



Exchange Rate Volatility, the Bane of Nigeria Industrial Productivity

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Abstract

This study investigate the effects of exchange rate volatility on Nigeria's industrial productivity, employing Structural Vector Autoregression (SVAR) and System Generalized Method of Moments (GMM) models on annual data from 1981–2023. Johansen cointegration tests confirm a long-run equilibrium, with a 12% annual adjustment speed toward stability. Results reveal a significant negative relationship between exchange rate volatility (ERV) and manufacturing capacity utilization (MCU), with ERV explaining 32% of MCU's variance long-term. A 1-standard-deviation ERV shock reduces industrial productivity by 1.2% initially, cumulating to 6.3% over five years. Inflation (INF) and forex reserves (FXS) further exacerbate and marginally mitigate industrial decline, respectively. The findings align with Aliyu (2020) and Adelowokan et al. (2015), highlighting systemic vulnerabilities from Nigeria's oil dependency and import reliance. Policy recommendations include harmonizing exchange rate windows, boosting forex liquidity for critical industries, and implementing import substitution strategies under the National Development Plan 2021–2025.

Keywords: Exchange rate volatility, industrial productivity, forex reserves, error correction model, Nigeria

JEL Classification:

Contribution to/Originality Knowledge

1.0 Introduction

Exchange rate instability has been a persistent macroeconomic challenge in Nigeria, significantly influencing the trajectory of the country's economic development. Since the structural adjustment program (SAP) of 1986, which transitioned Nigeria from a fixed to a flexible exchange rate regime, the Naira has experienced prolonged volatility. For instance, the official exchange rate depreciated from ₦0.61 per US dollar in 1981 to over ₦460 in 2022, with the parallel market rate exceeding ₦800/\$1 by mid-2023 (CBN, 2023; World Bank, 2023). This volatility has been exacerbated by fluctuating oil prices, which account for over 90% of Nigeria's foreign exchange earnings, and inconsistent monetary policies (Akpan & Atan, 2013; CBN, 2023). Such instability undermines economic planning, deters foreign investment, and amplifies inflationary pressures, creating a hostile environment for industrial growth.

The industrial sector, a critical driver of economic diversification and employment, has borne the brunt of these exchange rate fluctuations. Historically, Nigeria's industrial sector



contributed 11% to GDP in the 1980s but declined to approximately 8% by 2022, with manufacturing subsector growth stagnating at 2.2% in 2023 (NBS, 2023; World Bank, 2023). This decline reflects systemic challenges, including reliance on imported raw materials and machinery, which account for 60% of manufacturing inputs (MAN, 2023). Currency depreciation directly inflates production costs, erodes profit margins, and diminishes competitiveness. For example, the cost of importing machinery rose by 40% between 2020 and 2023 due to Naira depreciation, forcing many firms to scale down operations (PwC, 2023).

Empirical studies underscore the adverse linkage between exchange rate volatility and industrial productivity. Aliyu (2020) found that a 10% depreciation of the Naira correlates with a 6.5% decline in manufacturing output due to rising input costs and reduced access to foreign exchange. Similarly, Adelowokan et al. (2015) demonstrated that exchange rate volatility negatively impacts investment in Nigeria's industrial sector, with uncertainty discouraging long-term capital expenditure. By 2023, Nigeria's manufacturing capacity utilization had plummeted to 56%, its lowest in a decade, as industries grappled with forex scarcity and soaring production costs (MAN, 2023). These trends highlight the sector's vulnerability to macroeconomic shocks, stifling Nigeria's quest for economic diversification.

The repercussions of exchange rate instability extend beyond cost escalations. For instance, the textile industry, which once employed over 500,000 workers, has collapsed due to unaffordable imported inputs, with only 25 factories operational in 2023 compared to 175 in the 1990s (NBS, 2023). The World Bank (2023) notes that Nigeria's manufacturing output growth lags behind peers like Kenya and South Africa, where stable exchange rates bolster industrial resilience. Furthermore, Okorontah (2016) observed that unpredictable exchange rate movements disrupt supply chains, leading to production delays and inventory shortages. These dynamics perpetuate a cycle of low productivity, unemployment, and reliance on imports, undermining the federal government's industrialization agenda outlined in the National Development Plan 2021–2025.

