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Monetary policy and the manufacturing sector in Nigeria

Mercy Yongosi[1]*, Victor E. Oriavwote[2]
[1,2]*Department of Economics and Development Studies Faculty of Social Sciences, Federal University Otuoke, Bayelsa State, Nigeria*
**Corresponding author: mercyyongest@gmail.com*
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Abstract
Purpose: This study investigates how Nigeria's manufacturing sector responds to key monetary policy measures. Specifically, it examines the extent to which the treasury bill rate (TBR), prime lending rate (PLR), inflation rate (INF), and exchange rate (EXR) influence manufacturing sector output (MFO).
Methodology: The study employed time series data obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin covering 2010–2023. Preliminary econometric procedures, including unit root tests and the Johansen cointegration technique, were used to determine the stationarity status and long-run relationships among the variables. Based on these outcomes, an error-correction framework was estimated to capture short- and long-run dynamics between monetary policy indicators and manufacturing sector output.
Results and conclusion: The findings reveal that monetary policy variables, specifically the exchange rate, treasury bill rate, inflation rate, and prime lending rate, do not exert a significant influence on Nigeria's manufacturing output in both the medium and long run. The study concludes that the weak transmission of monetary policy to the real sector may stem from structural bottlenecks, policy inconsistencies, and an unfavourable operating environment that limit the responsiveness of manufacturers to monetary adjustments.
Implication of findings: The study suggests the need for the government to strengthen the regulatory framework by streamlining procedures, reducing bureaucratic delays, and lowering compliance costs. Enhancing transparency and ensuring stable, predictable policy implementation will improve the operating climate for manufacturers and support better monetary policy transmission to the sector.

Keywords: Monetary policy, Exchange rate, Treasury bill.

1. Introduction

Since the manufacturing sector supports employment, industrial output, and export revenue, its performance is essential to the general economic growth and development of any economy (Ogbonna, 2021). On the other hand, monetary policy has a big impact on how well the manufacturing sector does because it affects interest rates. Cut rates can cut the cost of borrowing for manufacturers, which promotes investment and expansion (Keji, 2023; Korolo & Korolo, 2025). In developing nations, monetary policy not only aims for economic stabilization but also seeks to foster economic growth, which directly influences the manufacturing sector (Musa & Sanusi, 2013). Conversely, higher interest rates can deter investment and expansion, negatively impacting the sector. Additionally, effective monetary policy can stabilize exchange rates, reducing input costs for manufacturers reliant on imports and enhancing their competitiveness in both domestic and international markets.

The success of Nigeria's manufacturing sector and monetary policy is closely related, and research on the impact of monetary policy instruments like interest rates, money supply, and exchange rates is vital for creating effective policies that can stimulate industrial growth and enhance productivity (Onyeizugbe & Umeagugesi, 2014). Despite its importance in job creation and GDP growth, the Nigerian manufacturing sector faces challenges, particularly in accessing credit, making monetary policy decisions crucial for its performance. Thus, effective monetary policy can foster a favorable environment for sustainable growth in the manufacturing sector by controlling inflation and enhancing access to credit (Onyeizugbe & Umeagugesi, 2014). Recent studies have explored various macroeconomic factors affecting manufacturing output in Nigeria, including credit sourcing for agribusiness and the impact of

foreign exchange market deregulation (Ogbonna, 2021; Ovwigho & Odemero, 2023; Ochei et al., 2016). Despite the attention given to these issues, the need for appropriate policy measures to improve manufacturing performance remains a critical area of focus (Nnanna & Onimole, 2023; Olomu et al., 2020).

Several studies have examined the relationship between monetary policy and the performance of Nigeria's industrial sector, but their findings remain mixed and inconclusive. Olofinlade et al. (2020) found that contractionary monetary policies negatively impacted growth by increasing production costs. Salam et al. (2023) similarly concluded that restrictive monetary policies limited sector expansion by hindering access to financing and discouraging investment. In contrast, Otiwu et al. (2024) indicated that expansive monetary policy during periods of low interest rates and high money supply improved manufacturing performance by fostering business expansion and reducing production costs. Despite these findings, there is no consensus on the direct effects of monetary policy variables. Further research into these processes is necessary to guide successful policy adjustments, as the impact of currency rates, in particular on Nigeria's manufacturing performance has remained elusive. The need for more research was highlighted by the lack of agreement on how monetary policy, in particular currency rates, impacts the performance of Nigeria's manufacturing sector.

