rates, $y_t \text{ and } y_t^f$ are the domestic and foreign national output levels, E_t represents the exchange rate at time t" (Bilson, 1978). The model operates under the assumption that Purchasing Power Parity (PPP) holds in the long term. The relationship between price levels and exchange rates is governed by the Purchasing Power Parity identity. It further assumes perfect mobility of capital, enabling asset-holders to promptly adjust their portfolios, resulting in instantaneous clearance of the money market.

The Sticky Price Model [SPM]

The Sticky Price Model [SPM] is a modification of the Monetarist Flex-Price Model [MFPM]. It incorporates differences in secular rates of inflation into the Monetarist Flex-Price Mode. According to Frankel (1979) "when a contractionary domestic monetary policy raises the nominal rate differential over its equilibrium level, an incipient capital influx causes the currency to decline proportionally from that level. The exchange rate then exceeds its equilibrium level by an amount equivalent to the real interest rate differential (nominal interest rate differential minus anticipated inflation differential)". Therefore, according to the sticky-price assumption, if there's a decrease in the domestic money supply compared to the demand for money (without a corresponding decrease in prices), it results in a rise in the domestic interest rate compared to the international rate. These higher rates incentivize capital inflows, leading to appreciation of the domestic currency. In contrast to the flexible-price model, this version posits a negative correlation between the exchange rate and the nominal interest rate differential. The Sticky Price Model [SPM] is stated as:

$$E_t = \beta_0 + \beta_1(M_t - M_t^f) + \beta_2(y_t - y_t^f) + \beta_3(\pi_{t+1}^e - \pi_{t+1}^{ef}) + \beta_4(P_t - P_t^f) + \mu_t \qquad (2)$$

Where $P_t \text{ and } P_t^f \text{ are}$ the domestic and foreign price levels and other are as previously defined. Theoretical expectations for the sticky price Dornbusch model are β_1, $\beta_4 > 0$, and β_2 $\beta_3 < 0$.

2.2.2. The portfolio balance model

The portfolio balance model of exchange rate is an extension of the monetary approach. The portfolio balance approach is based on the idea that investors hold a diversified portfolio of assets (money, local and foreign bonds) and they continuously adjust their portfolios to maintain an optimal balance between risk and return (Bilson, 1978). The adjustment process in the portfolio influences the exchange rates via demand changes for assets. The main difference between the monetary approach and the portfolio balance model is that the monetary model holds that domestic assets and foreign assets are perfect substitutes for each other whereas the portfolio balance model does not see domestic assets and foreign assets as perfect substitutes (Adenekan, Sanni, and Itodo, 2019). The portfolio balance model (PBM) is specified as

$$E_t = \beta_0 + \beta_1(M_t - M_t^f) + \beta_2(y_t - y_t^f) + \beta_3(\pi_{t+1}^e - \pi_{t+1}^{ef}) + \beta_4(P_t - P_t^f) + \beta_5(\int CCA) + \beta_6(\int CCA^f) + \mu_t, \qquad (4)$$

Where $\int CCA$ and $\int CCA^f$ represent the cumulative current accounts of the two countries, and the assumption to be tested is that $\alpha_1, \alpha_4, \alpha_5 > 0$ and $\alpha_2, \alpha_3, \alpha_6 < 0$ (Castillo, 2002).

2.2: Theoretical Review:

Traditional Models of Exchange Rate

Traditional models of exchange rate determination according to Wong, Khan, and Nsoul (2002) focused on three types of explanatory variables (focused on inflation, interest rate and balance of payments) and corresponding theories: inflation (Purchasing-Power-Parity Hypothesis). The PPP Hypothesis suggests that, in the long-term domestic inflation can influence the exchange rate. The theory states that the exchange rate of a currency of a particular country can be explained in terms of the purchasing power of the domestic currency. PPP postulates that an increase in the general price level in the domestic economy will lead to the depreciation of the domestic currency and vice versa. If domestic prices rise relative to those in foreign countries, it will incentivize imports over exports. This import increase will drive up the demand for dollars compared to the naira in the foreign exchange market. Gustav Cassel introduced PPP as a method for adjusting exchange rates or parities for countries aiming to re-establish the gold standard post-World War I (Lafrance and Schembri, 2002). However, the introduction of managed and flexible exchange rates in the early 1970s brought about increased capital mobility, which in turn increased exchange rate volatility and sparked a renewed interest in the economics of exchange rates. The advances brought about the monetary models, Portfolio Balance Theory (PBT), Chartist and other speculative models of exchange rate determination.