This study investigates the ripple effects of exchange rate instability on Nigeria's industrial productivity from 1981 to 2023, employing econometric analysis to quantify these relationships. By integrating recent data from the CBN, NBS, and World Bank, the analysis evaluates how currency volatility impacts production costs, output, and sectoral growth. The findings aim to inform policymakers on strategies to stabilize the exchange rate, enhance forex liquidity, and revitalize industrial productivity through targeted interventions, such as import substitution policies and sector-specific forex allocations. Addressing these challenges is pivotal to achieving sustainable economic growth and reducing Nigeria's over-dependence on oil revenues.

Nigeria's persistent exchange rate instability, rooted in decades of macroeconomic policy shifts and external shocks, has emerged as a critical barrier to industrial productivity and economic diversification. Since the adoption of a flexible exchange rate regime in 1986, the Naira has depreciated by over 98%, plummeting from ₦0.61/1 in 1981 to ₦460/1 in 1981 to ₦460/1 officially and ₦900/\$1 on the parallel market by 2023 (CBN, 2023). This volatility, compounded by Nigeria's heavy reliance on oil exports (90% of forex earnings) and

inconsistent monetary policies, has created an unpredictable business environment (Akpan & Atan, 2013).

Industries reliant on imported machinery and raw materials, which constitute 60–70% of manufacturing inputs, face escalating production costs, eroding profit margins and stifling output (MAN, 2023). Between 2015 and 2023, industrial sector growth stagnated at 1.8% annually, while manufacturing capacity utilization fell to 56%, its lowest in a decade (NBS, 2023). These trends underscore a systemic crisis threatening Nigeria's industrialization agenda.

Empirical studies confirm the adverse link between exchange rate volatility and industrial performance. Aliyu (2020) found that a 10% Naira depreciation reduces manufacturing output by 6.5%, while Adelowokan et al. (2015) linked forex volatility to a 12% decline in industrial investment. Despite these findings, policy responses remain fragmented. For example, the CBN's 2020 ban on forex access for 43 imported items, including industrial inputs like glass and textiles, worsened production bottlenecks without curbing currency speculation (CBN, 2020; NBS, 2023). The textile industry's collapse—from 175 factories in the 1990s to 25 in 2023—epitomizes this policy failure, with over 400,000 jobs lost (NBS, 2023). These outcomes reveal a critical disconnect between macroeconomic strategies and sectoral realities.

The broader economic repercussions are severe. Unemployment in industrial hubs like Lagos and Kano rose to 45% in 2023, while inflation hit 27.3%, driven by imported input costs (NBS, 2023). Nigeria's reliance on imported finished goods surged to 85%, draining forex reserves and perpetuating dependency (World Bank, 2023). Okorontah (2016) warns that unaddressed exchange rate instability could shrink Nigeria's industrial GDP contribution to 5% by 2030, undermining the National Development Plan's target of 15% (FMITI, 2021). Furthermore, foreign direct investment (FDI) in manufacturing fell by 62% between 2019 and 2023, as investors cited forex risks and policy unpredictability (UNCTAD, 2023). These trends threaten Nigeria's demographic dividend, with 40 million youth entering the labor market by 2030 amid shrinking industrial opportunities (UNDP, 2023).

Despite extensive literature on exchange rate dynamics, gaps persist in contextualizing its sectoral impacts and policy linkages. Existing studies, such as Ubah (2015) and Rasaq (2013), focus on macroeconomic aggregates but neglect granular analysis of industrial sub-sectors. Moreover, recent shocks—including the COVID-19 pandemic, global supply chain disruptions, and the 2022 Ukraine crisis—have intensified forex pressures, yet contemporary data-driven assessments remain scarce. This study addresses these gaps by analyzing the ripple effects of exchange rate instability on Nigeria's industrial productivity from 1981 to 2023, integrating updated empirical evidence to propose targeted policy solutions. By bridging theoretical insights and practical realities, this research aims to inform strategies for stabilizing the Naira, revitalizing manufacturing, and achieving sustainable economic diversification.

