IMPACT OF CHANGES IN BALANCE OF PAYMENT FACTORS ON EXCHANGE RATE VOLATILITY IN NIGERIA: FURTHER EVIDENCE FROM GARCH-IN-MEAN MODEL

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ABSTRACT

This study employs the GARCH-in-Mean model to determine the impact of balance of payments factors on exchange rates volatility in Nigeria. Specifically, we examine the extent to which changes in trade balance, FDI, FPI, external debt, remittances and current account balance affect the volatility of the Dollar/Naira exchange rate using weekly time series data from 2010 to 2024. We find that exchange rate return is persistent but not affected by risk-premia effect. Also, our findings show that changes in balance of payment factors significantly affect exchange rate volatility. However, while changes in trade balance, FDI, external debt, and current account balance increase exchange rate volatility, changes in FPI and remittances reduce exchange rate volatility. These findings have significant policy implications for effective management of exchange rate volatility towards macroeconomic stability in Nigeria.

KEYWORDS: Exchange rate volatility, balance of payments, GARCH-in-Mean Model.

1 INTRODUCTION

Economies, both developed and emerging, witness various levels of volatility in their foreign exchange market. Volatility leads to uncertainty in the market and makes achievement of fundamental macroeconomic and monetary policy goals more problematic. Fluctuating exchange rates correlate with erratic movements in relative prices within the economy. Scholarly literature has explained that achieving the optimal exchange rate or preserving relative stability is crucial for maintaining both internal and external balances (Oghenebrume, 2018).

Poor management of the exchange rate triggers distortions in production and consumption behaviors. Extreme swings in exchange rates bring about uncertainty and risks for economic participants, resulting in destabilizing outcomes for the macroeconomic outlook. Exchange rate variances have impact on investment portfolios, which may lead to capital gains or losses.

Balance of payment (BOP) shows a country's comprehensive monetary and trading activities with other countries over a designated period. A BOP deficit/surplus is seen to have a considerable influence on supply and demand mechanisms for a currency, thus affecting its exchange rate. For example, a deficit may precipitate currency depreciation, rendering imports costlier and exports more affordable, with the objective of rectifying the existing imbalance. Conversely, a surplus may result in currency appreciation (Juhro et al., 2022). The exchange rate and the BOP position are connected within a cycle of inter-country financial and trade adjustments.

Exchange rates respond to vulnerabilities in diverse macroeconomic fundamentals rather than a single source of risk. BOP components—such as current account balances (CAB), international capital flows, foreign reserves, and foreign debt obligations—constitute systematic fundamentals capable of affecting value of currency. According to the arbitrage pricing theory (APT) of Stephen Ross (1976), macroeconomic factors such as unexpected variations in these BOP components generate risk adjustments and introduce volatility into financial assets such as exchange rate. Thus, when exchange rate is modeled as a function of multi-macroeconomic dynamics, Arbitrage pricing theory gives a rigorous theoretical basis for handling BOP outcomes as basic determinant of exchange rate dynamic (Chen et al., 1986).

Experiences associated with Nigeria's exchange rate dynamics has been marked by recurrent volatility, largely driven by exchange rate management practices and increased exposure to external shocks. Supply and demand shifts for foreign exchange—driven by uncertainties in the global economic space and local structural weaknesses—have accelerated exchange rate risk (Ezeokoye*et al.,* 2025). Rather than being reduced through robust market-consistent structures, these risks have often been deepened by policy distortions. Although volatility in exchange rate may generate benefits in the short-term, such as improved export competitiveness or accelerated trading to hedge against future losses, such outcomes reflect speculative responses to risk rather than efficiency in risk pricing. In the absence of a well-functioning foreign exchange market, volatility becomes a sign of mispriced risk and not a mechanism for efficient adjustment.

This study investigates how BOP components, as a set of macroeconomic fundamentals, affect the volatility in the Nigerian foreign exchange market from 2010 to 2024 using the GARCH-in-Mean model. The guiding principle in this work is the understanding that the researcher's quest is not towards how the balance of payment determines exchange rates but how the changes and movements provide risk factors that investors take into consideration in their return expectations in the market.