2.2.1: The monetary approach

According to Castillo (2002), "monetary approach to exchange rates consists of two very different types of models that have distinct implications for the relationship between the exchange rate and the interest rate. The flexible-price model suggests a positive link between exchange rates and interest rate differentials, assuming that changes in interest rates reflect expected inflation. An increase in the domestic interest rate relative to the foreign rate signals expected currency depreciation due to inflation. In contrast, the sticky-price model posits an inverse relationship, where short-term price rigidity means interest rate changes reflect shifts in monetary policy. A rise in domestic rates attracts capital inflows, strengthening the currency.

The Monetarist Flex-Price Model [MFPM].

The monetary approach held that changes in the supply and demand of national currencies drive exchange rates and assumed perfect substitutability of assets on an international level. According to this school of thought, the home currency's exchange rate depreciates When the domestic money supply rises, the currency tends to depreciate, while a reduction in the money supply or an increase in domestic demand for money leads to appreciation. (Krugman, Obstfeld and Melitz, 2018). The MFPM relaxes the PPP assumption and the UIP assumption (Bilson, 1978). Econometrically Monetarist Flex-Price Model [MFPM], can be stated as follows:

$$E_t = \beta_0 + \beta_1(M_t - M_t^f) + \beta_2(y_t - y_t^f) + \beta_3(\pi_{t+1} - \pi_{t+1}^{ef}) + \mu_t \quad (1)$$

β_1, β_3 > 0 and β_2 < 0,

From Equation one, " M_t and M_t^f represent the domestic and foreign money supplies, π_{t+1} and π_{t+1}^{ef}

2.3 Empirical Literature

Insah and Chiaraah (2013) took a cursory look at the origins of real exchange rate instability in Ghana. Employing annual data spanning from 1980 to 2012, the ARDL results indicated that government expenditure positively correlates with exchange rate volatility, while money supply, domestic debt, and external debt had a negative association.

Chang and Su (2014) examined the dynamic relationships between exchange rates and macroeconomic fundamentals in Pacific Rim countries, building on prior studies that largely overlooked structural breaks in these relationships. The study aimed to uncover both long-run and short-run dynamics as well as the direction of causality among exchange rates and fundamentals, guided by theoretical frameworks such as asset-pricing models, purchasing power parity (PPP), and uncovered interest rate parity (UIP). Utilizing quarterly macroeconomic data from 11 Pacific Rim countries, the authors employed the unit root tests alongside the Vector Error Correction Model (VECM), cointegration tests, Granger causality analysis and a bootstrap rolling window approach to analyze time-varying causality. Key variables included exchange rates, money supply, real output, and interest rates. The findings indicated limited long-run equilibrium among the countries, with structural breaks influencing exchange rate adjustments, while causality varied—showing uni-directional relationships for Canada, Japan, and Thailand, and bi-directional for South Korea and the U.S. The strength of the study lies in its robust treatment of structural breaks; however, it limitations include restricted generalizability due to the focused country selection and potential unaccounted external factors affecting the exchange rate-fundamentals nexus

Azeez, Kolapo, and Ajayi (2014) investigated the impact of exchange rate volatility on Nigeria's macroeconomic performance between 1986 and 2010. Their analysis focused on key variables such as inflation rate, Exchange Rate (EXR), Balance of Payment (BOP), and Oil Revenue (OREV). They utilized Ordinary Least Squares (OLS) and Johansen cointegration techniques for their estimations. The findings revealed that rising exchange rates negatively affect inflation. The model indicated that, over the long term, increased exchange rate volatility contributes to higher inflation rates. The authors recommended that monetary authorities implement strategies aimed at controlling inflation and stabilizing currency exchange rates.

Cevik, Harris, and Yilmaz (2015): Using the GMM method on a panel of 115 countries from 1996 to 2011, the authors examined soft power and exchange rate volatility. Their findings showed persistent exchange rate volatility, especially in emerging markets. Additionally, the study identified that "soft power" indicators significantly influenced exchange rate volatility across different nations.

Oaikhenan and Aigheyisi (2015) investigated the factors explaining exchange rate volatility in Nigeria. The EGARCH model was applied to a data set covering the period from 1970 to 2013. They identified government expenditures, interest rate movements, and lagged exchange rates as the main contributors to exchange rate volatility.

Hassan, Abubakar, and Dantama (2017) using quarterly data from 1989 to 2015, this study applied the ARDL model to assess the determinants of exchange rate volatility in Nigeria. The findings showed that net foreign assets and interest rates had a significant positive impact on exchange rate volatility, while GDP was insignificant and negatively related to it. Fiscal balance, economic openness, and oil prices were found to be positive but statistically insignificant.

