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ARTICLE

Does Monetary Policy Have a Direct Impact on the Real Sector? Evidence from Nigeria's Manufacturing and Solid Mineral Sectors.

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Abstract

This paper investigates the influence of Nigerian monetary policy on both the manufacturing and solid minerals sectors. The study employed Autoregressive Distributed Lag Model (ARDL) to estimate the relationship. The uniqueness of this study lies in the use of extensive monetary policy variables (money supply, exchange rate, credit advanced to each studied sector, interest rate, and inflation rate) to provide comprehensive evidence of their impacts on the sectors under investigation and the inclusion of the investigation on solid minerals sector. It is established in this paper that the monetary policy variables jointly influence the output from both the manufacturing and solid minerals sectors within the study period. Consequently, expansionary policy with respect to money supply and credit advanced to the manufacturing sector is found to be jointly significant. While interest rate expectedly has inverse influence on manufacturing output, the exchange rate unexpectedly has positive influence on the sector. For the solid minerals sector, both the interest and exchange rates have inverse effects on the sector, in line with a priori expectation. The study's conclusion implies that policymakers should prioritize ensuring accessible credit to the manufacturing and solid minerals sectors. It emphasizes the adverse impact of interest rate hikes on sectoral growth, urging cautious management of interest rates. Stabilizing the foreign exchange market is deemed essential for creating a conducive environment for growth. Policymakers are encouraged to implement measures that facilitate credit accessibility to investors in these sectors, supporting investment and expansion initiatives.

Keywords*:* Exchange rate, Inflation rate, Interest rate, Manufacturing sector, Monetary policy, Monetary policy rate and Solid minerals sector.
JEL Classification: *C32, G20, G21, G53*
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1. Introduction

Both the manufacturing and solid minerals sub-sectors fall under the real economic sector, and researchers have touted that the real sector is strategic and vital to the growth of any nation (**Pasten, Shoenle, & Weber, 2020**). With well-articulated strategic plans, the sector brings numerous benefits to a nation since it has the strongest influence on both economic growth and employment generation of a nation (**Anyanwu, 2010**). Effectiveness of government policies are easily recognized and assessed if they positively impact on the production and distribution of goods and services. A functional, effective, vibrant, and productive real economic sector has the capacity to create more linkages in the economy as well as promote internal and external balances (**Khari, 2015**).

Given that both manufacturing and solid minerals sectors have vital influence in the classification of an economy into developed, developing or underdeveloped nation, the dwindling and poor contributions of the two sectors to the Nigeria's Gross Domestic Product (GDP) is an issue of concern. For instance, within the period of sample, manufacturing sector recorded its highest contribution to GDP in 1982, contributing 11. 78 percent to the nation's output, but has remained below 10 percent since then till the present period. The solid minerals sector is no different as the sector's contribution to the nation's output is well below 1 percent within the period under review. There is also evidence of massive shutting down of companies in these sectors with the attendant loss of jobs over the years. Manufacturers Association of Nigeria (MAN) reported that between 1983 and 2009, a whopping 834 companies had closed in the sector. Also, the Nigerian Association of Chambers of Commerce, Industry, Mines and Agriculture (NACCIMA) noted that not less than 800 manufacturing companies were shut down between 2009 and 2011. This has prompted several literatures into investigating the mechanism of revamping the real sector of Nigeria, with majority seeing the monetary policy as a major instrument to spur investment in the sector.

Essentially, the literature is ripe on the effectiveness of monetary policy in influencing macroeconomic variables in a desired direction (**Joseph, Nwolisa, Obikaonu, & Alase, 2021**; **Osakwe, Ibenta & Ezeabasili, 2019**). The monetary policy has such basic goals as the promotion of stable prices, sustainable level of output, as well as growth of employment. In accordance with the macroeconomic theory, it is expected that the monetary policy will impact on the real economy through alterations in interest rates and money supply, which will be followed by movements in the capital cost and investment in the productive sector. Monetary policy stimulates the economy via a range of channels - credit, asset prices via exchange rates, interest rates, equity and housing prices, etcetera (**Mishkin, 2007**: **Oladimeji et al, 2021**).

To ensure monetary stability, the Central Banks, as a monetary authority, formulate and implement guidelines that secure a systematic growth of the economy. They do these through stability of variables that impact money supply with mechanisms like the open market operations, cash reserve requirement, monetary policy rate, and liquidity ratio. These are aimed at influencing liquidity and credit processes of deposit money banks and movement of reserves (**Masha *et al*, 2004**). Traditionally, monetary policy has been devoted to price stability (**Pasten et al, 2020**), but recently, higher consideration has been placed on the effects of monetary policy on the economic sectors, going by different reactions of sectors to shocks of monetary policy. The inferences for the macroeconomic management compel authorities in charge of monetary policies to assess the costs of their decisions on different economic sectors. The monetary policy tightening, for instance, might be viewed as generous from the broad perspective, yet it could be seen to be extreme for some sectors of the economy.

Several studies have investigated the influence of monetary policy on the manufacturing sector (**Asogu, 1996**; **Tomola *et-al*, 2012**; **Owolabi and Adegbite, 2014**; **Imoughele and Ismaila, 2015**; **Osmond *et-al*, 2015**; **Okonkwo et-al, 2015**; **Igbinedion & Ogbeide, 2016**; **Omini et-al, 2017; Ezeaku et-al, 2018**; **Osakwe et-al, 2019**), yet, none of the studies investigated monetary policy influence on the real sector from the perspective of manufacturing and solid minerals in Nigeria. Similarly, most of the earlier studies are flawed by series of methodological issues which cast doubts on the conclusions emanating from the findings, thus the need for further research in this regard.

The rest of the paper is organized into four sections. Section 2 provides a theoretical and empirical framework for the development of the models. Section 3 discusses research methodology, section 4 delves into empirical results and discussions, while section 5 provides conclusion and policy implications.