The remainder of the study has four sections. The next section contains literature review, which is followed by the methodology and empirical results sections. The study is concluded in section 5.

2 Literature Review

2.1 Theoretical Foundation

Arbitrage Pricing Theory (APT), propounded by Ross (1976) is built on earlier foundations laid by Harry Markowitz's Modern Portfolio Theory in 1952, which introduced the decomposition of risk into systematic and unsystematic components and that investors select portfolios based on expected return–variance efficiency. APT clearly links economic factors to asset price dynamics through multi-risk factors. Like other financial assets, exchange rates respond to vulnerabilities in diverse macroeconomic fundamentals rather than a single source of risk. BOP components such as current account balances (CAB), international capital flows, foreign reserves, and foreign debt obligations constitute systematic fundamentals capable of affecting value of currency. Under APT, unexpected variations in these BOP factors generate risk adjustments and introduce volatility into exchange rate. Thus, APT gives a rigorous theoretical basis for handling BOP outcomes as basic determinant of exchange rate dynamic (Chen, et al., 1986).

2.2 Empirical Review

Lotfalipour and Bazargan (2014) examined the relationship between exchange rate volatility and trade balance in Iran, employing the GARCH approach alongside a balanced panel data model covering the period from 1993 to 2011. The study concluded that the real effective exchange rate did not exert a significant influence on the trade balance; conversely, the trade balance was found to significantly affect exchange rate volatility.

Mpofu (2016) examined the determinants of exchange rate volatility in South Africa. This study utilised monthly time series data spanning from 1986 to 2013, with the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) technique employed for data

analysis. The findings revealed that transitioning to a floating exchange rate regime had a markedly positive effect on the volatility of the rand. Furthermore, the results indicated that trade openness significantly mitigated rand volatility, albeit only in the context of bilateral exchange rates, while the opposite was observed when considering multilateral exchange rates. The study established that the volatility of output, commodity prices, money supply, and foreign reserves significantly influenced the volatility of the South African Rand (ZAR).

Alagidede and Ibrahim (2016) studied determinants of exchange rate volatility in the context of Ghana. The analysis employed time series data spanning from 1980 to 2013, utilizing the GARCH (1,1) model as its methodological framework. The findings of the research indicated that variables such as government expenditure, the growth rate of money supply, terms of trade, and output shocks serve as significant determinants of exchange rate volatility.

Nwanne and Eze (2018) explored the dynamics between external public debt servicing and receipts and fluctuations in the exchange rate in Nigeria from 1981 to 2013. The variables incorporated in the analysis included external public debt receipts, external public debt servicing, and the exchange rate. The theoretical frameworks employed in the study encompassed the monetary model of exchange rate determination and the monetary approach to international capital movements. The methodologies employed to achieve the specified objectives included OLS multiple regression and co-integration tests, which facilitated the assessment of both short-run and long-run relationships. The study's findings indicated that external debt receipts and external debt servicing exhibited positive relationships with fluctuations in the naira exchange rate in both the short and long run. The study concluded that while external public debt receipts positively influence the exchange rate, external public debt servicing has a deleterious effect on the exchange rate.

Alabi and Ogboru (2019) examined the impact of capital flight on the exchange rate within the Nigerian economy over a three-decade period (1986-2015). An OLS regression analysis, the Augmented Dickey-Fuller unit root test, and co-integration tests were utilized to conduct a comprehensive examination of various variables, including GDP, capital flight through debt servicing, and exchange rate. The findings indicated that these variables exerted a statistically significant positive effect. This suggested that capital flight engenders an increased demand for foreign currency, which tends to apply upward pressure on the exchange rate, among other contributing factors.