Adusei and Gyapong (2017) used the Partial Least Squares Structural Equation Modeling approach to investigate the impact of macroeconomic variables on exchange rate volatility in Ghana from 1975 to 2014. The results highlighted the significant roles of inflation, monetary policy rate, current account balance, money supply, GDP growth, and external debt in predicting exchange rate movements.

Alagidede and Ibrahim (2017) examined the impact of exchange rate volatility on economic growth in Ghana, using data from 1980 to 2013 and employing the Vector Error Correction Model (VECM). The findings indicated that government expenditure, money supply growth, terms of trade, FDI, and domestic output were key long-term determinants.

Cheung, Chinn and Pascual (2018) evaluated the predictive capabilities of various nominal exchange rate models, expanding on previous research that focused on a limited set of models. The study explored how these models perform against a random walk benchmark and across different forecasting horizons, using theoretical frameworks like Behavioral equilibrium exchange rate (BEER) models, purchasing power parity (PPP), Taylor rule fundamentals and Sticky price monetary model augmented by risk and liquidity factors. Quarterly data from 1973 to 2014 were employed and estimated using error correction and first-difference specifications. The model performance was assessed using metrics such as mean squared error and direction of change. Finding revealed that some structural models outperform the random walk 29% of the time, though forecast elasticity often deviates from unity, indicating mixed performance. The strength of the study lies in its systematic approach and comprehensive data analysis, while weaknesses stem from not testing for ARCH effects, inconsistent model performance and challenges in conclusively determining exchange rate predictability.

Sean, Pastpipatkul, and Boonyakunakorn (2019) investigated the relationship between money supply, inflation rate, and foreign exchange rate in Cambodia using monthly data from October 2009 to April 2018. The Bayesian Vector Autoregressive Model revealed that an increase in money supply had a positive impact on both the foreign exchange rate and inflation.

Eze and Markjackson (2020) analyzed the relationship between price levels and the foreign exchange rate in Nigeria using data from 1990 to 2018. Applying the error correction method to test the purchasing power parity theory, the results indicated that the foreign exchange rate had a positive but statistically insignificant impact on inflation in Nigeria. The study concluded that continuous rises in the exchange rate tend to increase the general price level.

David (2022) assessed the impact of exchange rate volatility on economic growth in Nigeria, building on existing literature that examined macroeconomic variables over extended periods. The study aimed to determine the long- and short-run effects of exchange rate fluctuations from 1981 to 2020, utilizing theoretical frameworks such as the Traditional Flow Model and Purchasing Power Parity (PPP) theory. It employed secondary timeseries data sourced from the World Bank and the Central Bank of Nigeria, focusing on five key variables: Growth Rate of Gross Domestic Product (GRGDP), Exchange Rate Volatility (EXRV), Balance of Trade (BOT), Oil Price (OILP), and Inflation Rate (INF). The analysis utilized unit root tests and ARDL bound tests for cointegration, alongside GARCH modeling for volatility measurement. Findings indicated that exchange rate volatility significantly negatively affects economic growth, with inflation also exerting a detrimental impact, while oil prices positively influenced growth. The study's strength lies in its rigorous methodological approach and extensive data analysis; however, weaknesses include a lack of exploration into the mechanisms underlying these relationships.

2.4 Gap in the literature

The existing models and approaches have not sufficiently explained the behavior of exchange rates in Nigeria especially the effect of fiscal factors n exchange rate and the impacts of Nigeria-United States differentials. Most importantly, the studies did not conduct a stylized fact on the Exchange Rate Regimes in comparison with the behavior of macroeconomic variables. Also, some studies used real exchange rates rather than nominal exchange rates to test for volatility, and others (Alagidede and Ibrahim, 2017) failed to smooth out the effect of the years or months of fixed exchange rate regime from the data used. Including data from both fixed and flexible regimes can introduce distortions that undermine the validity of the analysis. In a fixed regime, exchange rates are artificially pegged, often controlled by monetary authorities to maintain stability, which suppresses the natural market-driven forces of supply and demand. On the other hand, flexible regimes allow the currency value to fluctuate freely, driven by market conditions like inflation and interest rates. Also, some studies like Cheung, Chinn and Pascual (2018) did not test for ARCH effect and proceeded with inappropriate econometric techniques, while others used Annual data to test for volatility other than daily, weekly and monthly which can show the presence of volatility clustering or the existence of ARCH effects. This research addresses these limitations by modifying the Sticky Price Model to incorporate fiscal factors and other key determinants of exchange rates following that of Cheung, Chinn and Pascual (2018).