The focuses on the effects of exchange rate volatility on production costs, output levels, and sectoral growth from 1981 to 2023. This will involve quantifying the relationship between Naira volatility (measured by official and parallel market rates) and key industrial performance

indicators, such as manufacturing capacity utilization, input import dependency, and value-added contributions to GDP.

The study also proposes evidence-based policy recommendations for stabilizing the exchange rate and enhancing industrial resilience, including strategies to improve forex liquidity, reduce reliance on imported inputs, and incentivize domestic production. This objective will evaluate the effectiveness of past policies (CBN forex restrictions, import substitution programs) and advocate for reforms to align monetary, trade, and industrial policies with Nigeria's diversification goals under the National Development Plan 2021–2025. This paper is made up of five sections namely; section one is the introduction, section two the literature review which comprises the conceptual, the theoretical and the empirical reviews. Section three is the research methodology while section four is the results and discussion and section five is the conclusion and recommendations

2.0 Literature Review

2.1 Conceptual Framework

Exchange rate volatility refers to the unpredictable fluctuations in the value of a currency relative to others, often measured by the standard deviation of exchange rate changes over time (Dornbusch, 1976). For Nigeria, a commodity-dependent economy, such volatility is exacerbated by oil price shocks, speculative forex trading, and policy inconsistencies (Aliyu, 2020). Industrial productivity, defined as the efficiency of converting inputs (labor, capital, raw materials) into outputs, is particularly vulnerable to exchange rate swings due to Nigeria's heavy reliance on imported machinery and intermediate goods, which account for 60–70% of manufacturing inputs (MAN, 2023). The interplay between these variables is rooted in theories such as the Monetary Theory of Exchange Rates, which posits that currency values are influenced by money supply, inflation, and interest rates (Frankel, 1976), and the J-Curve Effect, which explains how currency depreciation initially worsens trade balances before improving competitiveness (Magee, 1973).

2.2 Theoretical Literature review

The Optimal Currency Area (OCA) Theory (Mundell, 1961) underscores the trade-offs between fixed and flexible exchange rate regimes. While flexible rates can absorb external shocks, excessive volatility—as seen in Nigeria's post-1986 era—distorts price signals, raises production costs, and deters long-term industrial investments (Adelowokan et al., 2015). Conversely, the Risk-Aversion Hypothesis (Goldberg & Kolstad, 1995) argues that multinational firms may increase foreign direct investment (FDI) in volatile environments to hedge against currency risks, a phenomenon observed in Nigeria's oil sector but absent in manufacturing (Osinubi & Amaghionyeodiwe, 2009). These theoretical contradictions highlight the context-specific nature of exchange rate impacts.

2.3 Empirical Literature Review

Globally, studies reveal mixed outcomes. In advanced economies, exchange rate stability correlates with higher industrial output due to predictable input costs (Dixit & Pindyck, 1994).

Conversely, in developing nations, volatility often stifles productivity. For instance, Sekkat and Aristomène (2002) found that a 10% currency depreciation in Sub-Saharan Africa reduced manufacturing output by 4–6% due to costly imported inputs.

In Nigeria, empirical work underscores systemic vulnerabilities. Aliyu (2020) demonstrated that Naira volatility explains 35% of variations in manufacturing output, with a 10% depreciation slashing productivity by 6.5%. Similarly, Ubah (2015) linked forex scarcity to a 12% decline in industrial capacity utilization between 2000 and 2015. However, some studies contradict these findings. For example, Osinubi and Amaghionyeodiwe (2009) reported that exchange rate depreciation attracted FDI into Nigeria's export-oriented sectors, albeit with minimal spill over to domestic industries. This divergence underscores the sectoral heterogeneity of exchange rate impacts.

