Mediating Role of Industrial Output on the relationship between Monetary Policy and Inflation in Nigeria

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Abstract
This study investigated the mediating role of industrial output on the relationship between monetary policy and inflation in Nigeria. Data were obtained from CBN statistical bulletin from 1990Q1 to 2019Q4. Monetary policy was proxied by monetary policy rate (MPR), prime lending rate (PLR), maximum lending rate (MLR), and treasury bills rate (TBR). The study employed Structural Equation Modelling (SEM) in analysis. It was found that monetary policy rate, prime lending rate, maximum lending rate, and treasury bills rate impacted positively on inflation in Nigeria. It was also found that industrial output impacted negatively on inflation, implying that an increase in industrial output will lead to a reduction in inflation in Nigeria. The study also found that industrial output played a partial mediation on the relationship between prime lending rate (PLR), maximum lending rate (MLR), and inflation but a complete mediation was found for industrial output on the relationship between monetary policy rates (MPR), treasury bills rate (TBR) and inflation in Nigeria. The study concluded that when industrial output is used as a mediator variable, on the relationship between monetary policy and inflation; monetary policy can effectively reduce inflation indirectly by boosting industrial output or production. The study recommends that to achieve the monetary policy objective of price stability, the monetary authority should reduce MPR, PLR, MLR, and TBR to boost industrial output, as industrial output has the potential of reducing the inflation rate in Nigeria.

Keywords: Inflation, Industrial Output, Prime Lending Rate, SEM

JEL Classification: C51, E31, E49, L70


1. Introduction

Monetary policy is a deliberate action of the monetary authorities to influence the supply, cost, and availability of credit in an economy, to achieve the desired macroeconomic objectives of internal, and external balances. The mandates of monetary authorities all over the world are to achieve price stability, rapid and sustainable industrial growth, full-employment equilibrium, and external balance. These aims of the monetary authority are achieved through the use of conventional and non-conventional monetary policy instruments such as monetary policy rate (MPR), treasury bill rate (TBR), prime lending rate (PLR), maximum lending rate (MLR), inter-bank rate (ITR), legal reserve requirement (LRR), deposit ratio (DR), money supply (M2), credit ceiling, special credits, moral suasion, and interventions.

The industry is an economic activity concerned with the processing of raw materials and the manufacture of goods...
in factories. It is the work and processes involved in collecting raw materials and making them into products in factories (Jhingan, 2004). A particular industry consists of all the people and activities involved in making a particular product or providing a particular service for human satisfaction. Inflation in economics is a sustained increase in the general price level of goods and services in an economy over some time. Economists are of the consensus that an increase in the general price level will lead to a unit of currency buying fewer goods and services, a reduction in the purchasing power per unit of money, loss of real value in the medium of exchange, and unit of account within the economy (Jhingan, 2004; Balami, 2006).

To the monetarists’ inflation is always and everywhere a monetary phenomenon, therefore change in monetary variables such as money supply can effectively control inflation. In the case of a rise in the prices of goods and services, a decrease in money supply can effectively reduce aggregate demand thereby reducing the prices of goods and services (Balami, 2006). This implies that monetary policy is and would continue to be an effective mechanism for controlling inflation. On the relationship between inflation and industrial output, the Phillips postulate observed that an increase in output can stimulate the supply of goods and services thereby reducing prices (inflation). This means that output (industrial output) can mediate the relationship between monetary policy and inflation. This could be done by increasing credit to the industrialists to boost their productivity, increase the supply of their products and reduce prices (inflation) (Phillip, 1958).

2. Literature Review

2.1 Theoretical Literature

Inflation is a persistent rise in the general price level of a broad spectrum of goods and services, especially goods consumed by the majority of the citizens of a country. There is a clear understanding that inflation can increase costs of living, which can in turn adversely affect the living standard of the people, hence the need to control it. The need to control inflation brought to the fore the monetary policy, which is a deliberate attempt by the monetary authority to ensure price and financial sector stability. The theoretical underpinning for this study, which links monetary policy, industrial output, and inflation is the Fisher quantity theory of money (MV=PQ), which says that inflation is determined by an increase in the money supply. This was based on the assumption that the velocity of money (V) and output (Q) is constant at full employment, hence any increase in money supply (M) leads to an increase in the price level (P). The study seeks to answer the question what if the volume of output (Q) in the Fisher equation changes? Can the change in the volume of output (industrial output) mediate the effect of monetary policy variables say money supply on inflation?