3.0 Methodology

To examine the exchange rate dynamics in Nigeria, the ex-post facto research design was adopted for the study considering the fact that this research relies on timeseries historical data. The core SPM variables on monthly data from the Nigeria and United States economies were utilized along with key determinants of exchange rate without neglecting the impact of fiscal factors on the Naira. Specifically, data from 1974 to 2022 was utilized in Table 2 to analyze the regimes and policies of the CBN, while time series data covering the period 1986 to 2022 was used to estimate the model. Data for the United States was utilized given the USD's status as the global reserve currency coupled with the fact that the USD is a benchmark currency for international transactions and a major trading partner with profound influence on exchange rates and macroeconomic variables in Nigeria. The data were sourced from the publications of the Central Bank of Nigeria, World Bank Commodity Price Data and WDI (2023).

3.1: Model specifications

This study adapts the Sticky Price Model following the specification of Bilson (1978). The SPM is stated as:

$$E_t = \beta_0 + \beta_1(M_t - M_t^f) + \beta_2(y_t - y_t^f) + \beta_3(R_{t+1}^e - R_{t+1}^{ef}) + \beta_4(P_t - P_t^f) + \mu_t \qquad 3.1$$

Where E_t represents the exchange rate at time t, $M_t \text{ and } M_t^f$ represent the domestic and foreign money supplies, $y_t \text{ and } y_t^f$ are the domestic and foreign national output levels, $R_{t+1} \text{ and } R_{t+1}^{ef}$ are the home and foreign exchange rate, Where $P_t \text{ and } P_t^f \text{ are}$ the expected inflation rates for the domestic and the foreign country.

Consequently, since the sticky price model is a pure monetary model and the exchange rate is **endogenized** in the model, key determinants of exchange rate and fiscal factor are incorporated into model considering the peculiarities of the Nigerian economy following a similar approach by Cheung, Chinn and Pascual (2018) who added VIX risk factor and the three-month Treasury-Libor (TED) spread to augment the standard SPM model. Thus model 3.1 is augmented and presented as equation 3.2:

$$EXR_t = \beta_0 + \beta_1(MS_t - MS_t^f) + \beta_2(y_t - y_t^f) + \beta_3(R_{t+1}^e - R_{t+1}^{ef}) + \beta_4(P_t - P_t^f) + \beta_5 Oilp + \beta_6 Mout + \beta_7 FIS + \beta_8 RES + \mu_t \quad (3.2)$$

EXR denotes nominal exchange rate, MS_t and MS_t^f represent the domestic and foreign money supplies, Oilp denotes crude oil price, MOUT denotes manufactures exports (% of merchandise exports) (MOUT), FIS denotes government expenditure inclusive of FAAC and RES denotes growth in total reserves (includes gold, current US$). The assumption to be tested is that are β_1, β_4, $\beta_5, \beta_8 > 0$, and β_2, β_3, $\beta_6, \beta_7 < 0$.

The volatility attached to the exchange rate is therefore estimated from the nominal exchange rate through the conditional variance. The model is given as follows:

$$EXR_t = \alpha_0 + EXR_{t-1} + \mu_t \quad (3.3)$$

$$h_t^2 = \alpha_0 + \alpha_1 \mu_{t-1}^2 + \alpha_2 \mu_{t-2}^2 + \alpha_3 \mu_{t-3}^2 + \cdots + \alpha_q \mu_{t-p}^2 + \mu_t$$

EXR_t represents the nominal exchange rate, EXR_{t-1} represents the previous nominal exchange rate, μ_t represents the error term, h_t^2 represents the conditional variance of u at time t. The significance of the parameter α_1 indicates the presence of conditional volatility (ARCH effects). Under the null hypothesis of no ARCH effect $\alpha_1 = \alpha_2 = \alpha_3 = \cdots = \alpha_q = 0$

While the alternative hypothesis: $\alpha_1 \neq 0$

3.3: Nature and Sources of Data

Data used for this study are time series data covering the period 1986 to 2022. Also, the months of fixed re-gimes were smoothed (excluded) to capture the dynamics. The data on GDP growth (annual %), Broad money growth (annual %), Inflation, consumer prices (annual %), and Real interest rate (%) were obtained for the United States and Nigeria economies. A similar measurement was used for both countries and the data were adjusted statistically to monthly frequency accordingly using quadratic interpolation to avoid bias, as large gaps between data points may obscure important long and short-term dynamics. Crude oil price, manufactures exports (% of merchandise exports) (MOUT), nominal exchange rate (EXR), growth in total reserves (includes gold, current US$) and Government expenditure inclusive of revenue from Federation Accounts Allocation Committee [FAAC] (FIS), were obtained from the World Bank development index (2023) CBN statistical bulletin (2023) and EIA (2023).