As a result, the study aims to explore how monetary policy instruments affect the manufacturing sector's performance in Nigeria, which is crucial for economic growth but faces obstacles, including restricted credit availability. By investigating the effects of monetary policy on Nigeria's manufacturing sector, the study hopes to provide empirical data to the body of knowledge regarding the effects of monetary policy on the performance of Nigeria's manufacturing sector performance in Nigeria, which is crucial for economic growth manufacturing sector. As a result, the study aims to explore how monetary policy instrument's function but faces obstacles, including restricted credit availability. By investigating the effects of monetary policy on Nigeria's manufacturing sector, the study hopes to provide empirical data to the body of knowledge regarding the effects of monetary policy on the performance of Nigeria's manufacturing sector.

One important issue that requires serious investigation is the connection between monetary policy and the industrial sector's performance in Nigeria. In addition to economic stabilization, monetary policy measures are employed in developing nations to encourage economic growth, which affects the sector's performance. For the purpose of creating suitable policies that would encourage industrial expansion, improve productivity, and advance economic development in Nigeria, it is crucial to understand how monetary policy instruments like interest rates, money supply, and exchange rates affect the manufacturing sector. The performance of Nigeria's manufacturing sector is vital for job creation and industrial development, but it faces obstacles like restricted credit availability. Thus, more empirical evidence of how monetary policy relates to the manufacturing sector's overall performance becomes crucial (Musa & Sanusi, 2013; Onyeizugbe & Umeagugesi, 2014; Yusuf, 2025; Yusuf et al.,2025). This study, therefore, intends to investigate how monetary policy influences the manufacturing sector's performance in Nigeria, with a focus on identifying the primary ways that monetary policy affects industrial activities.

The study's primary goal is to ascertain how monetary policy measures affect Nigeria's manufacturing sector's performance. Its particular goals are to ascertain how the manufacturing sector's output growth and exchange rate are related. Analyze how the prime lending rate affects the expansion of manufacturing production. Analyze how Treasury bills affect the manufacturing sector's performance.

2. Literature review

Theoretical review

Relevant theories and a review of empirical literature in the field are presented in this section. The Keynesian theory of aggregate demand, introduced by John Maynard Keynes in 1936, posits that total spending in the economy significantly influences overall economic activity, particularly output and employment (Keynes, 1936). This theory is particularly relevant in Nigeria, where government monetary policies can directly impact aggregate demand and, consequently, the performance of the manufacturing sector. Keynes emphasized that components of aggregate demand, such as consumption, investment, and government spending, are crucial for determining economic output, with insufficient demand leading to lower manufacturing output and higher unemployment. Critics, particularly from Monetarist and Classical schools, argue that the theory overemphasizes aggregate demand's role in long-term growth, suggesting that supply-side factors are more significant (Friedman, 1968). Furthermore, questions have been raised concerning the role of monetary policy and government intervention in controlling economic cycles, especially in light of possible inflationary pressures in developing nations such as Nigeria (Adebayo, 2019).

According to the Quantity Theory of Money (QTM), an economy's money supply and price level are directly correlated, significantly impacting monetary policy's effects on sectors like manufacturing, particularly in Nigeria (Friedman, 1968). The theory, formalized by Irving Fisher through the Equation of Exchange, suggests that an increase in the money supply leads to proportional increases in price levels and real output, although this relationship may only hold in the long run (Friedman, 1968). In Nigeria, expansionary monetary policies can initially stimulate the manufacturing sector by lowering interest rates and increasing credit availability, but these effects may be undermined by inflationary pressures and structural challenges (Ogunleye, 2020; Adebayo, 2019). Critics of the QTM argue that its assumptions, such as a constant velocity of money and a focus on demand-side factors, overlook the complexities of real-world economic conditions, especially in developing economies (Ojo, 2021; Okun, 1962). Recent studies indicate that while monetary expansion can yield short-term benefits for manufacturing output, long-term effects are often constrained by inflation and external factors like exchange rate volatility (Akinlo & Adejumo, 2022).

The monetarist view on monetary policy transmission, primarily associated with Milton Friedman, highlights how the money supply affects economic activity, especially in industries like manufacturing (Friedman, 1968). Monetarists contend that shifts in the money supply have a direct impact on prices, employment, and output, with a rise in the money supply resulting in lower interest rates and more manufacturing investment (Friedman, 1968). However, they caution that while short-term effects may stimulate economic output, long-term inflationary pressures can arise if money supply growth outpaces real output (Friedman, 1968). Critics of the Monetarist view highlight its overemphasis on money supply, arguing that factors like government spending and consumer confidence also significantly impact economic performance (Okun, 1962). Additionally, they point out that the role of credit channels and the negative effects of currency depreciation on manufacturing costs are often underestimated, complicating the connection between the success of the manufacturing sector and monetary policy (Ojo, 2021).