Aderemi et al. (2020) investigated the association between external debt and fluctuations in the exchange rate within Nigeria during the temporal frame of 1981 to 2018. Consequently, the research employed the ARDL model to fulfil the study's objectives. The principal

revelations emerging from this scholarly work are as follows: external debt, debt service payments, and foreign reserves exhibited a statistically significant positive influence on exchange rate fluctuations in the short-term context of Nigeria.

Gnangnon (2020) assessed the determinants of real exchange rate volatility by examining the effects of Aid for Trade flows on the volatility of real exchange rates within recipient nations. The study established that, across the entire sample, Aid for Trade flows exert a negative influence on real exchange rate volatility, exhibiting a comparatively lower mitigating effect on least developed countries (LDCs) in relation to non-LDCs. The mechanisms through which this impact is realized encompass export product concentration, the quality of institutions and governance, inflows of foreign direct investment, and fluctuations in terms of trade. The findings of the study clearly indicated that Aid for Trade flows are significant determinants of real exchange rate volatility.

In the case of Russia, Sohag *et al.* (2021) explored the responsiveness of exchange rates to the uncertainties surrounding economic policy. The exchange rate served as the dependent variable, while the independent variables included economic policy uncertainty, international oil prices, and trade volume, with the quantile autoregressive method employed for analysis. The findings revealed that the local currency experiences appreciation in response to heightened economic policy uncertainty in Russia across various quantiles of the managed floating exchange rate; conversely, it depreciates in the majority of quantiles during a period of floating exchange rates. The results substantiated the assertion that the Russian currency appreciates concomitantly with increases in oil prices and trade, given Russia's status as a prominent oil-exporting nation.

Rufai *et al.* (2022) scrutinized the long-term relationship between FDI inflows and exchange rate (EXC) dynamics in Nigeria by employing the Gregory-Hansen and Bayer-Hanck cointegration methodologies, covering the period from January 1980 to December 2019. The findings indicated the existence of a long-run association between FDI and exchange rate fluctuations in Nigeria. The Dynamic OLS technique was utilized to ascertain the influence of FDI on the exchange rate. A negative relationship was identified between the two variables, suggesting that an escalation in FDI resulted in the appreciation of Naira and vice versa.

Anoruo *et al.* (2023) investigated the nonlinear dynamics characterizing the relationship between workers' remittances and real effective exchange rates within the context of the WAEMU member states, employing panel smooth transition regression (PSTR) methodology. The PSTR was estimated by incorporating a singular transition function

alongside a location parameter, as dictated by the diagnostic assessments undertaken. The diagnostic evaluations indicated that the interaction between workers' remittances and real effective exchange rates is nonlinear in nature. The determined threshold value was identified at 3.07%. The findings indicated that increments in workers' remittances exert a depreciative influence on real effective exchange rates within regime one, which is associated with a threshold value below 3.07%. However, within the second regime, characterized by a threshold value equal to or exceeding 3.07%, augmentations in workers' remittances produced an appreciating effect on real effective exchange rates. These outcomes substantiated the notion that the relationship between workers' remittances and real effective exchange rates is asymmetric and thus necessitates an appropriate modelling approach. The results corroborated the existence of a Dutch disease effect in the second regime, wherein the estimated coefficient pertaining to workers' remittances was both negative and statistically significant.

Imoagwu et al. (2023) conducted an investigation into the ramifications of escalating external debt on the exchange rate within the Nigerian context, utilizing annual data spanning from 1980 to 2021. The acquired data were subjected to rigorous analysis employing the ARDL methodology, alongside stability and diagnostic assessments throughout the analytical process. The findings derived from the preliminary test analysis indicated that external debt exerted a negative yet statistically insignificant influence on the exchange rate in Nigeria. Furthermore, external debt Zhang and Hao (2023) analyzed the influence of distinct categories of capital flows on the real effective exchange rate throughout China's economic development trajectory. Utilizing a dataset encompassing three predominant forms of capital flows in China from 1994 to 2015 and employing cointegration analysis along with Granger causality assessment, the empirical investigation revealed that FDI exerted a relatively modest impact on the appreciation of the real effective exchange rate; conversely, securities investment demonstrated a significant effect on the appreciation of the real effective exchange rate; additionally, other investments exhibited a pronounced effect on the appreciation of the real effective exchange rate, with the impact of other investment being notably more substantial.