2.2 Empirical Literature

Studies were conducted on the relationship between monetary policy and inflation, monetary policy and industrial output as well as industrial output and inflation. Kutu and Ngalawa (2016) researched the monetary policy most of the studies reviewed were conducted on the link between either monetary policy and industrial output (see Kutu & Ngalawa, 2016; Ibe, et al. 2018), monetary policy and inflation (see Omolade, Nwosa, & Ngalawa, 2019; Nguyen, Papyrakisa, & Van Bergeijk, 2019), or industrial output and inflation (see Yakubu & Jibrin, 2013; Ezeaku, Gabriel & Paschal, 2017) with little or no study on the mediating role of industrial output on the relationship between monetary policy and inflation. The questions this study seeks to find answers to are: does industrial output mediate the effect of monetary policy on inflation in Nigeria? Can an increase in industrial production through the instrument of monetary policy reduce inflation in Nigeria? Does monetary policy have a direct significant effect on inflation in an industrialized economy?

The main objective of the study is to examine the mediating role of industrial output on the relationship between monetary policy and inflation in Nigeria. The study would contribute to the body of existing literature on the relationship between monetary policy, industrial output, and inflation, as well as serve as a policy document for the monetary and fiscal authorities. It will shed light on the mediating role of industrial output on monetary policy/inflation nexus in Nigeria and assist the government and the central banks to take an informed decision regarding price stability in Nigeria.

Following the introduction, Section 2 focuses on the literature review, Section 3 is the data and methodology, Section 4 is the results and discussion, and Section 5 is the conclusion and policy recommendations of the study.
Studies on inflation and output include Omolade, Nwosa, and Ngalawa (2019) who employed structural vector autoregression (SVAR) modeling technique and descriptive analysis in their study and found that manufacturing sector output growth is strongly affected by the inflation rate and monetary policy shocks. The study also revealed that the exchange rate channel of the monetary policy transmission mechanism is the most significant channel through which oil price shock affects manufacturing output growth in Nigeria. Similarly, Yakubu and Jibrin (2013) investigate the response of industrial output to changes in inflation rates and found that industrial output responds negatively to shocks emanating from changes in prices in Nigeria. In addition, Ezeaku, et al. (2017) observed that inflation, exchange rate, and real interest rate have a negative effect on industrial output in Nigeria.

There are studies conducted on how some variables mediate the effect of the relationship between other variables. Studies such as Agoba, Sare, and Bugri-Anarfo (2017) investigate the mediating role of financial development and innovation on the impact of financial inclusion on monetary policy in Ghana using content analysis and geographical distribution of studies. The study found that innovation directly spurs financial inclusion effectively through transfer or by mitigating the risk of providing financial services to the unbanked. Also, Almansour, Al-hajla, and Almansour (2019) investigated the mediating role of customer satisfaction in the relationship between factors influencing customers’ loyalty toward financial Services in Saudi Arabia using Structural Equation Modelling. They found that customer satisfaction significantly affects customers’ loyalty, but it does not have a significant mediating role in influencing the relationship between factors influencing the customers’ loyalty towards financial services in Saudi Arabia.

Most of the studies reviewed were conducted on the link between monetary policy and industrial output, monetary policy and inflation or monetary policy, industrial output and inflation with little or no study on the mediating role of industrial output on the relationship between monetary policy and inflation.