Empirical review

Obikaeze et al. (2023) examined the relationship between foreign direct investment (FDI) and the growth of Nigeria's manufacturing sector, concluding that the sector's underperformance stemmed more from inadequate macroeconomic policies than from FDI's inherent exploitative tendencies. Using econometric techniques such as cointegration tests and vector error correction models, the study revealed a strong

long-term relationship between FDI, manufacturing output, and key macroeconomic indicators, including exchange rates and monetary policy rates. The findings highlighted that Nigeria's limited ability to fully benefit from FDI was largely a result of suboptimal macroeconomic frameworks. Accordingly, the authors recommended comprehensive reforms in monetary and exchange rate policies, alongside initiatives to enhance human capital development, to strengthen manufacturing sector productivity.

Olawale and Ismail (2024) used a structural vector autoregressive (SVAR) model and ordinary least squares (OLS) regression analysis to examine how the monetary policies of the Central Bank of Nigeria affected the nation's economic growth between 2000 and 2023. The results revealed that monetary policy significantly affected short-term economic activity, with changes in the money supply positively correlating with GDP growth, accounting for 82% of systematic GDP changes. The research underscored the importance of addressing structural barriers and improving policy coordination to increase the efficiency of financial interventions.

Otiwu et al. (2024) examined how Nigeria's manufacturing sector performed between 1987 and 2022 in relation to the main monetary policy variables of cash reserve requirement (CRR), liquidity ratio (LR), monetary policy rate (MPR), and open market operations (OMO). It found a long-term equilibrium relationship between these financial variables and manufacturing performance by using sophisticated econometric tools and a quasi-experimental approach. Key findings indicated that while increases in OMO, CRR, and LR positively influenced manufacturing output, a rise in MPR detrimentally affected it. This suggested that the manufacturing sector was sensitive to monetary policy adjustments, particularly regarding interest rates. The study advocated for an expansionary monetary policy approach, emphasizing lower lending rates to stimulate investment and enhance manufacturing productivity. The relationship between monetary policy factors and the mining and quarry industry's performance in Nigeria was investigated by Otiwu et al. in 2024. The effects of important monetary policy tools, such as the money supply, monetary policy rate, Treasury bill rate, and credit to the private sector, were examined by the authors using sophisticated statistical approaches, including Vector Autoregression (VAR) and the Generalized Method of Moments (GMM). Key findings showed that while changes in the credit supply and Treasury bill rates had positive effects on industrial output, unforeseen changes in the money supply and monetary policy rates had negative effects. Notably, the research highlighted a significant transmission of monetary policy effects from the industrial sector to the broader economy, with an estimated growth effect of at least 30%. The implications of these findings underscore the importance of robust monetary policy in bolstering the mining and quarry sector, which was vital for Nigeria's economic development. The authors advocated enhanced financial market infrastructure, including stock and bond market development, to improve the efficacy of monetary transfer of policies to the private sector. The study's result confirmed a crucial connection between monetary policy and the mining and quarry industry's success. In order to solve financial issues and promote sustainable economic growth, it calls for calculated government interventions.

Adegoriola and Ben-Obi (2022) investigated how Nigeria's real sectors—agriculture, manufacturing, and services in particular—were affected by monetary policy tools. The authors found substantial long-term correlations between important economic variables like output levels, interest rates, exchange rates, money supply, and inflation using a Vector Autoregressive (VAR) model and Johansen co-integration tests. Key findings indicated that increases in agricultural and service outputs, alongside rising exchange rates and inflation, positively affected current agricultural performance. Conversely, higher manufacturing output and interest rates tended to hinder agricultural productivity. The stability of the

Structural Vector Autoregressive (SVAR) model suggested its effectiveness for forecasting and guiding policy decisions. The implications of this research underscore the importance of coherent monetary policies that acknowledge the interconnections between different economic sectors.

Effiong et al. (2024) examined the relationship between fiscal policy, particularly interest rates and government spending, and the manufacturing sector's success in Nigeria between 1981 and 2021. Both short-run and long-run dynamics were examined by the authors using the Autoregressive Distributed Lag (ARDL) model and the Error Correction Model (ECM). The main conclusions showed that government spending had a detrimental impact on manufacturing production, pointing to inefficient fiscal allocation. Foreign debt and government consumption spending were found to have incremental effects on industrial production, although both domestic and foreign indebtedness had negligible short-term effects on different sectors. These findings have important ramifications for politicians, who were encouraged to reconsider government expenditure plans in order to improve manufacturing performance. The report emphasized the need for fiscal measures that were in line with.

Korolo's (2022) study analyzed annual time series data from 1986 to 2018 to assess the impact of monetary policy on unemployment in Nigeria. Using an ex-post facto research design, the study applied the Johansen Cointegration and Error Correction Model (ECM) to examine relationships among key variables. The results revealed a long-term relationship between unemployment and monetary policy instruments, including the exchange rate, inflation, and external reserves. Specifically, the real exchange rate positively influenced real GDP per capita in the long run, while inflation, interest rates, and money supply had negative effects. These findings highlight the critical role of monetary policy in shaping employment and economic growth. The study recommended that policymakers carefully consider the employment implications of monetary policy tools when designing strategies, noting that, despite existing interventions, challenges in optimizing their impact remain.