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real effective exchange rate; conversely, securities investment demonstrated a significant effect on the appreciation of the real effective exchange rate; additionally, other investments exhibited a pronounced effect on the appreciation of the real effective exchange rate, with the impact of other investment being notably more substantial.

Peng et al. (2024) investigated how cross-border capital movements affect the stability of foreign exchange markets. Long-term depreciation pressures from the removal of cross-border capital inflows, such as FDI, were shown to outweigh appreciation pressures from growing cross-border capital inflows. Compared to negative fluctuations, the impact of positive changes in cross-border capital outflows was greater.

Rafie et al. (2025) evaluated the debt sustainability of Africa's lower-middle-income (LMIC) nations. It specifically looked at five African LMICs from 2000 to 2021: Morocco, Egypt, Tunisia, Benin, and Senegal. Morocco, Egypt, and Tunisia are in charge of their own monetary policies and reserve management, but Benin and Senegal, members of the Western African Economic and Monetary Union (WAEMU), are subject to further restrictions because they use the same currency. The study examined the relationship between external debt, reserves, currency rates, GDP growth, exports, and government spending using unit root tests, Johansen cointegration tests, and a VECM. The results showed that although these nations' public foreign debt fluctuates over the short term, fiscal and monetary measures tend to stabilize it over the long run. Furthermore, debt positions were greatly impacted by foreign reserves, and exchange rate agreements made in Morocco, Egypt, and Tunisia lower the danger of currency depreciation. On the other hand, Senegal and Benin's debt sustainability is limited by their shared currency.

3 METHODOLOGY

3.1 Data

This study uses weekly time series data for the period from 2010 to 2024. The dependent variable is exchange rate volatility while the explanatory variables are trade balance, FDI, FPI, external debt, and current account balance. All data are sourced from the CBN database and statistical bulletin, while data analysis is aided by EViews.

Consistent with previous studies, we transform exchange rate data into continuously compounded returns as follows:

$$r_t = \ln\left(\frac{E_t}{E_{t-1}}\right),$$

where ln = natural logarithm, r_t = exchange rate returns at time t, E_t current exchange rate,

E_t previous exchange rate.

Figure 1 shows the graph of exchange rate and remittances. Figure 2 shows the trend remittances and current account balance, while Figure 3 shows trend in trade balance, FDI, FPI, and external debt. As expected, Figure 1 shows that the Dollar/Naira exchange rate has increased overtime, its returns series fluctuate around a stable mean.
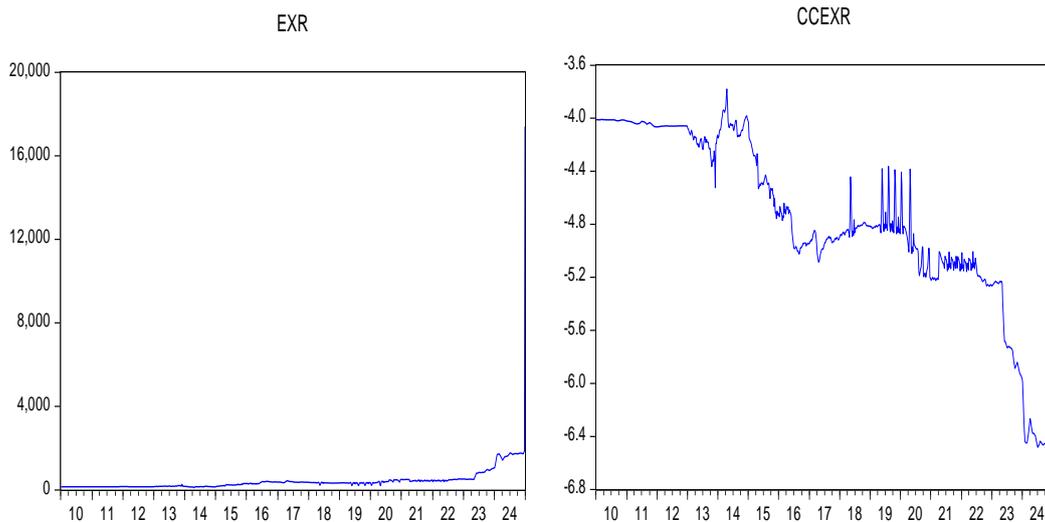