Table 1: Presentation of Variable Measurements and Sources

Variable	Measurement	Acronym	Source(s)
GDP differentials	GDP growth (annual %)/ Output gap between the domestic country and its foreign counterpart	$Y_t - Y_t^f$	WDI (2023).
Money Supply differentials	Broad money growth (annual %) of domestic and foreign counterpart	$M_t - M_t^f$	WDI (2023).
inflation differentials	Consumer prices (annual %) of domestic and foreign counterpart	$P_t - P_t^f$	WDI (2023).
interest rate differential	Real interest rate (%) domestic and foreign counterpart	$R_t - R_t^f$	WDI (2023).
Fiscal factor	Government expenditure	**fis**	CBN (2023)
oil price	Crude oil price	**oilp**	EIA (2023).
Reserve	Gowth in total reserves (includes gold, current US$),	**Res**	WDI (2023).
Manufacturing output	Manufactures exports (% of merchandise exports)	**Mout**	WDI (2023).
Exchange rate	**Nominal exchange rate**	**EXR**	**CBN (2023)**

Source: Author's Compilation (2024).

3.4: Dynamic Ordinary Least Squares (DOLS) procedure

The study employed the Dynamic Ordinary Least Squares (DOLS) techniques to examine exchange rate dynamics and economic performance variables in Nigeria. The Dynamic Ordinary Least Squares (DOLS) techniques is widely used for estimating long-run relationships between variables in the presence of cointegration. By including lags and leads of the differenced explanatory variables, DOLS corrects for potential endogeneity and serial correlation (Stock and Watson, 1993). In this study, DOLS was employed after the unit root tests revealed that variables were integrated at both levels and first differences, and cointegration was confirmed via the Hansen Parameter Instability test. With no evidence of volatility from the ARCH LM test and no multicollinearity, DOLS provides efficient and unbiased estimates.

[1]Revenue from the Federation Accounts Allocation Committee (FAAC) refers to the monthly distribution of centrally collected funds, such as oil revenues and taxes, to Nigeria's federal, state, and local governments for financing public expenditure.

4.0 Data, Analysis and Discussion

Table 2: Exchange Rate Regimes/ Practices/Policies in Nigeria.

S/N	Exchange Rate Regime	Period	Average Exchange Rate	Average % chg in Reserve	Avg Real Interest Rate	Average GDPGR
1	Nigerian Pound	1960-1973	N/A	N/A	N/A	N/A
2	Fixed Peg to either GBP or USD	1974 -1976	0.6241	269.536	-15.501	4.992
3	Fixed exchange rate regime	1976-1986	0.7116	-8.497	-8.364	3.280
4	Dual Exchange System (SFEM)	Sept.,1986	2.0206	-25.981	-5.805	3.101
5	Retail Dutch Auction System (RDAS)	April, 1987	4.016	10.958	-4.770	3.200
6	Enlarged FEM	July 2,1987	4.2723	10.958	-4.770	3.200
7	AFEM	1988	4.5369	-37.711	-2.963	7.334
8	Interbank FX market (IFEM)	Jan., 1989	7.3647	118.767	-6.612	1.919
9	Bureau de Change/Dealers	1989	7.3647	118.767	-6.612	1.919
10	Re-introduction of DAS	1990	8.0382	102.285	17.466	11.777
11	Float	1992	17.2984	-74.433	-14.987	4.631
12	Administratively Pegged	1993	21.99	37.155	-7.052	-2.035
13	Fixed	1994	21.996	0.532	-15.920	-1.815
14	AFEM Re-introduced/Fixed	1995	21.996	3.635	-31.453	-0.073
15	AFEM/Fixed Abolished	1998	84.4	-6.203	11.485	2.581
16	IFEM Re-introduced	0ct 20 1999	92.3381	-22.591	6.047	0.584
17	IFEM/ Travellers'Cheques	FEB, 2002	120.5781	-28.927	3.024	15.329
18	RDAS/ BTA and PTA Restriction	2002-2005	120.5781	41.927	2.190	9.591
19	Wholesale Dutch Auction System (WDAS)	2006-2009	142.6098	24.073	5.366	6.778
20	RDAS/Card Limits & BDC	2013-2015	157.3116	-13.289	12.051	5.211
21	Dutch Action	Feb, 2015	168	-17.276	13.596	2.653
22	Pegged System	2015- 2016	197	-10.346	10.141	0.518
23	Managed Float (M.F)/FMDQ intro-duced	2016	351.82	-3.417	6.686	-1.617
24	M.F/ (I&E) window	2017-2022	305.5	5.613	3.981	1.674