2.0 Literature Review

2.1 Theoretical Framework

Theoretical foundations laid by **Fisher (1932)**, **Keynes (1936)**, **Modiglani (1963)**, and **Friedman (1968)** have provided insight on how monetary policy transmit to the economy. For instance, Fisher in his quantity theory of

money - 'equation of exchange', established how monetary authority can influence both economic growth [volume of transactions (T)] and price level (P) through changes in money supply (M) and circulation of money [velocity(V)]. Specifically, Fisher believes that if velocity remains constant, doubling money supply will double the price level in an economy (**Ghauri et al., 2022; Wang et al., 2022**).

However, later economists like **Keynes (1936)** focused on the demand side and explained how money supply (through altering interest rate) influenced demand. This is done when the interest rate is prompted thereby touching cash holding and economic agents' investment. It is Keynes' idea that unemployment occurs from insufficient cumulative demand which could be altered through increase in money supply (**Aikman, Lehnert, Liang, & Modugno, 2020; Wang et al., 2022; Tonuchi & Onyebuchi, 2019**). This, according to Keynes, will generate increase in spending, increase in employment, and facilitates economic growth. Keynes believes that when demand is low, output will be falling and price will be rising but with increase in money supply, interest rate will fall which will increase investment and output and ultimately fall in price level. Some literature have argued that monetary policy from Keynes perspective works perfectly only during recession given that increasing money supply through lowering interest rate will put pressure on the price level and increasing price rather than decreasing the price level (**Pasten et al, 2020**).

Friedman (1968) extensively discussed the role of monetary policy that is swaying the size, cost and path of money supply. His stance is that inflation is often and universally a monetary sensation. He reasoned that, in the short run, unemployment could be reduced by increase in money supply, but inflation can also be generated. Therefore, he recommends that the monetary authorities should be cautious about a decision to increase money supply particularly when the economy is in upward trend.

Both the monetarist and Keynesian theorists largely scrutinized various transmission channels through which economy is affected by monetary policy. According to the monetarists, a money supply variation leads directly to a variation in the money real size. Friedman and Schwartz (1963 cited in **Pasten et al, 2020**) observed that the central banks' expansive open market operations increase stock of money, and these also leads to an upsurge in commercial banks' reserves and capacity to generate credit, which leads to an increase in money supply through the multiplier effect. They revealed in their work that both bank and non-bank establishments buy securities which feature the category traded by the apex bank so as to cut the amount of money in their portfolios. This is aimed at stimulating activities in the real sector. Tobin (1978 cited in **Aikman et al, 2020**) agrees with this view and looks at transmission influence as regards the choice assets portfolio as the monetary policy prompts asset swapping among bonds, equity, bank deposits, and commercial paper. His thinking is on the side of a belief that constricted monetary policy shakes liquidity and banks' capacity to loan out, and thus limits lending to business firms and key borrowers to the exclusion of consumption expenditure. These, he concluded, would contract effective investment and demand (**Ghauri et al., 2022; Wang et al., 2022**).

In the postulation of Keynesians, the variation in the stock of money does facilitate financial market activities by impacting on investment, interest rate, employment, and output, while **Modigliani (1963)** agrees with that opinion and in addition brought up 'the idea of capital rationing'. He believes that the readiness of banks to offer loan affects transmission of monetary policy. **Friedman (1968)** and some monetarists stressed that money supply is a main issue touching the safety of the economy. They want money supply to move at a stationary rate, rather than being structured and changed by the monetary authority. **Friedman (1968)** believes that the effects of money supply variations on spending and investment will be both direct and indirect, as long as money supply is a substitute for not only bonds but also numerous products.

2.2 Empirical Review

Several literatures have been devoted to investigating how monetary policy impacts the real sector. For instance, **Ezeaku, Imo, Ugwuanyi, Modebe, Agbaeze (2018)** investigated monetary policy transmission to Nigeria industrial sector using time series data between 1981-2014. The study specifically employed Error Correction Mechanism (ECM) and Johansson cointegration test to

investigate the impact of monetary policy on industrial sector output. The study reported a negative relationship between monetary policy mechanism variables (credit to private sector, interest rate, and exchange rate) and industrial sector output. Their findings contradict the most empirical literature that investigated the issue including prior literature. For instance, **Okonkwo and Godslove (2015)** investigated the impact of monetary policy on manufacturing sector in Nigeria between 1981 and 2012 using time series data. The study employed ECM to establish short-term relationship between the two variables. The study revealed a positive relationship between monetary policy variables and manufacturing sector output which is contrary to the negative relationship reported by **Ezeaku et al (2018)**.

Osakwe, Ibenta, Ezeabasili (2019) investigated the impact of monetary policy on the performance of the manufacturing sector between 1986 to 2017. The study employed Autoregressive Distributive Lag (ARDL) to model manufacturing sector output against monetary policy rate, treasury bills, money supply, and cash reserve requirement. It was discovered that in the short-run, monetary policy causes a positive impact on manufacturing sector output but not in the long run. The study concluded that monetary policy cannot be trusted to achieve economic stabilization in the long-run but could be effective in achieving macroeconomic stability in the short-run. This stance was also shared by **Akpunonu and Orajaka (2021)** despite employing a different methodology (ordinary least square (OLS) to investigate the impact of monetary policy on industrial sector output in Nigeria for the period of 1986 to 2019. It was reported that monetary policy variables like "Open Market Operation (OMO) measured by Treasury bill rate, Cash Reserve Ratio (CRR), had positive and significant effect on the Nigerian Manufacturing Domestic Sector Gross Product", while monetary policy rate has negative impact on manufacturing sector output. The study concluded that monetary policy had significant impact on industrial sector output and that monetary policy rate should be kept low to encourage investment in the manufacturing sector.