3. Data and Methodology

3.1 Data

The study used quarterly data ranging between 1990Q1 and 2019Q4 to evaluate and assess the mediating role of industrial output on the relationship between monetary policy and the inflation rate in Nigeria. Data for the study were sourced from CBN statistical bulletin 2019. The monetary policy is proxied by Monetary Policy Rate (MPR), Treasury Bills Rate (TBR), Prime Lending Rate (PLR), and Maximum Lending Rate (MLR), industrial output is the total output of the industrial sector, and the inflation rate.

3.2 Model specification

The model of this study was specified as follows:

\[ Y' = X' \beta' + \varepsilon' \] ……………………………… (3.1)

Where \( Y' \) is the vector of the dependent variables, \( X' \) is the matrix of the independent variables, \( \beta' \) is the vector of the parameters or coefficients, and \( \varepsilon' \) is the vector of the error term. The model is further specified thus:

\[ INF = f(MPR, TBR, PLR, MLR, IND) \] ……………………………… (3.2)

\[ INF = \alpha_1 + \beta_1 MPO + \varepsilon_1 \] ……………………………… (3.3)

\[ IND = \alpha_2 + \beta_2 MPO + \varepsilon_2 \] ……………………………… (3.4)

\[ INF = \alpha_3 + \beta_3 IND + \varepsilon_3 \] ……………………………… (3.5)

Where \( INF \) is the inflation rate, \( MPO \) is monetary policy variables, which includes MPR, TBR, PLR, and MLR, while \( IND \) is the industrial output, and \( \beta i \) are the parameters of the model while \( \varepsilon 1, \varepsilon 2, and \varepsilon 3 \) are the error terms.

3.3 Estimation Procedure

The study employed the Structural Equation Model (SEM) technique in estimating the mediating role of industrial output in the relationship between monetary policies proxied by Monetary Policy Rate (MPR), Treasury Bills Rate (TBR), Prime Lending Rate (PLR), and Maximum Lending Rate (MLR) as independent variables, while industrial output as mediating variable which served both as dependent and independent variable in the model. Industrial output is a dependent variable for monetary policy and an independent variable for inflation. Inflation served as the main dependent
variable in the model. Four different models were estimated in this study.

The choice of the model was based on the quantity theory of money. The Structural Equation Model (SEM) was chosen because it has an advantage over descriptive statistics, Multiple Regression Techniques, and Factor Analysis. SEM is the combination of factor analysis and multiple regression analysis; as well was used to test the proposed causal relationships between variables of a model which the aforementioned methods cannot do. It allows a set of relationships between one or more independent variables (IVs), either continuous or discrete, and one or more dependent variables (DVs). It also uses confirmatory factor analysis to reduce measurement error by having multiple indicators per latent variable, test model overall rather than coefficients individually, and test model with multiple dependents. SEM also can determine the mediating role of variables as well as handle complex and difficult data that may be non-normal and incomplete (Tabachnick & Fidell, 2014). The model of the study was estimated using the SPSS Analysis of Moments Structures (AMOS) graphic software, which is the theoretical linkage between monetary policy, industrial output, and inflation rate.

4. Results and Discussion

This section consists of the presentation and discussion of the results. Four different models of SEM with individual monetary policy variables (MPR, PLR, MLR and TBR) as an independent variable, industrial output as a mediating variable and inflation as the dependent variable.

Figure 4.1: Direct relationship between MPR and inflation in Nigeria

Source: SPSS Amos’s output

Figure 4.1 shows a direct relationship between monetary policy and the inflation rate in Nigeria. The regression result is captured in table 4.1.

Table 4.1: Regression Results for a direct effect of MPR and Inflation

<table>
<thead>
<tr>
<th>Inflation &lt;- MPR</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>C.R.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.274</td>
<td>.406</td>
<td>3.138</td>
<td>.002</td>
</tr>
</tbody>
</table>

Source: SPSS Amos’s output

The results revealed that an increase in MPR by one per cent will increase inflation by 1.274 per cent. The critical value of 3.138 and the probability value of 0.002 implies that MPR positively and significantly affects inflation in Nigeria when industrial output is not used as a mediating variable.