Source: Author's Computation from CBN (2023) and WDI (2023)

To effectively manage the exchange rate, it is pertinent to x-ray the exchange rate regimes viz-a-viz key macroeconomic variables. Nigeria has employed majorly fixed and managed float exchange rate regimes at various points. A fixed exchange rate regime was used between (1973-1986, 1994 to 1998, 2015 to 2016). Table 1 shows a sufficiently large average change in reserve between 1974 and 1976 when the Naira was pegged to both the USD and GBP. The GDP growth rate was 4.992, however, the average real interest rate was -15% which may be attributed to the high rate of inflation during the period. A fixed exchange rate was adopted during this period to stabilize the currency. The deregulation of September 1986, the adoption of mixed regimes, the creation of dual exchange rate markets and the introduction of BDCs in 1989 led to significant depreciation.

lowing the transition to civilian rule in 1999, Nigeria continued to operate under returned to the managed float exchange rate regime. Between 1999 to 2002, the central bank intervened in the foreign exchange market to manage the value of the Naira against major currencies. The measures did not have a significant impact as Table 1 shows a negative average reserve and a sporadic depreciation of the Naira from 17 to 92 Naira within the period. The Naira continued the free fall from 92 to 120 Naira in 2002, due to insufficient external reserves as shown by the negative average reserve in 1998, 1999 and 2002 respective-

However, there were periods of increased volatility and pressure on the currency due to various economic factors. Between 2013 and 2015, the depreciation of the Naira was attributed to the US Fed's tapering, the decline in oil prices, the lack of fiscal buffers and the depletion of foreign exchange reserves as shown in the negative average percentage change of -13.2%. The fixed regime was temporarily adopted between 2015 and 2016 and the rate was pegged at 197. However, from 2016 to 2022, the managed float has been in use. The continuous decline of the currency can thus be attributed to policy inconsistency

Table 3: Descriptive Statistics

	EXR	$M_t - M_t^f$	$Y_t - Y_t^f$	RES	$R_t - R_t^f$	$P_t - P_t^f$	OILP	MOUT	FIS
MEAN	92.042	19.082	2.637	0.159	0.013	14.510	47.834	2.484	0.269
MEDIAN	95.655	14.935	2.955	0.054	2.109	10.844	43.670	2.068	0.204
MAXIMUM	209.552	76.048	13.633	1.327	15.588	54.214	128.080	10.748	1.135
MINIMUM	2.600	-7.422	-4.787	-0.744	-18.871	1.966	8.570	-2.360	-0.260
STD. DEV.	61.199	19.889	4.169	0.465	7.975	13.883	30.675	3.113	0.310
SKEWNESS	0.188	1.077	0.555	0.846	-0.360	1.907	0.514	0.662	1.367
KURTOSIS	2.244	3.936	3.315	3.420	2.614	5.283	2.034	2.924	4.773
JARQUE-BERA	10.474	80.861	19.496	44.543	9.797	289.746	29.159	25.802	155.799
PROBABILITY	0.005	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000
OBSERVATIONS	352	352	352	352	352	352	352	352	352

Source: Author's computation (202)

From Table 3: The mean exchange rate (EXR) value is 92.04. The standard deviation is 61.19 and it measures the variability of the data points around the mean. The exchange rate showed a high standard deviation. Money supply differentials, inflation differentials, and oil prices also suggests a high variability indicating that changes in these factors, influences exchange rate movements.

Unit Root Test

The unit root test result in Table 4 indicates that money supply differentials ($M_t - M_t^f$), inflation differentials ($P_t - P_t^f$), Fiscal factor (fis), oil price (oilp), Reserve (Res) and Manufactures exports (% of merchandise exports) (Mout) are stationary at levels while GDP differentials ($Y_t - Y_t^f$), interest rate differential ($R_t - R_t^f$), and exchange rate (EXR) are stationary at first difference.