Chukwu (2023) examined how monetary policy affected Nigeria's economy between 2000 to 2021, with a particular emphasis on the banking, manufacturing, and agricultural sectors. It utilized econometric methods, including unit root and cointegration tests, and revealed that while monetary policy significantly influenced the banking sector, affecting interest rates and lending practices, it had an insignificant effect on the manufacturing and agricultural sectors. The findings highlighted the necessity for enhanced communication between the Central Bank of Nigeria and economic stakeholders to develop more effective monetary policies tailored to stimulate growth in the less responsive sectors. The study underscored the importance of sector-specific strategies in optimizing the overall Nigerian monetary policy's effects on the economy.

Oladimeji (2022) examined the impact of monetary policy on Nigeria’s real sector, emphasizing its role in promoting sustainable economic growth. Using econometric techniques and time series data, the study demonstrated that monetary policy is a powerful macroeconomic tool in developing economies. However, the authors cautioned against generalizing Nigeria’s findings to other developing countries, recommending the use of broader datasets to improve understanding. For policymakers, the study highlighted the importance of a nuanced approach that accounts for the specific characteristics of the real sector, alongside coordinated monetary and fiscal policies, to support economic stability and growth in Nigeria.

Salam et al. (2023) addressed a significant gap in the literature by examining how monetary policy affected Nigeria's solid minerals and industrial industries. The authors examined time series data using

an Auto-Regressive Distributed Lag (ARDL) model to determine the long-term correlations between sector outputs and monetary policy variables. Key findings showed a significant long-term relationship: manufacturing output decreased 7.8% with a 1% increase in the monetary policy rate and increased 11.2% with a 1% increase in the money supply. Notably, credit advanced to the manufacturing sector had a pronounced effect, with a 1% increase correlating to a 45.9% rise in output. The implications of these findings suggested that expansionary monetary policies, particularly those enhancing money supply and credit availability, were vital for the growth of these sectors. Conversely, high-interest rates negatively impacted sectoral performance.

Adamu et al. (2022) investigated, using return on assets (ROA) as a lens, the connection between monetary policy and Flour Mills Nigeria Plc's financial performance. Using an Autoregressive Distributed Lag (ARDL) model using yearly data from 1990 to 2021, the authors examined managerial effectiveness in addition to important monetary indicators such as the inflation rate, exchange rate, and monetary policy rate. Key findings showed that monetary policy and other economic indicators had no discernible short-term effects on the firm's financial performance. On the other hand, managerial effectiveness turned out to be a crucial factor in determining financial success, indicating that better results could come from operational enhancements. Additionally, the analysis showed that the variables had a long-term equilibrium connection, with a rapid adjustment speed of 92%. From an economic perspective, the implications of this research highlighted that reliance on monetary policy alone might have been inadequate for improving financial performance in the consumer goods sector. Instead, a strategic focus on enhancing managerial practices could have provided a more effective pathway for firms like Flour Mills.

Nwagu and Udeagbala (2024) investigated the effect of private sector (CPS) bank lending on Nigeria's manufacturing production. The authors used the Autoregressive Distributed Lag (ARDL) methodology to examine the association between important variables using data from the National Bureau of Statistics and the Central Bank of Nigeria. The main conclusions showed that 93.9% of the differences in manufacturing output could be explained by CPS, interest rates, and exchange rates taken together. Notably, during the study period, the effects of interest rates and CPS were determined to be statistically negligible, despite the fact that the exchange rate had a beneficial impact on industrial performance. These findings' ramifications indicated that the Central Bank of Nigeria ought to have stepped up its efforts to facilitate credit access for the manufacturing sector, alongside government policies aimed at reducing interest rates for critical sectors. The study concluded that despite the recognized importance of CPS, its current influence on manufacturing output was limited, highlighting the need for enhanced credit conditions to stimulate economic expansion in Nigeria. All things considered, this study advanced knowledge of the relationship between financial intermediation and industrial performance, highlighting the need for legislative measures to support credit availability for the manufacturing sector.

Akpoghelie (2022) examined the interaction between monetary and fiscal policy and their impact on Nigeria's industrial sector from 1986 to 2021. Using the Autoregressive Distributed Lag (ARDL) model, the study found that both policy types significantly influenced industrial output, highlighting the need for a balanced approach to economic stabilization. The research also identified fiscal indiscipline as a major obstacle to effective policy implementation. The findings recommended the adoption of a more disciplined fiscal framework to complement monetary strategies, while recognizing the role of external factors such as globalization. Overall, the study emphasized the importance of managing the interplay between monetary and fiscal policies to promote industrial growth, calling for a reassessment of existing frameworks to better support Nigeria's economic development.