Similarly, **Oladimeji, Ebenezer, and Okodua (2021)** investigated the monetary policy mechanism to the real sector of the economy using quarterly data between Q1-2008 to Q4-2018. The study employed Structural Vector Autoregressive (SVAR) model to see whether there is a spillover effect of monetary policy on the real sector. The result revealed that there is a contemporaneous response of credit to real sector shocks from real sector business outlook. The study concludes that when there is prosperity and stability in the economy, business grows as they have access to more finance. The finding is consistent with the study of **Ayunku (2020)** who investigated the impact of monetary policy on manufacturing sector performance between 1981 and 2018. The study employed Vector Error Correction Mechanism (VECM) to validate a positive significant impact on manufacturing sector output within the period of review. The causality test also proved that changes in money supply precede changes in the performance of the manufacturing sector. The study therefore proposed that monetary authorities should implement feedback policies that will make for more loans to be given to the manufacturing sector. Also, the study proposed that government should create more intervention policies and a thorough feedback mechanism targeted to the manufacturing sector, as this will cause loans to be cheaper for investors.

Similarly, **Egbulonu and Ukwuoma (2018)** investigated "the impact of monetary policy on manufacturing sector growth in Nigeria from 1981-2016". The study employed VECM to ascertain the long-run and short-run relationship where exchange rate, interest rate, and money supply were regressed against manufacturing sector output. However, the study fails to find sufficient evidence that monetary policy has significant impact on manufacturing sector output, as it concludes that monetary policy should be made more innovative to impact the economy.

Bakare-Aremu and Osobase (2015) investigated the impact of both fiscal and monetary policy on the industrial sector of Nigeria using Error Correction Mechanism. It was discovered that there exists long-run relationship between monetary policy and industrial sector which is consistent with the literature. The study reached a conclusion that monetary policy has significant impact on the industrial policy of Nigeria. **Charles-Anyaogu (2012)** earlier used similar

econometrics test procedures such as unit root, diagnostic and granger causality to investigate how monetary policy affects manufacturing sector in Nigeria between 1980 and 2009. Money supply was found to be positively affecting manufacturing index performance, whereas inflation rate, exchange rate, lending rate, and company income tax rate negatively impacted on the performance of manufacturing sector. This indicates the importance of monetary policy in the growth of the manufacturing sector in Nigeria, and hence the economic growth.

In an attempt to determine the link among bank lending, economic growth and manufacturing sector in Nigeria, **Tomola *et-al* (2012)** used co-integration and vector error correction model (VECM) techniques in their work. The results show that manufacturing output in Nigeria is considerably influenced by both manufacturing capacity utilization and bank lending rates. It is shown in the paper that the manufacturing output growth is insufficient to produce substantial growth in the economy. However, the main research gap in the study lies in its inability to clearly establish relationship between manufacturing sector performance and economic growth in Nigeria. Making use of the error-correction model approach, **Igbinedion and Ogbeide (2016)** examined the relationship between monetary policy and manufacturing capacity utilization where the result of their work indicated that monetary policy variables considerably described roughly 81 percent of manufacturing sector performance.

Money supply, exchange rate, and private sector credit were all discovered to have positive outcome on manufacturing sector performance, while interest rate had a negative influence on the sector. Examining the effect of monetary policy on the performance of the manufacturing sector in Nigeria with the autoregressive distributive lag (ARDL), **Osakwe et-al (2019)** discovered in their paper that tools of monetary policy significantly influenced the manufacturing sector output in Nigeria, but only in the short run. They thereby concluded that tools of monetary policy might not be having a long run effect on the growth of the manufacturing sector output in the country.

However, a number of findings in the literature give the fiscal policy an edge over the monetary policy when we consider the speed and size of fiscal policy on the output and economic growth. For instance, **Bernanke and Blinder (1992)** argued that although money supply may be affected immediately by the policy change, it will take a long period before the real output is affected. In line with this argument by assessing the monetarist and Keynesian views, **Kretzmer (1992)** with the aid of causality test, variance decompositions, and impulse response functions, found that the power of monetary policy tends to deteriorate over time.

Awad and Al Sowaid (2005), while looking at the effectiveness of monetary and fiscal policy in Qatar, established that fiscal changes, compared to monetary changes, are more closely related to output growth over the study period. The results supported the argument that, in the long run, fiscal policy is more effective than the monetary policy. Going by their findings, over the long run, an increase of 10 percent in the money supply growth will raise economic growth by about 2.1, while an increase of 10 percent in government spending causes output to grow by 6.5 percent. The implication of these results is that public spending has larger influence on economic growth than changes in the money supply.

2.3 Developments in the Nigeria Manufacturing and Solid Minerals Sectors

Sectoral Analysis

The manufacturing and solid minerals sectors in Nigeria have largely enjoyed lifelines from the government when it comes to funding and policy directions. With the private sector making a tremendous contribution to the manufacturing sector in terms of investment and supporting the government in formulating appropriate policy for the sector's wellbeing, the private sector plays an important role in the success of the real sector (**Akpunonu and Orajaka, 2021**). The international best practice is designed for the private sector to play an active role only to be supported by the provision of conducive environment on the part of the government, and this propels the manufacturing and solid mineral sector to the path of growth expected. It is not

expected to see public institutions single handedly drive economic and political space of a country, and where public institutions are populated by many players, then the country will not be able to realise its full potentials.

In the 1980s, credit available for both manufacturing and solid minerals sectors was too meager for any meaningful activities to take place in those sectors. The credit advanced to the solid minerals sector was even worse. For instance, in 1981, N2.7 billion and N97.0 million were provided by the nation's economy to the manufacturing and solid minerals sectors, respectively. It was not until 1990s that the credit to both sectors became more significant for a reasonable growth to take place in those sectors. However, the credit given to solid minerals sector did not rise beyond a billion naira until 1993 when it stood at N1.6 billion.