Table 4: ADF unit root test

Variables	ADF Stat	Critical Values			P Value	Remarks
		1%	5%	10%		
EXR	-19.13905	-3.984496	-3.422716	-3.134249	0.0000	I(1)
$M_t - M_t^f$	-3.521996	-3.984420	-3.422679	-3.134227	0.0000	I(0)
$Y_t - Y_t^f$	-18.64369	-3.984496	-3.422716	-3.134249	0.0000	I(1)
$R_t - R_t^f$	-8.445311	-3.985361	-3.423136	-3.134497	0.0000	I(1)
$P_t - P_t^f$	-3.713790	-3.984420	-3.422679	-3.134227	0.0226	I(0)
Oilp	-3.641015	-3.984420	-3.422679	-3.134227	0.0226	I(0)
Mout	-3.559461	-3.984420	-3.422679	-3.134227	0.0226	I(0)
FIS	-3.925815	-3.984420	-3.422679	-3.134227	0.0226	I(0)
RES	-3.839144	-3.984420	-3.422679	-3.134227	0.0226	I(0)

Source: Author's computation (2024)

Cointegration Test

Since the DOLS is used to obtain long-run estimates when the variables in a model are cointegrated, the Hansen parameter stability and cointegration test was conducted. The test result with Lc statistic value (0.004193) and p-value (0.2) greater than 0.05 provide evidence to support the idea that the series included in the analysis are cointegrated, implying they share a stable long-term relationship.

Table 5: Cointegration Test - Hansen Parameter Instability

	Stochastic	Deterministic	Excluded	
Lc statistic	Trends (m)	Trends (k)	Trends (p2)	Prob.*
0.004193	8	0	0	> 0.2

Source: Author's computation (2024).

LM ARCH Test for Volatility

To use the ARCH or GARCH model it is imperative to check the presence of volatility in time series data. Volatility is said to occur when the values of the variable change rapidly from time to time in an unpredictable manner. The result of Table 6 revealed the absence of ARCH effects in the monthly EXR as the LM test p-value was greater than 0.5% and volatility clustering was not evident in the data

Table 6: LM ARCH Test for Volatility

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.787523	0.938494	0.839135	0.4014
EXR(-1)	0.996212	0.005570	178.8561	0.0000
	Variance Equation			
C	14.33967	6.896627	2.079230	0.0376
RESID(-1)^2	0.079506	0.071858	1.106435	0.2685
GARCH(-1)	0.518951	0.235471	2.203881	0.0275
ARCH LM : Obs*R-squared		0.021486 Prob. Chi-Square(1)	0.8835	

Source: Author's computation (2024).

Multicollinearity which makes parameters become inefficient, rendering the coefficient values and signs unreliable was tested. Given the absence of very strong or exact correlations among the variables in Table 6, the analysis suggests that multicollinearity is not a concern, confirming the reliability of the model.

Table 7: Correlation matrix of variables

	EXR	$M_t - M_t^f$	$Y_t - Y_t^f$	RES	$R_t - R_t^f$	$P_t - P_t^f$	OILP	MOUT	FIS
EXR	1								
$M_t - M_t^f$	-0.553	1							
$Y_t - Y_t^f$	-0.070	0.021	1						
RES	-0.087	0.028	-0.044	1					
$R_t - R_t^f$	0.433	-0.396	0.458	-0.118	1				
$P_t - P_t^f$	-0.436	0.233	-0.297	-0.049	-0.572	1			
OILP	0.535	-0.247	0.173	-0.130	0.476	-0.409	1		
MOUT	0.713	-0.581	0.168	-0.348	0.463	-0.378	0.561	1	
FIS	-0.182	0.217	-0.414	0.006	-0.184	0.365	-0.307	-0.336	1

Source: Author's computation (2024).

Regression Result: Dynamic Least Squares (DOLS)

DOLS is used to provide more robust and accurate estimates when dealing with long-run relationships between variables that are cointegrated. Sensitivity analysis was conducted using various lead and lag structures to assess the robustness of the DOLS results. Ultimately, the model of Table 8 was selected based on the Schwarz Information Criterion (SIC) which proved to be the most suitable, as it exhibited lower standard errors and statistically significant coefficients, as well as variables with sigs that are relatively consistent with theoretical expectations.

