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MONETARY POLICY AND INDUSTRIAL SECTOR PERFORMANCE IN NIGERIA: MEASURING THE EXTENDED IMPACT ON THE ECONOMY

Christopher Nyong Ekong[1] and Uduak Michael Ekong[2]

[1]*Department of Economics, Faculty of Social Sciences, University of Uyo, Uyo, Akwa Ibom State, Nigeria.*
E-mail: chrisnekong@gmail.com
[2]*Department of Economics, Faculty of Social Sciences, University of Uyo, Uyo, Akwa Ibom State, Nigeria.*
E-mail: uduakekong123@gmail.com

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Abstract: The study empirically investigates the impact of monetary policy shocks on the performance of the industrial sector in Nigeria, and how this affect the general growth performance of the economy in the periods 1980-2018. Monetary policy variables used were money supply ($M2_t$), monetary policy rate (Mpr_t), Treasury bill rate (Tbr_t) and Credit to the private real sector ($Cred_t$). We also gauged the system with other control variables like gross fixed capital formation (gcf_t), inflation (π_t) and exchange rate (exr). Utilizing Vector Autoregression (VAR) and Generalized Method of Moments (GMM), we found that any unanticipated shock on monetary policy rate and money supply growth will produce falling impact on industrial sector output that is consistent with no sign of convergence throughout the period. However, shocks to credit supply and treasury bill rate produces positive growth outliers at different magnitudes in the industrial sector. We also found statistically significant pass-through effect of monetary policy from the industrial sector to the general economy of at least 30 percent growth effect. A number of possible policy menu capable of deepening monetary policy-industrial performance nexus in Nigeria in years following the study have been prescribed in the study-including improved stock market development, bond market development and other credit channels that easily linked policy to the private sector for seamless policy transmission.

Keywords: Monetary Policy, Industrial Sector, Passthrough, Performance, Nigeria.

1. INTRODUCTION

Earlier perception of the effect of monetary policy on output was that monetary policy affects the general economy at the same magnitude. The baseline frame work for the

analysis was the traditional investment-savings money market nexus where a single interest rate determines a single output level in the economy. There are well-documented evidences in the literature both theoretical and empirical, that monetary policy affects the real economy in the short run and in the long run both in developed as well as developing countries (Omotor, 2007; Samba, 2013). In Nigeria for instance, many studies have investigated this economy-wide impact of monetary policy (Chuku, 2009; Ndekwu, 2012; Obadeyi, Okhiria and Afolabi, 2016). As Ghosh (2009), pointed out, this view conveys a potential weakness as it ignores the possible differential effects of monetary policy across sectors of the economy, notably the industrial sector. Thus, this disaggregated effect of monetary policy is gaining greater popularity in the financial literature. For instance, Fares and Srour (2001) showed evidence of disaggregated sectoral response to innovations in monetary policy in the Canadian economy, and Peersman and Smets (2005) demonstrated that differential effects across industries in the Euro Area has been a major factor in explaining the conduct of monetary policy in the region. More generally, an economy could be disaggregated on two major bases. An economy could be disaggregated on regional basis or on sectoral basis contributing to the aggregate output of an economy. Our study focuses on the second proposition, the influence of monetary policy on the industrial sector of the Nigerian economy and how this transmits to the entire economy over time.

Monetary policy affects different sectors of the economy at multivariate level. The differences may be due to difference in the structural makeup of the sectors, or it may be due to the nature and volume of production generated by the sector. Otero (2017) showed that this may also be due to the higher elasticity of demand for produced goods. Ahmed, Shah, Agha and Mubarik (2005) argued that access to credit market may limit a sector's response to monetary policy. Also, not to be swept away is the time lag in responding to policy changes which may be different across sectors of the economy. As noted by Alam and Waheed (2006) the differential sectoral response has serious implications for the conduct of monetary policy which must be taken into account by central bankers because while a particular monetary policy innovation might have favourable output effects on the economy as a whole, the individual sectors might react differently to it. Based on the forgoing, superior consideration should be given to the impact of monetary policy innovations on the performance of other sectors such as the industrial sector. This is important for as Omini, Ogbeba and Okoi (2017) rightly noted, any adverse effects of monetary policy on the industrial sector will usually be transmitted to the rest of the economy.

The industrial sector is the life wire of any economy. It is the productive hub of the economy. It confers many benefits to the nation as it has been adjudged to have the strongest pull on a nation's economic growth and employment generation (Anyanwu 2010). In many economies, the performance of the industrial Sector is a gauge for

assessing the effectiveness of macroeconomic policies. Government policies can only be deemed successful if they impact positively on the production and distribution of goods and services. A vibrant and productive industrial sector creates more linkages in the economy and promotes internal and external balance (CBN, 2014).

Understanding the responses of the disaggregated components of the real economy is important for a number of reasons. A disaggregation is imperative given that different sectors have different capital intensities that generate different responses in sectoral performance from monetary policy. These differences in responses are largely disguised at an aggregate level – thus making the disaggregated approach more informative than aggregate method for the purpose of analyzing the transmission mechanism of monetary policy (CBN, 2014).Furthermore, knowledge of the size, timing, and persistence of monetary policy shocks on economic activities provides the monetary authority with vital information required to fine-tune policy initiatives towards stabilizing the macroeconomy, and the sub-sectors in particular.