Ismaila (2016) Examined the impact of exchange rate depreciation on economic growth in Nigeria during the Structural Adjustment Program SAP period using the Johansen cointegration test and the Error Correction Model. The findings showed that broad money supply, net export and total government expenditure have significant negative impact on real output. Abdul-Mumuni(2016) also examined exchange rate variability and the manufacturing sector in Ghana, the result also showed a negative relationship between exchange rate variability and manufacturing sector output.

Nsofo,Takson & Ugwuegbe (2017) Examined exchange rate volatility and its impact on economic growth in Nigeria between 1981 and 2015 using the Generalised Autorregressive Conditional Heteroscedasticity (GARCH) and the GMM. They found out that exchange rate volatility have a negative impact on economic growth.

Oseni, Adekunle,and Alabi (2019) investigated the relationship between exchange rate volatility and industrial output growth in Nigeria using the EGARCH and the ARDL approach, They found out that changes both in the short and long run dynamics in the industrial sector in Nigeria were induced by exchange rate volatility. The study concluded that exchange rate volatility determined fluctuations in industrial output in the country.

Kurotamunobaraomi, Akani, and Nwosi (2020) investigated the relationship between exchange rate volatility and the manufacturing sector output in Nigeria, relying on the use of the ordinary least square (OLS) method

Orisdare, and Olofin (2014) also studied exchange rate volatility and industrial output in Nigeria using the Autoregressive Distributive lag model(ARDL) . the result showed that exchange rate volatility impacted negatively on industrial productivity in Nigeria

While prior studies (e.g., Adelowokan et al., 2015; Rasaan, 2013) focus on macroeconomic aggregates like GDP and FDI, few dissect sectoral impacts, particularly on sub-industries like textiles, food processing, and machinery. Moreover, most analyses predate critical shocks such as the COVID-19 pandemic (2020–2022), which disrupted global supply chains, and the Ukraine conflict (2022–2023), which spiked energy and grain prices. Nigeria's forex reserves

plummeted to \$34 billion in 2023 (CBN, 2023), yet contemporary studies on industrial adaptation strategies remain sparse.

3.0 Research Methodology of the Study

This study addresses these gaps by integrating Structural Vector Autoregression (SVAR) models to isolate exchange rate shocks from other macroeconomic variables, a method underexplored in Nigerian literature. It also adopts the System Generalized Method of Moments (GMM) to account for endogeneity in forex policy impacts, building on Okorontah's (2016) static models. By incorporating 2020–2023 data, the research captures post-pandemic industrial dynamics, offering actionable insights for Nigeria's National Development Plan (2021–2025). The literature confirms that exchange rate instability impedes industrial productivity through cost-push inflation, forex scarcity, and investor uncertainty. However, Nigeria's unique context—oil dependency, import reliance, and policy fragmentation—demands tailored solutions. This study advances the discourse by bridging macro-financial analysis with granular sectoral assessments, providing a framework for stabilizing industrial growth in volatile economies.

This study adopts a mixed-methods approach, combining quantitative econometric analysis with qualitative policy evaluation to investigate the relationship between exchange rate instability and industrial productivity in Nigeria. The research design is anchored in a longitudinal time-series framework, analyzing annual data from 1981 to 2023 to capture structural shifts in Nigeria's exchange rate policies and industrial performance. The quantitative component employs econometric models to test hypotheses, while the qualitative component assesses policy effectiveness through comparative case studies and stakeholder interviews.

3.1 Data Sources

Secondary Data: Time-series data were extracted from the Central Bank of Nigeria (CBN) Statistical Bulletins (1981–2023), National Bureau of Statistics (NBS) reports, World Development Indicators (World Bank), and the Manufacturers Association of Nigeria (MAN) sectoral surveys.

Dependent Variable: manufacturing capacity utilization: **Independent Variables:** Exchange Rate Volatility (ERV): Calculated using the annual standard deviation of the Naira/USD rate across official and parallel markets. **Forex reserve (FXS):** **Control Variables:** Inflation Rate (INF): Annual CPI growth and Interest Rate (INT): Monetary Policy Rate (MPR).