TABLE 8: Dynamic Least Squares (DOLS), Dependent Variable: EXR

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$M_t - M_t^f$	-0.701416	0.301378	-2.327363	0.0208
$Y_t - Y_t^f$	-0.901356	1.328456	-0.678499	0.4981
$R_t - R_t^f$	-2.869479	1.217459	-2.356941	0.0192
$P_t - P_t^f$	-2.836863	0.582125	-4.873291	0.0000
RES	33.36926	11.67886	2.857236	0.0047
OILP	0.318360	0.162953	1.953687	0.0519
MOUT	16.04136	2.138801	7.500162	0.0000
FIS	76.13438	26.11491	2.915360	0.0039
C	65.30576	18.55659	3.519276	0.0005
R-squared	0.893918	**Mean dependent var**		88.96168
Adjusted R-squared	0.846971	**S.D. dependent var**		59.25572
S.E. of regression	23.18018	**Sum squared resid**		126270.4
Long-run variance	2513.663			

Source: Author's computation (2024).

The estimated Dynamic Least Squares result indicates that GDP differential ($Y_t - Y_t^f$) is insignificant and negatively related to the exchange rate. The negative sign conforms to the SPM a-priori expectation. This aligns with the empirical evidence suggesting that countries with negative economic output tend to experience currency depreciation due to decreased demand for their goods and services and low consumer and investor confidence. The result indicates that GDP growth is not a key determinant of exchange rate movements in Nigeria.

The coefficient interest rate differential ($R_t - R_t^f$) was negatively signed contrary to the Sticky price postulation. This finding is consistent with the interest rate parity theory, which suggests that differences in interest rates between countries can influence exchange rate movements. The coefficient of money supply differentials ($M_t - M_t^f$). is negatively related to exchange rate contrary to the a-priori expectation. The result however conforms with that of Insah and Chiaraah (2013). This suggests that an increase in money supply differentials may lead to a depreciation of the exchange rate. The coefficient of inflation differentials ($P_t - P_t^f$). was negative contrary to the sticky price postulation. The negative coefficient indicates that higher domestic inflation relative to foreign inflation leads to a decrease in the exchange rate. This aligns with the purchasing power parity theory, which suggests that changes in relative price levels between countries can affect exchange rates. The coefficient of Manufactures exports (% of merchandise exports) is positively signed in line with the a-priori expectation. This suggests that a strong manufacturing sector can contribute to currency appreciation by boosting exports and attracting foreign investment.

The coefficient of reserve is positively signed suggesting that an increase in reserves leads to an appreiation in the exchange rate. This finding is consistent with the idea that higher reserves can instil confidence in the domestic currency and lead to currency appreciation. The coefficient of Fiscal Factor (FIS) is positively signed. It suggests that positive fiscal factors, such as increased government expenditure, lead to an increase in the exchange. This finding is consistent with that of Insah and Chiaraah (2013) and it highlights the importance of fiscal policy in influencing exchange rate dynamics in developing economies.

5.0: Conclusion and Recommendation

A firm understanding of exchange rate dynamics is vital to the monetary authority as it helps create clear policy direction and appropriate monetary measures in the effective management of the country's exchange rate. The study examined the exchange rate regimes and policies used in the management of the Naira; it also examined the dynamics of the exchange rate using the sticky price model. Findings from the exchange rate regimes and policies utilized since 1974 indicated that the Naira continued to have a free fall despite the regimes adopted partly due to a decline in the average percentage change in reserve over the periods.

The result shows that oil price, reserve, fiscal variable (FIS) and Manufactures exports had a significant positive impact on the exchange rate. EXR shows $M_t - M_t^f$, inflation differentials ($P_t - P_t^f$), and interest rate differentials ($R_t - R_t^f$), were inversely related to exchange rate in Nigeria. Output (GDP growth rate). GDP differential ($Y_t - Y_t^f$) was shown to be insignificant in the model.

Based on the outcome of the study the following recommendations are suggested.

Given the positive relationship between foreign reserves, oil prices, and the Naira exchange rate, efforts should be made to build foreign reserves during periods of high oil prices. The government should sustain the Sovereign Wealth Fund (SWF) and allocate a portion of oil revenues directly to foreign reserves when oil prices exceed the specified budgetary benchmark. This will help provide a buffer against external shocks.

Given the positive relationship between manufacturing exports and the Naira exchange rate, efforts should be made to enhance the manufacturing sector's export capacity. The government should implement supportive industrial policies, including incentives for manufacturers, to boost production and competitiveness in international markets.

Since interest rate differentials had a negative impact on exchange rates, policymakers should consider measures to align domestic interest rates with those of developed markets. This could involve adopting monetary policies that ensure interest rate parity, thereby reducing exchange rate volatility.

Given the negative relationship between money supply differentials and exchange rates, efforts should be made to manage growth in money supply effectively. Central banks need to implement prudent monetary policies to curb increased money creation which can lead to currency depreciation.

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