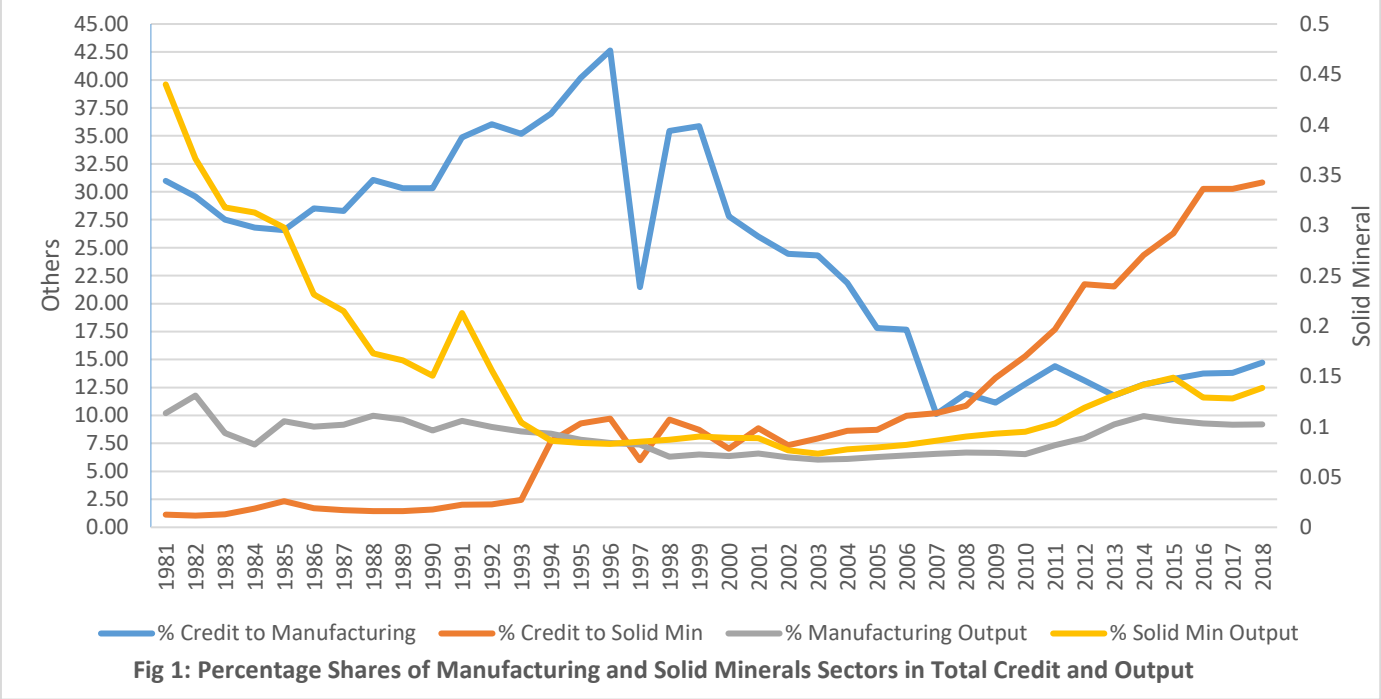

Figure 1: Percentage Shares of Manufacturing and Solid Minerals Sectors in Total Credit and Output

The credit for manufacturing sector continued to be multiples of that of the solid minerals sector over the years until 2007 when the credit to solid minerals sector began to be larger than that of the manufacturing sector. By that time, the credit to the solid minerals sector had become N490.71 billion when that of the manufacturing was N487.58 billion.

However, the availability of funds for both sectors could be better analysed if the credit available for either of the sectors is expressed as a percentage of the total credit available in the economy. Although, the percentage share of the manufacturing sector's credit was relatively high between 1981 and 2006 (17.66 to 42.63 percent), that of the solid minerals sector (1.04 to 9.96 percent) was very low. In 2007, the share of the total credit available to the solid minerals sector moved to 10.19 percent. By this period, the share from the total credit going into the manufacturing sector had begun to lie below that of the solid minerals sector (see Figure 1).

The contributions of both sectors in terms of output to the Gross Domestic Product (GDP) have been poor. While the manufacturing sector's contribution to the nation's total output was 10.2 and 11.78 percent in 1981 and 1982, respectively, it was never up to 10 percent in the remaining period under review. Worse still, that of the solid minerals sector was almost non-existent as its share was below 1.0 percent throughout the period.

The Manufacturers Association of Nigeria Local Content Group (MANLOG), in a paper presented at a workshop in 2011, provided clues to some of the reasons why the country is lagging so behind in terms of its manufacturing sector's contribution to the GDP when compared with countries of identical status. The Group, in its paper for the study carried out by the United Nations Industrial Development Organisation (UNIDO) in 2008, identified inadequate local raw materials, undue foreign competition, inadequate capital, insufficient demand, and inadequate physical infrastructure as some of the factors inhibiting the capacity of the sector to meaningfully contribute to the nation's economy. The mining industry worldwide spends about 10 percent of the value of its production annually on exploration, but in contrast, Africa only spends just about 1 percent. Although Africa holds more than 30 percent of the global resources of minerals and metals, the mineral exploration budget in 2010 was about $1.4 billion (13 percent of 2010's global budgets) [Metal and Economics Group (MEG, 2011)].

However, South Africa is a way above Nigeria and most other African countries as far as the development of solid minerals sector is concerned. For instance, in 2009, 2011, and 2013 when the sector accounted for 0.09, 0.10, and 0.13 percent of GDP in Nigeria, it contributed 9.1, 6.0 and 4.9 percent, respectively in South Africa and this is equivalent to one-third of the total capitalization of the Johannesburg Stock Exchange (JSE). Also, in Chile, the sector contributed a whopping 15.2 percent to the GDP in 2011. In the records of the Nigerian Federal Ministry of Mines and Still Development, the country generated N5.2 billion between 2009 and 2013 from royalties in mining (BusinessDay, 13 July, 2014). According to the Ministry, N736.92 million was generated in 2009; N889.46 million in 2010, N970.78 million in 2011, N1.12 billion 2012, and N1.45 in 2013.