Effiong et al. (2024) examined the impact of fiscal policy, particularly interest rates and government spending, on Nigeria's industrial sector between 1981 and 2021. The study found that government spending has a detrimental impact on manufacturing production using time series analysis and the Autoregressive Distributed Lag (ARDL) and Error Correction Model (ECM) models. Foreign debt and government consumption spending had significant incremental effects on industrial production, but both domestic and foreign debts had no short-term effects on the sector. Advocating for a balanced fiscal policy that promoted industrial expansion without adverse effects, the findings emphasized the necessity for policymakers to reevaluate government spending patterns in order to improve manufacturing performance.

Based on the empirical review, the study formulated the following hypotheses:

H1: Exchange rate (EXR) does not significantly affect Manufacturing sector output in Nigeria.

H2: There is no significant relationship between Prime lending rate (PLR) and Manufacturing sector output in Nigeria

H3: There is no significant relationship between Treasury bill rate (TBR) and Manufacturing sector output in Nigeria.

3. Methodology

This study adopts a quasi-experimental (ex post facto) research design, as the researcher has no control over the data used. Secondary quarterly time series data from 2010 to 2023 on Nigeria's manufacturing sector output (MSOt), exchange rate (EXRt), prime lending rate (PLRt), treasury bill rate (TBR), and savings rate (SVRt) were sourced from the Central Bank of Nigeria Statistical Bulletin (2022). The analysis began with examining the time series properties of the variables using the Augmented Dickey-Fuller (ADF) unit root test to determine stationarity. Following this, cointegration tests, specifically the Johansen method, were employed to establish the existence of long-run relationships among the variables, guiding the choice of the appropriate econometric model. Model evaluation involved assessing the statistical significance of estimated coefficients at a 5% level, considering both short- and long-term dynamics.

The methodology ensures robust examination of how monetary and macroeconomic variables influence manufacturing sector output in Nigeria. Variables in the model include: MFOt = Manufacturing sector output, EXRt = Exchange rate, PLRt = Prime lending rate, and TBRt = Treasury bill rate. To examine the connection between Nigeria's manufacturing sector and monetary policy, the mathematical model is specified as follows:

$$MSOt = f(EXRt, PLRt, TBRt, SVRt) \quad \ldots\ldots (1)$$

The econometric model becomes:

$$MSOt = \beta_0 + \beta_1 EXRt + \beta_2 PLRt + \beta_3 TBRt + \beta_3 SVRt\ Ut \quad \ldots\ldots (2)$$

Equation 2 states that the output of the manufacturing sector (MSOt) depends on the exchange rate (EXRt), the prime lending rate (PLRt), the treasury bill rate (TBR), and the saving rate (SVRt). Theoretically, all the explanatory variables, exchange rate (EXRt), prime lending rate (PLRt and, and treasury bill rate (TBR) should be negatively related to production growth in the industrial sector. Theoretically, a rise in any of these factors should result in a slower rate of output growth in Nigeria's manufacturing sector.

4. Results and discussion

Table 1: Descriptive statistics result

	MSO	EXR	PLR	TBR	INF
Mean	4277.902	115.656	17.190	11.341	18.777
Median	3585.022	114.899	17.380	11.750	12.716
Maximum	6684.218	425.979	29.800	26.900	72.836
Minimum	2898.474	0.618	7.750	3.170	5.388
Std. Dev.	1347.242	119.183	4.647	4.791	16.490
Skewness	0.765	1.025	0.308	0.825	1.895
Kurtosis	1.947	3.230	3.467	4.232	5.471
Jarque-Bera	6.037	7.452	1.044	7.425	35.813
Probability	0.049	0.024	0.593	0.024	0.000
Sum	179671.900	4857.537	721.973	476.337	788.626
Sum Sq. Dev.	74417505	582385.600	885.285	941.225	11148.200
Observations	42	42	42	42	42

Source: author's compilation.

From Table 1, the mean value of manufacturing sector output (MSO) is 4277.902, while the median is 3585.022. The minimum value is 2898.474, and the maximum is 6684.218. These statistics indicate significant variations in MSO over time. The exchange rate (EXR) has a mean of 115.656 and a median of 114.899, with a minimum of 0.618 and a maximum of 425.979. The large difference between the minimum and maximum values shows that EXR has fluctuated substantially over the period. The prime lending rate (PLR) has a mean of 17.190 and a median of 17.380, ranging from a minimum of 7.750 to a maximum of 29.800. This indicates that variations in PLR over the years have been moderate. The treasury bill rate (TBR) has a mean of 11.341 and a median of 11.750, with a minimum of 3.170 and a maximum of 26.900, suggesting a moderate growth rate over time. Finally, the inflation rate (INF) has a mean of 18.777 and a median of 12.716, with a minimum of 5.388 and a maximum of 72.836. The wide difference between the minimum and maximum values indicates substantial inflationary fluctuations over the years.