Figure 4.2: Mediating role of Industrial output on the relationship between MPR and Inflation

Source: SPSS Amos’s output
Table 4.2: Regression results for MPR and Inflation with industrial output as a mediator

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>S.E.</th>
<th>C.R.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>MPR</td>
<td>-0.029</td>
<td>.004</td>
</tr>
<tr>
<td>Inflation</td>
<td>MPR</td>
<td>.276</td>
<td>.436</td>
</tr>
<tr>
<td>Inflation</td>
<td>Industry</td>
<td>-34.649</td>
<td>7.705</td>
</tr>
</tbody>
</table>

Ra² = 0.234, Rb² = 0.191

Source: SPSS Amos's output

Figure 4.2 shows the indirect relationship between the monetary policy rate and inflation rate in Nigeria with industrial output as a mediator. The regression result is captured in Table 4.2.

The study revealed that when industrial output is incorporated in the model as a mediating variable, MPR impacted negatively on industrial output, and positive on inflation but industrial output impacted negatively on inflation in Nigeria. This implies that an increase in MPR will result in a decrease in industrial output but an increase in inflation. Also, an increase in industrial output will lead to a decrease in inflation as indicated by their coefficients of -0.029, 0.276, and -34.649 respectively, this is consistent with the theoretical expectation of the study. Also, a negative and significant indirect relationship was observed between MPR and industrial output, as well as between industrial output and inflation. This is reflected by their probability values of 0.000 and 0.000 respectively.

The study further revealed that the direct relationship between MPR and inflation was insignificant as indicated by its probability value of 0.527 when industrial output was incorporated as a mediating variable. The study, therefore, concluded that industrial output played a complete mediation in the relationship between MPR and inflation in Nigeria. This implies that for Nigeria as a country to achieve a reduction in inflation, MPR should be fixed in such a way that it will boost industrial output first, which can, in turn, reduce inflation, this is because with industrial output the direct effect of MPR is insignificant. The Ra² value of 0.234 linking MPR and industrial output implies that there is a moderate link between MPR and industrial output in Nigeria, while the Rb² value of 0.191 linking industrial output and inflation revealed also a moderate link between industrial output and inflation in Nigeria. Finally, the study found that a one per cent increase in the monetary policy rate will lead to a 0.029 per cent decrease in industrial output. While a one per cent increase in industrial output will lead to a 34.649 per cent decrease in inflation. This further implies that for a reduction in inflation to be achieved monetary policy rate must decrease.

Figure 4.3 shows the direct relationship between the monetary policy rate and the inflation rate in Nigeria. Table 4.3 contained the regression result.

Table 4.3: Regression results for a direct effect of PLR and Inflation

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>S.E.</th>
<th>C.R.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INFLATION</td>
<td>PLR</td>
<td>2.156</td>
<td>.389</td>
</tr>
</tbody>
</table>

Source: SPSS Amos's output

The results revealed that an increase in Prime Lending Rate (PLR) by one per cent will increase inflation by 2.156 per cent. The critical value of 5.546 and the probability value of 0.000 implies that PLR positively and significantly affects inflation in Nigeria when industrial output is not used as a mediating variable.

Figure 4.4: Mediating role of Industrial output on the relationship between PLR and Inflation
Table 4.4: Regression results for PLR and Inflation with industrial output as a mediator

<table>
<thead>
<tr>
<th></th>
<th>Coefficients</th>
<th>S.E.</th>
<th>C.R.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INDUSTRY &lt;---- PLR</td>
<td>-.038</td>
<td>.004</td>
<td>-9.188***</td>
<td></td>
</tr>
<tr>
<td>INFLATION &lt;---- PLR</td>
<td>1.297</td>
<td>.493</td>
<td>2.629 .009</td>
<td></td>
</tr>
<tr>
<td>INFLATION &lt;---- INDUSTRY</td>
<td>-22.830</td>
<td>8.444</td>
<td>-2.704 .007</td>
<td></td>
</tr>
</tbody>
</table>

Ra²=0.415, Rb²=0.251

Source: SPSS Amos’s output

Figure 4.4 shows the indirect relationship between prime lending rate (PLR) and inflation rate in Nigeria with industrial output as a mediator. The regression result is captured in table 4.4.