Employment wise, while less than 10,000 jobs were created in the Nigerian solid minerals sector by 2012, those who were directly employed were over 500,000 in South Africa, 670,000 in the USA, 320,000 in Australia, and 200,000 in Canada (*www.brandsouthafrica.com*).

3.0 Research Methodology

3.1 Model Specification

Friedman (1968) proved that inflation is a function of money supply, with real national income (GDP) staying constant in the long-run; that is an increase in price level (inflation) is triggered by a rise in money supply, which is fueled by any rise in aggregate demand. **Keynes (2006)** established that the effect of money supply on interest rate only influences price level indirectly and its negative relationship on investment causes change in output and then price level. Based on these theoretical prepositions, the operational and analytical procedure of this study is founded on Keynesian IS–LM theory. To determine if manufacturing and solid mineral sectors' outputs are impacted by monetary policy, the study modeled both manufacturing and solid mineral sectors' outputs as a function of broad money supply, monetary policy rate, treasury bill rate, exchange rate, and credit advanced to manufacturing or solid mineral sector as seen in both equation (1) and (2).

$$LnMO_t = \beta_0 + \beta_1 LnM2_t + \beta_2 LnMPR_t + \beta_3 LnTBR_t + \beta_4 LnEXR_t + \beta_5 LnCRM_t + \varepsilon_t \quad (1)$$

$$LnSMO_t = \beta_0 + \beta_1 LnM2_t + \beta_2 LnMPR_t + \beta_3 LnTBR_t + \beta_4 LnEXR_t + \beta_5 LnCRSM_t + \varepsilon_t \quad (2)$$

Where: LnMO = Log of manufacturing sector output in GDP, LnSMO = log of solid mineral output in GDP, MPR = monetary policy rate, TBR = treasury bill rate, LnEXR= log of exchange rate, LnCRM = log of credit advanced to manufacturing sector, LnM2 = log of broad money supply, and LnCRSM = log of credit advanced to solid minerals sector. This study applied dynamic ARDL bounds testing to estimate both the short-run and long-run effects of equation (1) and (2) (Pesaran, Shin, & Smith, 2001). Equation (1 and 2) can be expressed in the ARDL form as given in equation (3 and 4):

$$\Delta lnMO_t = \alpha_0 + \sum_{i=1}^{n-1} \beta_1 \Delta lnMO_{t-i} + \sum_{i=0}^{M-1} \beta_2 \Delta lnMPR_{t-i} + \sum_{i=0}^{M-1} \beta_3 \Delta lnTBR_{t-i} + \sum_{i=0}^{M-1} \beta_4 \Delta lnM2_{t-i} + \sum_{i=0}^{M-1} \beta_5 \Delta lnInEXR_{t-i} + \sum_{i=0}^{M-1} \beta_6 \Delta lnCRM_{t-i} + \varphi_1 lnMO_{t-1} + \varphi_2 lnMPR_{t-1} + \varphi_3 lnTBR_{t-1} + \varphi_4 lnM2_{t-1} + \varphi_5 lnInEXR_{t-1} + \varphi_6 lnCRM_{t-1} + \mathcal{E}_t \ldots\ldots\ldots (3)$$

$$\Delta lnSMO_{Lt} = \alpha_0 + \sum_{i=1}^{n-1} \beta_1 \Delta lnSMO_{t-i} + \sum_{i=0}^{M-1} \beta_2 \Delta lnMPR_{t-i} + \sum_{i=0}^{M-1} \beta_3 \Delta lnTBR_{t-i} + \sum_{i=0}^{M-1} \beta_4 \Delta lnM2_{t-i} + \sum_{i=0}^{M-1} \beta_5 \Delta lnEXR_{t-i} + \sum_{i=0}^{M-1} \beta_6 \Delta lnCRSM_{t-i} + \varphi_1 lnMO_{t-1} + \varphi_2 lnMPR_{t-1} + \varphi_3 lnTBR_{t-1} + \varphi_4 lnM2_{t-1} + \varphi_5 lnInEXR_{t-1} + \varphi_6 lnCRM_{t-1} + \mathcal{E}_t \ldots\ldots\ldots (4)$$

Where *ln* is logarithm function, Δ is the first difference operator, and α_0 is the drift component. The expression with summation sign ($\beta_1 - \beta_6$) represents the short-run dynamics of the model, while the coefficients ($\varphi_1 - \varphi_6$) represents the long-run relationship and $\mathcal{E}_t$ is the serially uncorrelated disturbance with zero mean and constant variance. Once it is established that there exists a long-run relationship through the application of bounds cointegration test, the long-run relationship of the ARDL model can be estimated as given in equation (5 and 6):

$$lnMO_{Lt} = \varphi_1 lnMO_{t-1} + \varphi_2 lnMPR_{t-1} + \varphi_3 lnTBR_{t-1} + \varphi_4 lnM2_{t-1} + \varphi_5 lnEXR_{t-1} + \varphi_6 lnCRM_{t-1} + \mathcal{E}_t \quad (5)$$

$$lnSMO_{Lt} = \varphi_1 lnSMO_{t-1} + \varphi_2 lnMPR_{t-1} + \varphi_3 lnTBR_{t-1} + \varphi_4 lnM2_{t-1} + \varphi_5 lnEXR_{t-1} + \varphi_6 lnCRSM_{t-1} + \mathcal{E}_t \quad (6)$$

3.2 Data and Source

The data used in this study were obtained from various issues of the statistical bulletin of the Central Bank of Nigeria (CBN). Thus, the sample period consists of quarterly observations from 1981 to 2020 for each variable in the study. The values of manufacturing and solid minerals outputs in gross domestic product at constant basic prices were used as proxies for the performances of the sectors in the economy.