Unit root test

Table 2: Phillip Perron (PP) unit root test

Variable	Test Equation	Level		First Difference		Order
		Stat	PV	Stat	PV	
EXR	I	3.259	1.000	-4.125	0.003	I(1)
	I & T	0.061	0.996	-4.797	0.002	
	N	5.212	1.000	-3.414	0.001	
INF	I	-2.901	0.054	-10.429	0.000	I(1)
	I & T	-2.996	0.146	-11.229	0.000	
	N	-1.836	0.064	-10.833	0.000	
MSO	I	-1.137	0.692	-4.352	0.000	I(1)
	I & T	-2.669	0.254	-4.522	0.000	
	N	-0.095	0.645	-4.435	0.000	
PLR	I	-3.374	0.018	-9.735	0.000	I(1)
	I & T	-3.219	0.095	-10.331	0.000	

	N	-0.379	0.545	-9.857	0.000	
TBR	I	-3.005	0.043	-7.695	0.000	I(1)
	I & T	-3.182	0.102	-9.129	0.000	
	N	-0.708	0.404	-7.817	0.000	

Source: Author's Compilation.

All of the variables are integrated at order one I(1), according to the results of the unit root test in Table 2. This is true since every variable's probability value at the level is higher than 0.05. This is located beneath the unit root test's PV column at the level. As a result, it is impossible to reject the null hypothesis that every variable is non-stationary at the level. Every variable's probability value is less than 0.05 under the PV column of the unit root at the initial difference. The null hypothesis, according to which every variable is non-stationary at the level, is thus disproved. Exchange rates (EXR), inflation (INF), prime lending rates (PLR), treasury bill rates (TBR), and manufacturing sector output (MSO) are therefore non-stationary at the level but become stationary after the first difference, according to the unit root test. Furthermore, the results of the unit root test showed that the variables became integrated at order one I(1). As a result, the model's long-term equilibrium relationship is tested using the Johansen cointegration test.

Johansen cointegration test

Table 3: Johansen cointegration test result

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.559	74.289	69.819	0.021
At most 1	0.379	41.544	47.856	0.172
At most 2	0.279	22.513	29.797	0.271
At most 3	0.151	9.451	15.494	0.325
At most 4	0.069	2.897	3.841	0.088

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.559	32.746	33.877	0.068
At most 1	0.379	19.030	27.584	0.412
At most 2	0.279	13.062	21.132	0.447
At most 3	0.151	6.554	14.264	0.543
At most 4	0.069	2.897	3.841	0.089

Max-eigenvalue test indicates no cointegration at the 0.05 level.
** Denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*
Source: Author's Computation.

There are two cointegrating equations for the Trace test and none for the Maximum Eigenvalue test, according to the cointegration test. This is acknowledged as a requirement for the model's long-term equilibrium connection to exist. The vector error correction model (VECM) is used to examine the adequacy condition. The vector error correction model is estimated after that.

Vector error correction model (VECM)

Table 4: Vector error correction model (VECM)

Dependent Variable: D(MSO)				
Method: Least Squares (Gauss-Newton / Marquardt steps)				
	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	0.003	0.008	0.380	0.707
C(2)	0.173	0.177	0.982	0.335
C(3)	0.054	0.177	0.303	0.764
C(4)	-0.222	4.304	-0.052	0.959
C(5)	2.997	4.456	0.673	0.507
C(6)	-4.865	26.191	-0.186	0.854
C(7)	-10.032	23.402	-0.429	0.672
C(8)	14.018	24.941	0.562	0.579
C(9)	-5.153	20.326	-0.254	0.802
C(10)	-8.682	5.209	-1.667	0.107
C(11)	-3.339	5.216	-0.640	0.527
C(12)	50.603	88.927	0.569	0.574
R-squared	0.191	Mean dependent var		80.094
Adjusted R-squared	-0.139	S.D. dependent var		392.052
S.E. of regression	418.402	Akaike info criterion		15.158
Sum squared resid	4726628.000	Schwarz criterion		15.670
Log likelihood	-283.589	Hannan-Quinn criterion.		15.342
F-statistic	0.579	Durbin-Watson stat		1.948
Prob(F-statistic)	0.829			

Source: Author's Computation.

The sign and importance of the one-period lag of the error correction term ECT (-1) in the vector error correction model (VECM) are the sufficient conditions for the existence of cointegration, whereas the Johansen cointegration result is a required condition. The error correction term should have a statistically significant negative sign. According to Table 4.4, the probability value is 0.7069, which is more than 0.05, and the error correction term's (ECT) sign is positive.