The study revealed that when industrial output is incorporated in the model as a mediating variable, PLR impacted negatively on industrial output, and positive on inflation but industrial output impacted negatively on inflation in Nigeria. This implies that an increase in PLR will result in a decrease in industrial output but an increase in inflation. Also, an increase in industrial output will lead to a decrease in inflation as indicated by their coefficients of -0.038, 1.297, and -22.830 respectively. This is also consistent with the theoretical expectation of the study. The study also reveals a negative and significant indirect relationship between PLR and industrial output, as well as between industrial output and inflation as shown by their respective probability values of 0.000 and 0.007. The study further revealed that the direct relationship between PLR and inflation was significant as indicated by its probability value of 0.009 when industrial output was incorporated as a mediating variable. The study, therefore, concluded that industrial output played a partial mediation in the relationship between PLR and inflation in Nigeria. Finally, this study also implies that for Nigeria as a country to achieve a reduction in inflation, PLR should be fixed in such a way that it will boost industrial output first, which can, in turn, reduce inflation, even though PLR exert a significant direct effect on inflation but it cannot reduce inflation. Prime Lending Rate can only reduce inflation via industrial output stimulation. The Ra² value of 0.415 linking PLR and industrial output implies that there is a strong link between PLR and industrial output in Nigeria, while the Rb² value of 0.251 linking industrial output and inflation revealed also a moderate link between industrial output and inflation in Nigeria.

Finally, the study found that a one per cent increase in the prime lending rate will lead to a 0.038 per cent decrease in industrial output. While a one per cent increase in industrial output will lead to a 22.830 per cent decrease in inflation. This further implies that for a reduction in inflation to be achieved prime lending rate must decrease. Figure 4.5 shows the direct relationship between the maximum lending rate and the inflation rate in Nigeria. Table 4.5 contained the regression result.

Table 4.5: Regression results for MLR and Inflation

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>S.E.</th>
<th>C.R.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INFLATION &lt;---- MLR</td>
<td>.239</td>
<td>.363</td>
<td>.660</td>
<td>.509</td>
</tr>
</tbody>
</table>

Source: SPSS Amos’s output

The results revealed that an increase in the Maximum Lending Rate (MLR) by one per cent will increase inflation by 0.239 per cent. The critical value of 0.660 and the probability value of 0.509 implies that MLR positively but insignificantly affects inflation in Nigeria when industrial output is not used as a mediating variable. Figure 4.6 shows the direct relationship between the maximum lending rate and inflation rate in Nigeria. Table 4.5 contained the regression result.

Source: SPSS Amos’s output
Figure 4.6 shows the indirect relationship between maximum lending rate (MLR) and inflation rate in Nigeria with industrial output as a mediator. The regression result is captured in Table 4.6.

Table 4.6 revealed that when industrial output is incorporated in the model as a mediating variable, MLR impacted positively on industrial output and inflation but industrial output impacted negatively on inflation in Nigeria. This implies that an increase in MLR will translate into an increase in industrial output and inflation. On the other hand, an increase in industrial output will lead to a decrease in inflation as indicated by their coefficients of 0.006, 0.483, and -38.420 respectively. The indirect relationship between MLR and industrial output was found to be positive but insignificant at 1 per cent as indicated by its probability value of 0.152. The indirect relationship between industrial output and inflation was negative and statistically significant at 1 per cent. This is captured by the probability value of 0.000. The study further revealed that the direct relationship between MLR and inflation was insignificant as indicated by its probability value of 0.135 when industrial output was incorporated as a mediating variable. The study, therefore, concluded that industrial output played a partial mediation in the relationship between MLR and inflation in Nigeria. Finally, this also implies that for Nigeria as a country to achieve a reduction in inflation, MLR should be fixed in such a way that it will boost industrial output first, which can in turn reduce inflation. The $R^2$ value of 0.017 linking industrial output and inflation implies that there is a weak link between MLR and industrial output in Nigeria, while the $R^2$ value of 0.223 linking industrial output and inflation revealed a moderate link between industrial output and inflation in Nigeria.