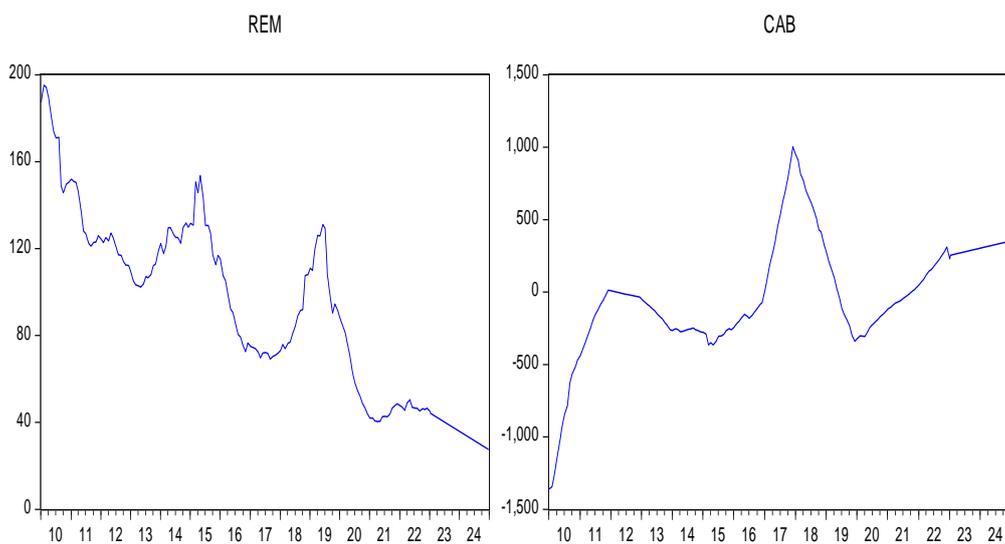**Figure 1: Trend in Exchange Rate and Exchange Rate Returns.**