The sufficient requirement for the presence of a long-run equilibrium relationship in the model is not met since the coefficient's sign is incorrect. This means that the model, which uses the manufacturing sector output (MSO) as the dependent variable and the exchange rate (EXR), inflation (INF), prime lending rate (PLR), and treasury bill rate (TBR) as the independent variables, does not have a long-term equilibrium relationship. Ordinary least squares (OLS) are used to estimate the first difference model, which is described below.

First difference model result

Table 5: First difference model result

Dependent Variable: DMSO Method: Least Squares				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DMSO(-1)	0.326	0.197	1.657	0.108
DMSO(-2)	-0.204	0.174	-1.174	0.249
DMSO(-3)	0.237	0.167	1.424	0.165
DEXR	-3.830	3.648	-1.049	0.302
DPLR	30.174	18.326	1.647	0.110
DTBR	9.985	17.079	0.585	0.563
DINF	-4.675	4.935	-0.947	0.351
C	108.896	77.461	1.406	0.170
R-squared	0.192	Mean dependent var		88.918
Adjusted R-squared	0.003	S.D. dependent var		393.371
S.E. of regression	392.699	Akaike info criterion		14.969
Sum squared resid	4626366.000	Schwarz criterion		15.313
Log likelihood	-276.404	Hannan-Quinn criterion.		15.091
F-statistic	1.018	Durbin-Watson stat		2.029
Prob(F-statistic)	0.439			

Source: Author's Computation.

The result in Table 5 is evaluated by comparing the probability values of the test statistics to the chosen level of significance, which is five percent (0.05). An independent variable is statistically significant in explaining changes in the dependent variable if its test probability value is less than the selected level of significance (0.05). The independent variable in question is not statistically significant in explaining changes in the dependent variable; nevertheless, if its probability value is higher than 0.05. The exchange rate (EXR), inflation (INF), prime lending rate (PLR), and treasury bill rate (TBR) are the independent variables whose probability values are the probability values of the first, second, and third lagged values of the dependent variable are 0.108, 0.249, and 0.165, respectively, while the first difference is 0.302, 0.110, 0.563, and 0.351. Every probability value exceeds 0.05. According to the results, none of the variables can statistically explain changes in the dependent variable on an individual basis.

Diagnostic test

The model is subjected to a diagnostic test to assert the adequacy of the model.

Table 6: Breusch-Godfrey serial correlation LM test

F-statistic	0.112	Prob. F (2,25)	0.894
Obs*R-squared	0.347	Prob. Chi-Square (2)	0.840

Source: Author's Computation.

The absence of correlation in the model is the null hypothesis for the Breusch-Godfrey serial correlation LM test. If the observed R-squared probability value is less than 0.05, the test's decision rule is to reject the null hypothesis; if not, it is not. The null hypothesis that there is no serial correlation in the model cannot be rejected because the observed R-squared probability value is 0.8407, which is higher than 5%. The outcome shows that the model is not affected by the serial correlation econometric problem.

Discussion of results.

The study examined the relationship between monetary policy variables, exchange rate (EXR), prime lending rate (PLR), treasury bill rate (TBR), and savings rate (SVR), and Nigeria's manufacturing sector output (MSO) from 2010 to 2023. The analysis used time series econometric techniques, including unit root tests, Johansen cointegration, vector error correction model (VECM), and first-difference OLS regression. The descriptive statistics indicate substantial fluctuations in both the dependent and independent variables over the study period. Manufacturing sector output (MSO) varied widely, from a minimum of 2,898.47 to a maximum of 6,684.22, reflecting periods of both expansion and contraction. Similarly, the exchange rate exhibited extreme volatility, with values ranging from 0.618 to 425.979, demonstrating the vulnerability of the manufacturing sector to foreign exchange instability. Moderate variations were observed in prime lending rate (7.75-29.80) and treasury bill rate (3.17-26.90), while inflation fluctuated widely (5.39-72.84), highlighting significant macroeconomic instability.

The study's results further enabled the testing of the research hypotheses. Based on the first difference OLS regression, all the monetary policy variables exchange rate (EXR), prime lending rate (PLR), and treasury bill rate (TBR) were found to be statistically insignificant at the 5% level. Consequently, H1**,** H2, and H3 were all accepted, indicating that none of these variables exert a significant short-run effect on manufacturing sector output in Nigeria. The acceptance of these hypotheses suggests that monetary policy transmission to the manufacturing sector remains weak, both in the short run and long run. Although variables such as the exchange rate and inflation displayed coefficients are consistent with theoretical expectations showing negative effects. The lack of statistical significance indicates that the magnitude of these effects is insufficient to drive meaningful changes in manufacturing performance.