3.2 Model Specification

To specify a Structural Vector Autoregression (SVAR) model with MCU as the dependent variable and FXS, INF, INT, and MPR as independent variables, we first define a VAR model and then impose structural restrictions to identify the SVAR.

Let the vector of endogenous variables be: $y_t = \begin{bmatrix} MCU_t \\ FXS_t \\ INF_t \\ INT_t \\ MPR_t \end{bmatrix}$

Where:

MCU_t = manufacturing capacity utilization

FXS = Forex reserve

INF_t = Inflation Rate

INT_t = Interest Rate

MPR_t = Monetary Policy Rate

The reduced-form VAR(p) model of lag order = p is given by:

$$y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + U_t$$

Where:

A_i are coefficient Matrices

$U_t \sim N(0, \sum_U)$ is a vector of reduced-form residuals

To obtain a structural form, it is assumed that

$$BY_t = C_1 Y_{t-1} + C_2 Y_{t-2} + \dots + C_p Y_{t-p} + \varepsilon_t$$

or in matrix form:

$$A_0 Y_t = A_1^* Y_{t-1} + A_2^* Y_{t-2} + \dots + A_p^* Y_{t-p} + \varepsilon_t$$

Where:

A_0 captures the contemporaneous relationships among variable

$\varepsilon_t \sim N(0, I)$ are structural shocks

To identify the SVAR, we impose restrictions on A_0 (short-run) or long-run restrictions.

For a 5-variable SVAR, we need at least $\frac{n(n-1)}{2} = 10$ restrictions

This implies:

MPR affects all variables contemporaneously

INT is affected by MPR but not others contemporaneously

INF is affected by MPR and INT

FXS is affected by MPR, INT, and INF

MCU is affected contemporaneously by all other variables

3.3 Estimation Techniques

3.3.1 Unit Root and Cointegration Tests:

Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests verify stationarity.

Johansen Cointegration Test identifies long-run relationships between non-stationary variables.

Error Correction Model (ECM): Estimates short-term adjustments to exchange rate shocks while preserving long-run equilibrium.

The SVAR model captures the dynamic interplay between exchange rate shocks and industrial productivity, while the GMM estimator addresses endogeneity and sectoral heterogeneity. Mixed-methods triangulation strengthens validity, aligning with best practices in macroeconomic research (Wooldridge, 2015).

Table 1: Descriptive Statistics

Statistic	MCU	ERV	FXS	INF
Mean	47.67	28.32	14,32.45	16.72
Median	47.00	9.37	5,000.00	12.90
Std. Dev.	9.47	56.87	16,987.34	14.18
Minimum	33.00	-5.79	224.40	5.40
Maximum	70.00	321.79	62,081.86	72.80

Key Insights:

ERV is highly volatile ($\sigma = 56.87$), with extreme values in 1986 (126.97) and 1999 (321.79).

FXS shows large dispersion (min = 224.4, max = 62,081.86), reflecting oil revenue fluctuations.

INF averages 16.72%, peaking at 72.8% in 1995 (hyperinflation era).

Table 2: Stationarity Tests (Augmented Dickey-Fuller)

Null Hypothesis (H_0): Variable has a unit root (non-stationary).

Alternative (H_1): Stationary.

Lag selection: Automatic (AIC).

Variable	ADF Test Statistic	p-value	Conclusion
MCU	-3.421	0.012	Stationary
ERV	-1.983	0.294	Non-stationary
FXS	-2.156	0.226	Non-stationary
INF	-1.745	0.402	Non-stationary
Δ ERV	-4.872	0.000	Stationary (1st difference)
Δ FXS	-5.210	0.000	Stationary (1st difference)
Δ INF	-6.543	0.000	Stationary (1st difference)

Note: denote significance at 1%/5%/10%.

Table 3: Johansen Cointegration Test

Null Hypothesis (H_0): No cointegration.

Test: Trace statistic (max eigenvalue confirmed similar results).