4.0 Empirical Results and Discussions

The study firstly subjected the time series to a unit root to determine if the series were integrated and at what level were they integrated. Specifically, the study employed both Augmented Dickey Fuller test and Phillip Perron (PP) to determine the absence or presence of unit root in the series. The result reveals that manufacturing sector output (MO), monetary policy rate (MPR), and treasury bill rate (TBR) are all stationary at level while exchange rate (EXR), money supply (M2), credit advanced to manufacturing sector (CRM), and credit advanced to solid minerals sector (CRSM) were stationary after the first difference. The fact that the series are fractionally integrated justifies the application of auto regressive distributed lag model (ARDL) to estimate both the short-run and long-run relationship of the model (**Joseph et al., 2021b**). As such, the study has employed bond long-run estimate to determine the existence of long-run relationship between monetary policy and the performance of the manufacturing and solid mineral sector.

Table 1: Augmented Dickey-Fuller and Philip Perron Test (trends and intercept)

Variable	ADF		I(d)	Philip Perron		I(d)	REMARKS
	At Level	1st Difference		At Level	1st difference		
lnMO	-5.028748***	-	I(0)	-5.311800***	-	I(0)	Stationary
LnSMO	-3.145615*	-8.378052***	I(1)	-3.119838*	-8.112880***	I(1)	Stationary
LnMPR	-3.737534***	-	I(0)	-3.721415***	-	I(0)	Stationary
LnM2	-3.325966*	-8.15166***	I(1)	-3.246146	-8.564073***	I(1)	Stationary
lnTBR	-3.651079**	-	I(0)	-3.747256***	-	I(0)	Stationary
LnEXR	-2.422031	-6.166022***	I(1)	-2.335426	-6.189396***	I(1)	Stationary
LnCRM	-2.821619	-6.617517***	I(1)	-2.733891	-6.764539***	I(1)	Stationary
LnCRSM	-3.243077*	-8.434895***	I(1)	-3.230159*	-8.934895***	I(1)	Stationary

Significance is indicated as follows: ***, ** and * for 1%, 5% and 10% respectively, all variables are logged
Source: **Researchers' Computation**

It is believed that given that some of the series are integrated at first order, that is, they were stationary after it was differenced, it means the long-run information might be lost in the process prompting the need to check for long-run relationship. To determine the existence or not of long-run relationship between the series, the study first specified a generalized ARDL model where the "optimal lag length, a VAR model was first specified for each of the models in Table 2. The optimal lag length was selected using a combination of AIC, FPE, SC, and HQ information criteria, and where there is a conflict between the various criteria, AIC" overrides others. This approach is consistent with the work of **Peters, Yaaba, Adetoba, Tomologu-Okunomo, and Joseph (2020)**. Similarly, the Breusch-Godfrey Serial Correlation test was also conducted for each of the models to ensure that the model is free from serial correlation while CUSUM square test was used to check for the stability of the model.

Table 2: ARDL Models for Monetary Policy Transmission in Nigeria

Variable	MO	SMO
Bond Statistics	6.6414***	7.546***
	LONG-RUN	**Relationship**
LnMPR	-0.078 (0.032)**	-0.021 (0.082)*
LnM2	0.112 (0.024)**	0.014 (0.048)**
lnTBR	-0.042 (0.121)	-0.003 (0.289)
LnEXR	0.113 (0.024)**	0.041 (0.023)**
LnCRM	0.459 (0.000)***	-
LnCRSM	-	0.383 (0.000)***
C	5.392 (0.000)***	0.445 (0.011)
R^2	0.6565	0.6181
F*(p-value)	0.0000***	0.0000***
Breusch-g	0.4261	0.3561
	SHORT	**RUN**
d(LnMPR)	-0.058 (0.022)**	-0.026 (0.032)**
d(LnM2)	0.142 (0.036)**	0.114 (0.040)**

d(LnTBR)	-0.012 (0.221)	-0.023 (0.189)
d(LnEXR)	- 0.103 (0.024)**	0.101 (0.023)**
d(LnCRM)	- 0.538 (0.000)***	-
d(LnCRSM)	-	0.305 (0.000)***
C	5.450 (0.000)***	5.797 (0. 003)
ECM(-1)	-0.4765 (0.000)***	-0.3415 (0.000)***
R^2	0.7467	0.6743
F*(p-value)	0.0000	0.0000***
Breusch-g	0.4382	0.1344

Significance is indicated as follows: ***, ** and * for 1%, 5% and 10% respectively, p-value in parenthesis. MPRI =(MPR*Infg), Breusch-G = Breusch-Godfrey Serial Correlation f-test p-value.

From the data in Table 2, we could see that there is a long-run relationship between and among the series at one (1) percent level of significance, given that the F-statistics of the bounds test is greater than the 1% critical value of the bond co-integration critical value of 4.35. Secondly, for all the models, that is for manufacturing sector and solid mineral models as seen in Table 2, the serial correlation test reveals the absence of serial correlation in each of the models whether in the long-run or short-run. The study further examines the CUSUM stability test which is used to check for the stability of the model, and to examine if each of the models is stable and consistent overtime as presented in Figure 2. The outcome reveals that all the models are stable given that the blue line in each case is bounded by the two red line.