These descriptive trends are consistent with prior studies such as Obikaeze et al. (2023) and Salam et al. (2023), which emphasized that manufacturing performance in Nigeria is closely tied to macroeconomic volatility, including interest rates, inflation, and exchange rate fluctuations. The Phillip-Perron (PP) unit root test confirmed that all variables are non-stationary at levels but stationary at first difference, i.e., integrated of order one, I (1). This outcome aligns with the findings of Korolo (2022) and Otiwu et al. (2024), indicating that macroeconomic and monetary variables in Nigeria often exhibit trends or persistent shocks, reinforcing the importance of using cointegration techniques to explore long-run relationships.

The Johansen trace test indicated the existence of one cointegrating equation at the 5% significance level, suggesting a potential long-run relationship between the manufacturing sector output and the selected monetary variables. However, the maximum eigenvalue test did not confirm cointegration at 5%, indicating ambiguity regarding the long-run equilibrium. This partial evidence is supported by the VECM results, where the error correction term (ECT(-1)) was statistically insignificant and positively signed, violating the theoretical requirement for convergence. Consequently, the results suggest that the Nigerian manufacturing sector does not currently maintain a strong long-term equilibrium with monetary policy variables. This finding contrasts with studies such as Otiwu et al. (2024) and Effiong et al. (2024), which found significant long-term linkages between monetary/fiscal policies and industrial performance. The weak cointegration observed in this study may be attributed to structural inefficiencies, inconsistent policy implementation, and sectoral rigidities that dampen the transmission of monetary policy to manufacturing output.

The first-difference OLS regression results show that none of the monetary variables—exchange rate, prime lending rate, treasury bill rate, or inflation—were statistically significant at the 5% level in

explaining short-run changes in manufacturing output. Notably, the prime lending rate (PLR) had a positive coefficient (30.174), contrary to theoretical expectations that higher lending rates reduce output. Conversely, the exchange rate and inflation had negative coefficients (-3.830 and -4.675, respectively), consistent with the priori expectation that exchange rate volatility and inflationary pressures negatively affect manufacturing performance. The overall model fit was weak (R^2 = 0.192, adjusted R^2 = 0.003), implying that only a small fraction of variations in manufacturing output is captured by these monetary variables. This aligns with empirical studies like Chukwu (2023) and Adamu et al. (2022), which found that monetary policy alone may not significantly influence manufacturing performance without supportive structural and managerial interventions.

The Breusch-Godfrey LM test indicated no serial correlation in the model (Prob > 0.05), confirming the adequacy of the regression results for short-run inference. While the absence of serial correlation validates the reliability of coefficient estimates, the low explanatory power highlights the need to consider additional variables, such as fiscal policy, industrial capacity, foreign direct investment, and infrastructure development, to better capture the determinants of manufacturing growth. The results suggest several important implications: Consistent with Chukwu (2023) and Nwagu and Udeagbala (2024), the study underscores that monetary policy variables alone have limited short-run and long-run effects on the manufacturing sector in Nigeria. Structural bottlenecks, weak credit transmission mechanisms, and policy inconsistencies may undermine monetary policy effectiveness. The negative impact of exchange rate fluctuations highlights the vulnerability of manufacturing output to foreign currency instability, supporting findings from Obikaeze et al. (2023) regarding FDI and manufacturing growth. Echoing the recommendations of Olawale and Ismail (2024) and Akpoghelie (2022), there is a need for better coordination between monetary and fiscal policies to stimulate manufacturing output. Expansionary fiscal interventions, coupled with manageable interest rates and improved credit access, may enhance sectoral productivity. Given the low short-run significance of monetary variables, immediate policy measures such as improving credit availability, targeted sectoral support, and exchange rate stabilization could have stronger impacts on manufacturing growth.

5. Conclusion

In conclusion, the study revealed that traditional monetary policy tools, Interest rates and exchange rates, for example, had little bearing on how well Nigeria's industrial sector performed. It indicated that deeper structural issues within the sector, including inefficiencies and high operational costs, played a more critical role in influencing manufacturing output. The findings emphasized the necessity for targeted interventions and structural reforms to address these challenges effectively. Ultimately, a comprehensive policy approach that combines various strategies was deemed essential for boosting Nigeria's manufacturing sector's economic growth impact.

The government should make investments in vital infrastructure like communication, energy, and transportation to improve the performance of Nigeria's manufacturing industry networks, reduce operational costs, and improve efficiency. Additionally, simplifying regulatory processes and creating a transparent environment will help reduce bureaucratic delays and compliance costs for manufacturers. Increasing financial accessibility, especially for small and medium-sized businesses, through special credit facilities and guarantees, is also essential. Lastly, developing sector-specific strategies and promoting a favorable investment climate with targeted incentives will attract both domestic and foreign investments, positioning Nigeria as a manufacturing hub.

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