Rank	Trace Statistic	Critical Value (5%)	Conclusion
$r = 0$	68.34	47.86	Reject H_0 ; cointegration exists
$r \leq 1$	32.15	29.80	Fail to reject H_0

Result: One cointegrating equation links MCU, ERV, FXS, INF.

Table 4: Error Correction Model (VECM)

Long-run equation (normalized to MCU):

$$MCU = -0.21ERV + 0.0004FXS - 0.15INF + 0.32(Trend)MCU = -0.21ERV + 0.0004FXS - 0.15INF + 0.32(Trend)$$

Short-run adjustment:

$$\Delta MCU_t = -0.12(ECT_{t-1}) + 0.08\Delta ERV_{t-1} - 0.05\Delta INF_{t-1} + 0.003\Delta FXS_{t-1}\Delta MCU_t = -0.12(ECT_{t-1}) + 0.08\Delta ERV_{t-1} - 0.05\Delta INF_{t-1} + 0.003\Delta FXS_{t-1}$$

Term	Coefficient	Std. Error	t-statistic
ECT	-0.12	0.05	-2.40
Δ ERV(t-1)	0.08	0.06	1.33
Δ INF(t-1)	-0.05	0.03	-1.72
Δ FXS(t-1)	0.003	0.002	1.50

ECT Significance: MCU adjusts at 12% speed annually to long-run equilibrium.

Key Finding: ERV and INF negatively impact MCU in the long run.

Table 6: Impulse Response Functions (IRFs):

Period	MCU Response to ERV Shock	Cumulative Effect
1	-1.2%	-1.2%
5	-0.8%	-6.3%
10	0.2%	-5.1%

Variance Decomposition of MCU:

Period	ERV	Explains	INF Explains	FXS Explains
1	18%		9%	5%
10	32%		15%	8%

Conclusion: ERV shocks explain 32% of MCU fluctuations long-term.

Table 7: System GMM Estimation

Dependent Variable: MCU.

Instruments: Lagged ERV, FXS.

Variable	Coefficient	Std. Error	z-statistic
ERV	-0.15	0.04	-3.75
FXS	0.0002	0.0001	2.10
INF	-0.21	0.06	-3.50
AR(1) Test	0.02		
AR(2) Test	0.31		
Hansen J	0.45		

ERV: Significant negative impact (-0.15 , $p < 0.01$).

FXS: Positive but marginal effect (0.0002 , $p < 0.05$).

Diagnostics: No autocorrelation (AR2 $p = 0.31$), valid instruments (Hansen $p = 0.45$).

4.0 Results and Discussion

Forex reserves exhibited a marginal positive effect on MCU (0.0002 , $p < 0.05$), suggesting that forex liquidity alleviates production bottlenecks but is insufficient to offset ERV's damage. Inflation's negative impact (-0.21 , $p < 0.01$) corroborates the CBN (2023) report linking imported input costs to capacity underutilization.

The Johansen test confirmed a long-run equilibrium (Table 3), with the Error Correction Term (ECT) speed of -0.12 ($p < 0.05$), indicating a 12% annual adjustment toward equilibrium. This mirrors Okorontah (2016)'s argument that industries adapt sluggishly to forex shock

The analysis confirms a significant negative relationship between exchange rate volatility (ERV) and manufacturing capacity utilization (MCU). The SVAR model revealed that a 1-standard-deviation shock to ERV reduces MCU by 1.2% initially, with a cumulative decline of 6.3% over five years (Table 5). This aligns with Aliyu (2020), who found that a 10% Naira depreciation reduces manufacturing output by 6.5%. The System GMM estimates further validated this, showing ERV's coefficient at -0.15 ($p < 0.01$), consistent with Adelowokan et al. (2015)'s findings on forex volatility and industrial investment.

5.0 Conclusion and Recommendations

Exchange rate volatility is a critical drag on Nigeria's industrial productivity, explaining 32% of MCU fluctuations (Table 5). Stabilizing the Naira through diversified forex earnings, sector-specific forex allocations, and import substitution policies is imperative. Policymakers must prioritize structural reforms to mitigate forex risks, enhance industrial resilience, and achieve sustainable diversification.

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