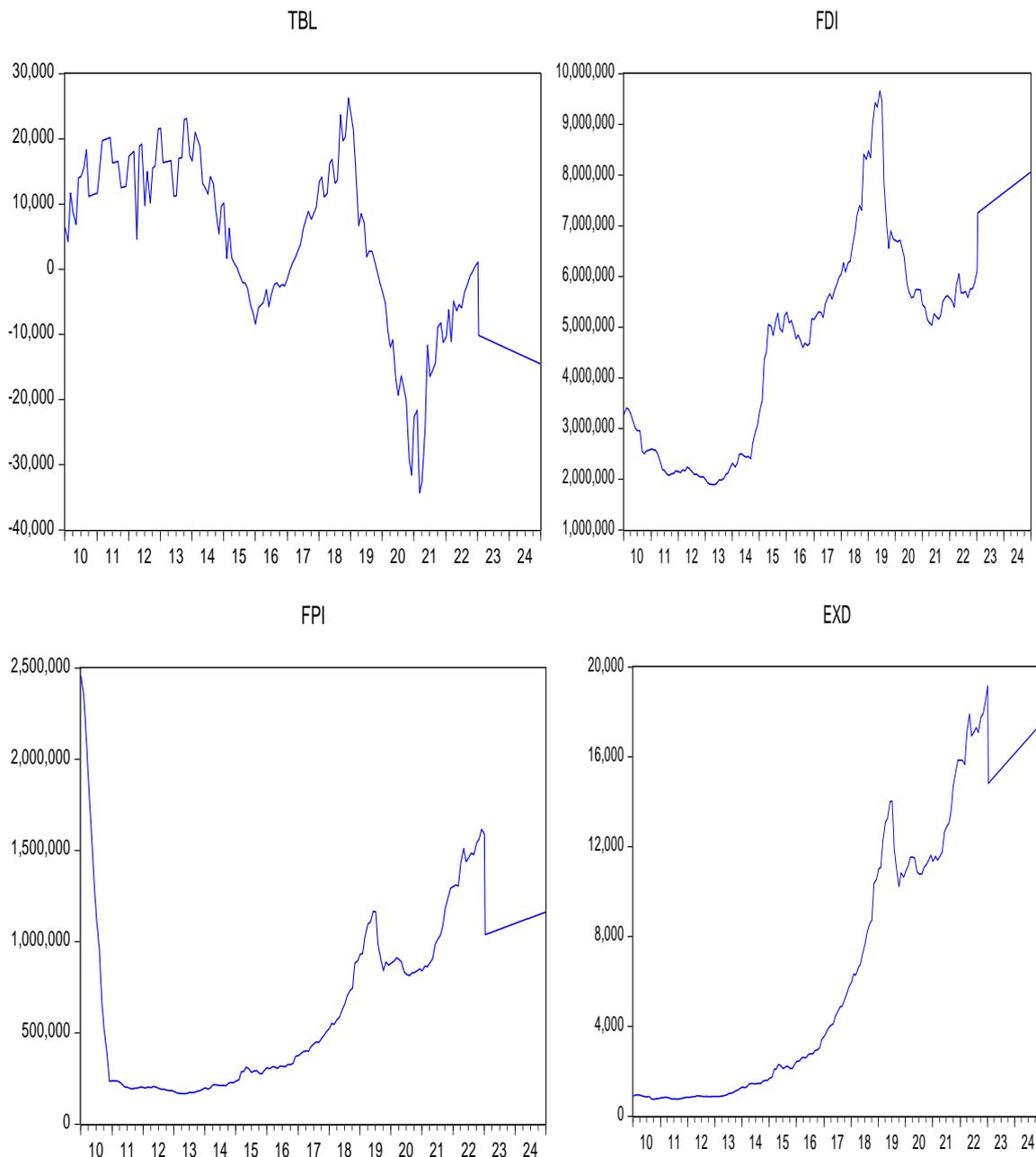**Figure 2: Trend in Remittances and Current Account Balance.**

Figure 3: Trend in Trade Balance, FDI, FPI, and External Debt,

3.2 Research Models

The GARCH-in-Mean (GARCH-M) model, propounded by Engle et al. (1987), incorporates the risk-premia effect in the mean equation of a standard GARCH model. The conditional mean and variance equations for a standard GARCH-M model is typically expressed as:

$$EXRR_t = \phi_0 + \phi_1 EXRR_{t-1} + \phi_2 EXVOL_t + \epsilon_t \tag{1}$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \sigma_{t-1}^2 + \lambda_1 X_t + \tag{2}$$

From the mean equation at (1), ϕ_0 is the model intercept, ϕ_1 captures the persistence in exchange rate returns, ϕ_2 captures the conditional variance (risk-premia) effect, and ϵ_t is the model error terms.

From the variance equation at (2), σ_t^2 is the conditional variance at time t, ω, α, γ, and β are parameters to be estimated, and ϵ_{t-1}^2 is the squared error term (shock) from the previous period. Further, X_t represents the balance of payment factors: namely, _Further, X_t represents the balance of payment factors: namely, trade balance, FDI, FPI, external debt, remittances, and current account balance._trade balance, FDI, FPI, external debt, remittances, and current account balance.

4 Empirical Results

Table 2 presents the GARCH-M estimation results for the impact of balance of payment factors on exchange rate volatility.

Table 1: GARCH-in-Mean Estimation Results.