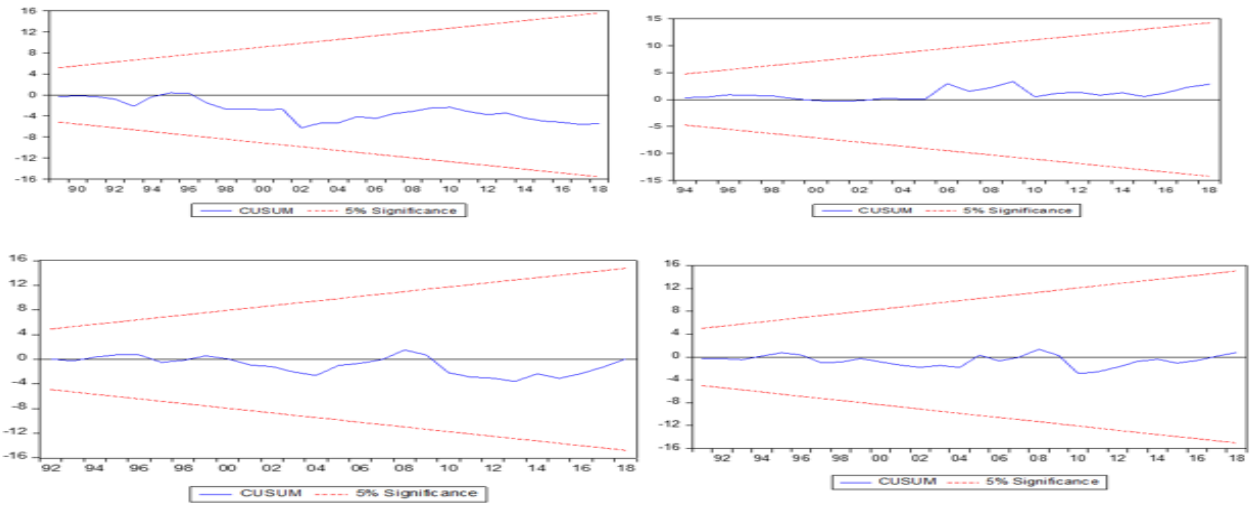

Figure 2: CUSUM Stability test

The study reveals that, of all the monetary policy variables examined, only treasury bill was found not to have significant impact on manufacturing sector output at 5 percent level of significance. In particular, it was revealed that a one percent increase in monetary policy rate will lead to about 7.8 percent decrease in manufacturing sector output in the long-run, while it will lead to 5.8 percent decrease in manufacturing sector output in the short run. Similarly, a one percent increase in money supply will lead to about 11.2 percent increase in manufacturing sector output in the long-run and about 14.2 percent increase in the short-run, which is consistent with apriori sign. A one percent increase in exchange rate will lead to about 4.2 percent increase in manufacturing sector output in the long-run, and lastly, a one percent increase in credit to manufacturing sector will lead to about 45.9 percent increase manufacturing sector output

within the sample period. The finding is consistent with apriori expectation that more credit to manufacturing sector will encourage more investment in the sector, which will in turn increase the output of the sector.

The second model is also consistent with the apriori expectation that a rise in interest rate will discourage funding in the solid minerals sector, as this will reduce credit to the sector and ultimately the investment in the sector. For instance, it was revealed that a one percent increase in monetary policy rate will lead to about 2.1 percent decrease in output of the solid minerals sector, while it will reduce the sector's output in the short-run by 2.6 percent. Similarly, a one percent increase in money supply will lead to increase in the sector output by 1.4 percent in the long-run and 11.4 percent in the short-run.

Lastly, a one percent increase in credit to the sector will increase the sector output by 30.5 in the short-run and 38.3 percent in the long-run. The study also revealed from the ECM that each of the models has the ability to adjust from long-run disequilibrium in the short-run. The f-statistics also revealed that monetary policy has significant impact on the output of both manufacturing and solid minerals in the country within the sample period. The study is consistent with the earlier studies by **Osakwe, Ibenta, Ezeabasili (2019)**, **Ayunku (2020)**, and **Igbinedion and Ogbeide (2016)**, who found that there is positive relationship between money supply, credit to manufacturing sector, and exchange rate on manufacturing sector output. The implication is that monetary policy is a veritable tool to influence investment in both manufacturing and solid minerals sector.

Furthermore, given that the marginal effect of credit to each of the sectors stands tall for both manufacturing and solid mineral sector implies that the central bank, through the deposit money banks, has a key role to play towards driving growth in the real sector by encouraging investment in the sector. This can be achieved through lowering the interest rate on credit advanced to the sectors. The finding is also consistent with the economic theory which argues that there is a negative relationship between interest rate and output.

V. Conclusion and Policy implication

The major finding from the study is that all the monetary policy variables jointly influenced the output from both the manufacturing and the solid minerals sectors within the study period except for treasury bill, which is only significant at 10 percent level in the long-run. Most importantly, expansionary policy with respect to money supply and credit advanced to the manufacturing sector is found to be significant and positive to the growth of the sectors in Nigeria. Similarly, hiking interest rate is inimical to the growth of both sectors, indicating that expansionary monetary policy will spur the needed growth in both sectors. This is also consistent with earlier studies and the theoretical literature.

The study concludes that monetary policy has a significant impact in both manufacturing and solid minerals sector within the period under review. It is also discovered that expansionary monetary policy will drive the needed growth in the sectors, if the monetary authorities intensify efforts in formulating policies that stabilize the foreign exchange market while making credit available to investors at an attractive interest rate in both sectors.

The study's conclusion implies that policymakers should prioritize ensuring accessible credit to the manufacturing and solid minerals sectors. It emphasizes the adverse impact of interest rate hikes on sectoral growth, urging cautious management of interest rates. Stabilizing the foreign exchange market is deemed essential for creating a conducive environment for growth. Policymakers are encouraged to implement measures that facilitate credit accessibility to investors in these sectors, supporting investment and expansion initiatives. The study underscores the significance of policy coordination among relevant authorities to ensure a harmonized and effective implementation of growth-supportive measures. In essence, fostering growth in the manufacturing and solid minerals sectors requires a targeted and coordinated approach to monetary policy.