Finally, the study found that a one per cent increase in maximum lending rate will lead to a 0.006 per cent increase in industrial output. While a one per cent increase in industrial output will lead to a 38.420 per cent decrease in inflation. This implies that for a reduction in inflation to be achieved maximum lending rate must decrease and industrial output is increased.

Figure 4.7 shows the direct relationship between the Treasury bill rate and the inflation rate in Nigeria, and the regression result is shown in Table 4.7.

Table 4.7: Regression results for TBR and Inflation

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>S.E.</th>
<th>C.R.</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>INFLATION -- TBR</td>
<td>1.054</td>
<td>.29</td>
<td>3.58</td>
</tr>
</tbody>
</table>

Source: SPSS Amos’s output

Table 4.7 revealed that an increase in treasury bills rate (TBR) by one per cent will increase inflation by 1.054 per cent. The critical value of 3.583 and the probability value of 0.000 implies that TBR positively and significantly affects inflation in Nigeria when industrial output is not used as a mediating variable.

Figure 4.7: Direct relationship between Treasury bills rate (TBR) and Inflation

Source: SPSS Amos’s output

Figure 4.8: Mediating role of Industrial output on the relationship between TBR and Inflation

Source: SPSS Amos’s output
The study revealed that when industrial output is incorporated into the model as a mediating variable, TBR impacted negatively on industrial output but positively on inflation. Industrial output impacted negatively inflation in Nigeria. This implies that an increase in TBR will translate into a decrease in industrial output but an increase in inflation. On the other hand, an increase in industrial output will lead to a decrease in inflation as indicated by their coefficients of -0.023, 0.306, and -33.112 respectively. This further suggests that the result is consistent with the theoretical expectation of the study. In addition, a negative and significant indirect relationship was observed between TBR and industrial output, as well as between industrial output and inflation. This is reflected by their probability values of 0.000 and 0.000 respectively. The study further revealed that the direct relationship between TBR and inflation was insignificant as indicated by its probability value of 0.350 when industrial output was incorporated as a mediating variable. The study, therefore, concluded that TBR has the potential of reducing inflation rate in Nigeria. It was also found that industrial output impacted negatively on inflation, implying that an increase in industrial output will lead to a reduction in inflation in Nigeria. In conclusion, therefore, when industrial output is used as a mediating variable, monetary policy can reduce inflation indirectly by boosting industrial output or production. The study also found that industrial output played a partial mediation on the relationship between prime lending rate (PLR), maximum lending rate (MLR), and inflation. A complete mediation was found for industrial output on the relationship between monetary policy rates (MPR), treasury bills rate (TBR), and inflation in Nigeria.

The study recommends that to achieve the core mandate of the Central Bank of Nigeria of maintaining price stability (controlling inflation), the monetary authority should reduce MPR, PLR, MLR, and TBR to boost industrial output, as industrial output serves as a mediating variable in the relationship between monetary policy and inflation rate and has the potential of reducing inflation rate in Nigeria.

5. Concussion and policy recommendation
This study was conducted to examine whether or not industrial output can mediate the effect of monetary policy on inflation in Nigeria. Monetary policy was proxied by monetary policy rate (MPR), prime lending rate (PLR), maximum lending rate (MLR), and treasury bills rate (TBR). The study revealed that monetary policy rate, prime lending rate, maximum lending rate, and treasury bills rate impacted positively inflation in Nigeria. It was also found that industrial output impacted negatively on inflation, implying that an increase in industrial output will lead to a reduction in inflation in Nigeria. In conclusion, therefore, when industrial output is used as a mediating variable, monetary policy can reduce inflation indirectly by boosting industrial output or production. The study also found that industrial output played a partial mediation on the relationship between prime lending rate (PLR), maximum lending rate (MLR), and inflation. A complete mediation was found for industrial output on the relationship between monetary policy rates (MPR), treasury bills rate (TBR), and inflation in Nigeria.

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