Variable	Coefficient	Prob.
Mean Equation		
$EXVOL_t$	0.0063	0.9538
CCEXR(-1)	1.0018	0.0000
C	0.0086	0.6174
Variance Equation		
C	0.0017	0.0000
RESID(-1)^2	0.9989	0.0000
GARCH(-1)	0.0502	0.1196
TBLC	-0.0001	0.0028
FDIC	-0.0477	0.0000
FPIC	0.0109	0.0000
EXDC	-0.0484	0.0000
REMC	0.0706	0.0000
CABC	-0.0001	0.0000
Diagnostic Tests		
DOF	18.344	0.0029
ARCH-LM	0.0401	0.8412
Q-statistics	1.2585	0.2620

From the mean equation, the coefficient on $EXVOL_t$ (0.0063) was statistically insignificant (prob. = 0.9538), meaning that exchange rate returns did not strongly respond to risk dynamics. In other words, higher volatility did not result in higher expected returns, showing that market participants did not demand additional compensation for taking exchange rate risk. At the same time, CCEXR(–1) remained highly significant with a coefficient of 1.002, showing persistence in returns. The insignificant constant term reinforced the idea that the expected return was essentially driven by past movements and not by a risk premium.

The variance equation showed strong ARCH effects (coefficient = 0.999, p < 0.01), meaning that new shocks had a very large and instantaneous impact on volatility, while the GARCH term was weaker and statistically insignificant. This pattern suggested that risk was highly reactive to fresh disturbances rather than being influenced by long-run persistence. The significance of the BOP variables demonstrated how external sector fundamentals shaped the pricing of exchange rate risk. Changes in trade balance, FDI, external debt, and the CAB all significantly reduced volatility when they improve, implying that stronger external sector fundamentals lowered the level of risk priced into the currency market. Conversely, changes in FPI inflows increased volatility, denoting the destabilizing nature of speculative and short-term capital flows. Remittances contributed positively to volatility, possibly because inflows might be highly sensitive or irregular to external shocks. Overall, the variance equation showed that BOP conditions directly shaped how risk was priced in the exchange rate market. The diagnostic tests held that the GARCH-M model was properly specified. The ARCH-LM test indicated no remaining ARCH effects (p = 0.8412), and the Q-statistic suggested no autocorrelation in residuals (p = 0.2620). The strong degrees-of-freedom (DOF ≈ 18.34) supported the use of a non-normal distribution, which was appropriate following the heavy-tailed behaviour of exchange rate returns. However, the major implication was that the insignificant GARCH-in-Mean term shows that risk was not priced into exchange rate returns —even though volatility was driven by BOP conditions, the market did not reward or penalize investors for taking on more exchange rate risk. Instead, return behaviour was dominated by significant past-return persistence, while risk operated mainly through the variance equation rather than via the pricing mechanism in the mean equation. This suggested that while the exchange rate market perceived and reacted to macroeconomic risk through changes in BOP components, it did not embed a compensatory risk premium into expected returns.

5 CONCLUSION

This study employs the GARCH-in Mean model to empirically explore the impact of balance of payments factors on exchange rates volatility in Nigeria. More specifically, the study examines the extent to which changes in trade balance, FDI, FPI, external debt, remittances and current account balance affect the volatility of the Dollar/Naira exchange rate using weekly time series data from 2010 to 2024. The main findings of the study can be summarized as follows:

1. Exchange rate return is persistent but not affected by risk-premia effect.

2. Trade balance changes exert a highly significant negative effect on exchange rate volatility.

3. Changes in FDI exert a highly significant negative effect on exchange rate volatility.

4. Changes in foreign portfolio investment have a highly significant positive effect on exchange rate volatility.

5. Changes in external debt exert a significant negative effect on exchange rate volatility.

6. Changes in remittances exert a highly significant positive effect on exchange rate volatility.

7. Changes in current account balance exert a highly significant negative impact on exchange rate volatility.

Overall, our empirical findings show that changes in balance of payment factors significantly influence the volatility of weekly exchange rate, thereby underscoring the significance of balance of payment in maintaining exchange rate stability in Nigeria.

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