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References

Aikman, D., Lehnert, A., Liang, N., Modungno, M. (2020). Credit, financial conditions, and monetary policy transmission. *International Journal of Central Banking, International Journal of Central Banking, 16(3), pages 141-179*

Akpunonu, U. E., Orajaka, U. P. (2021). Effect of monetary policy on industrial growth in Nigeria. *International Journal of Entrepreneurship and Business Innovation 4(1), 47- 60*

Akpunonu, U., Orajaka, U.P. (2021). Effect of Monetary Policy on Industrial Growth in Nigeria. Mutual Funds. *International Journal of Entrepreneurship and Business Innovation, 4(1), 47-60.*

Anyanwu, C. M. (2010). An overview of current banking sector reforms and the real sector of the Nigerian economy. *Central Bank of Nigeria (CBN) Economic and Financial Review, Vol. 48/4,31-57.*

Asogu, J. O. (1996). An econometric analysis of the relative potency of monetary and fiscal policy in Nigeria. *CBN Economic and Financial Review, 36(2), 1-21*

Awad, T., Alsowaidi, S. (2005). Effectiveness of monetary and fiscal policies: the Case of Qatar. *Journal of Business and Economics, 11(1), 112-129.*

Ayunku, P. E. (2020). An evaluation of monetary policy and manufacturing sector performance in the Nigerian economy. *KIU Journal of Social Sciences, 6(1), 19–27*

Bakare-Aremu, T. A., Osobase, A. O. (2015). Effect of fiscal and monetary policies on industrial sector performance-evidence from Nigeria. *Journal of Economics and Sustainable Development, 6(17), 67-82*

Egbulonu, K. G., Ukwuoma, C. C. (2018). Impact of monetary policy on the growth of the Nigerian manufacturing sector (1980-2016). *International Journal of Scientific & Engineering Research, 9(9), 1888-1900*

Ezeaku, H. C., Imo, G. I., Ugwuanyi, U. B., Modebe, N. J., Agbaeze, E. K. (2018). Monetary policy transmission and industrial sector growth: empirical evidence from Nigeria. SAGE Open, 8(2), 21582440187

Fisher, I. (1932). The theory of interest rate. *New York: Augustus Macmillan*.

Friedman, M. (1968). The role of monetary policy. *American Economic Review 58 (1):1-17.*

Gertler, M., Gilchrist, S. (1991). Monetary policy, business cycles and the behaviour of small manufacturing firms. *National Bureau of Economic Research, 2(5), 23-31*

Ghauri, S. P., Hamid, H., & Zaman, S. I. (2022). The Analyzing Various Channels of Monetary Policy Transmission Mechanism: The Case of Pakistan. *Market Forces*, *17*(1), 103-120.

Idowu, P.A., Baba, Y.N., Olufunso, A.O., Aduni, T.O., & Joseph, T.E. (2020). How effective is monetary policy in the presence of high informality in Nigeria. *Journal of Accounting, Business and Finance Research*, 10(2), 84-93

Igbinedion, S. O. & Ogbeide, F. (2016). Monetary policy and manufacturing capacity utilization: further evidence from Nigeria. *South-Eastern Europe Journal of Economics*, 2, 159–174.

Imoughele, L. E., Ismaila, M. (2015). Monetary policy and balance of payments stability in Nigeria. *International Journal of Academic Research in Public Policy and Governance*, 2(1), 1 – 14.

Joseph, T., Obikaonu, P., Ariolu, C., Nwolisa, C., & Aderohunmu, A. (2021). SMEs Intervention Programmes in Nigeria: Evaluating Challenges Facing Implementation. *Applied Journal of Economics, Management and Social Sciences*, *2*(1), 16–25

Joseph, T. E., Nwolisa, C. U., Obikaonu, P. C., & Alase, G. (2021). Monetary policy effectiveness and financial inclusion in Nigeria: FinTech, 'the Disrupter' or 'Enabler'. International Journal of Applied Economics, Finance and Accounting, 9(1), 19-27.

Keynes, J. M. (1936). *The general theory of employment, interest, and money. New York:*

Keynes, J. M. (2006). The general theory of employment, interest, and money. *New York: Atlantic Publishers & Distributors; originally published in 1936.*

Kretzmer, P. (1992). Monetary vs. Fiscal Policy: New Evidence on an Old Debate. *Economic Review, Federal Reserve Bank of Kansas City*, 77(2,) 21-30.

Macmillan Publishers.

Mishkin, F. S. (2007). Housing and the monetary transmission mechanism. *NBER Working Paper No 13518.*

Modigliani, F. (1963). The monetary mechanism and its interaction with real phenomena'. *Review of Economics and Statistics*, Supplement, 79-107

Okonkwo, O. N. et-al (2015). Monetary policy and the manufacturing sector in Nigeria". *SSRG International Journal of Economics and Management Studies,* 2(1), 11 – 19.

Oladimeji, O. E., Ebenezer K. Bowale, E. K., Okodua, H. (2021). Real sector business outlook and the effectiveness of monetary policy on the real sector in Nigeria. *International Conference on Energy and Sustainable Environment 23-25*

Omini, E. E. et-al (2017). Monetary policy shocks and industrial output in Nigeria". *British Journal of Economics, Management & Trade Article*. BJT.30459, 16 (2), 1–13.

Osakwe, A. C., Ibenta, S.N., Ezeabasili, V. N. (2019). Monetary Policy and the Performance of the Manufacturing Sector in Nigeria (1986-2017). *International Journal of Academic Research in Business and Social Sciences.*

Owolabi, A. U., Adegbite, T. A. (2014). Impact of monetary policy on industrial growth in Nigeria. *International Journal of Academic Research in Business and Social Sciences,* 4(1), 18 – 31.

Pasten, E., Schoenle, R., Weber, M. (2020). The propagation of monetary policy shocks in a heterogeneous production economy. *Journal of Monetary Economics, Elsevier, vol. 116(C), pages 1-22*

Tobin, J. (1978). A proposal for international monetary reform. *Easter Economic Journal, Easter Economic Association, 4(3):153-159.*

Tomola, M. O., Adebisi, T. E., Olawale, F. K. (2012). Bank Lending, Economic Growth, and the Performance of the Manufacturing Sector in Nigeria. *European Scientific Journal, 8(3), 67-81*

Tonuchi, J. E., & Onyebuchi, N. A. (2019). Economic diversification in Nigeria: The role of agriculture and manufacturing sector. International Journal of Research in Electronics and Computer Engineering, 7(3), 916-919

Wang, Y., Whited, T. M., Wu, Y., & Xiao, K. (2022). Bank market power and monetary policy transmission: Evidence from a structural estimation. *The Journal of Finance*, *77*(4), 2093-2141.