Despite the emergence of disaggregated sectoral response to monetary policy innovations in the literature, little evidence on this count has been forthcoming in the context of emerging economies (Ghosh, 2009), and much less in Nigeria. However, the Central Bank of Nigeria (CBN) (2014) undertook sectoral analysis of the real economy at a disaggregated level including the manufacturing sector. Also, Omini, Ogbeba and Okoi (2017) showed the effect of monetary policy on two subsectors of the industrial sector. This study seeks to bridge the existing gap in the literature.

The industrial sector is very germane to the growth and development of every economy, more so a developing economy like Nigeria. Its importance is seen in, but not limited to, employment creation and wealth creation. Thus, concern is raised whenever the industrial sector is not working optimally. This is the case with the Nigerian industrial sector. Available data shows that the Nigeria industrial sector is dwindling. As shown in Figure 1.0 the subsectors performance declined for most of the years between 1977 and 2017. The manufacturing subsector contribution to real sector output fell from 7.7 percent in 1977 to 5.60 percent in 1981. It further declined from 6.0 percent in 1987 to 4.3 percent in 2003 and ultimately 3.7 percent in 2009. In 2016, the manufacturing subsector's contribution to real output was negative, -2.9 percent. The building and construction subsectors' contribution to real sector output did not fare any better. The sector's contribution fell steadily from 7.8 percent in 1977 to 2.8 percent in 1981, and to as low as 1.8 percent in 1990. In 2007 building and construction subsector contributed not more than 1.72 percent to real sector output and has grown from there to above 6 percent in 2011. However, that growth was not sustaining, as its contribution suddenly fell again to approximately 3.0 percent in 2016 and 2017 respectively. Empirical evidence from the mining and quarrying subsector showed that their contribution to

real output however, of around 30 percent between 1977 and 2003, had taken a continuous downward trend to as low as 15 percent in 2011 and further decline to a much lower value of 10 percent in 2017.

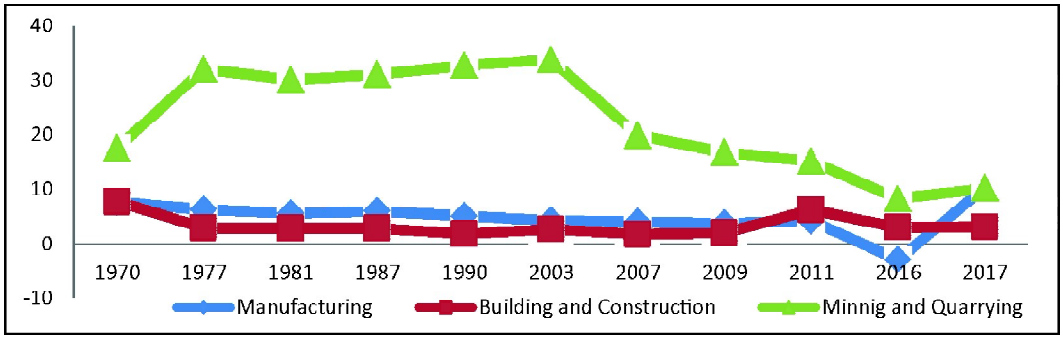

Figure 1: Industrial subsector's contribution to real output in Nigeria, 1970 – 2017

Source: Author, based on data from National Accounts Statistics of Nigeria and National Bureau of Statistics.

Such sub-sectoral decline may have no doubt translated into the general industrial sector decline (Figure 1.2). As noted by the World Bank Development indicators, industrial sector contribution to GDP fell from 52 percent in year 2000 to less than 44 percent in 2005. It further declined to 25.3 percent in 2010, losing more than 18 percent of its contribution. In the year 2015, the contribution of the industrial sector to GDP was less than 21 percent.

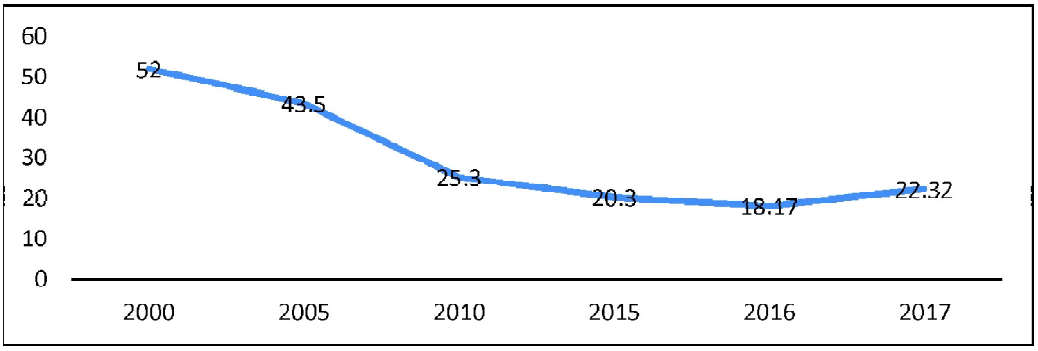

Figure 1.2: Contribution of Industrial Sector to GDP in percentages, 2000-2017

Source: Author, based on data from World Development Indicators for| Nigeria

The downward performance of the industrial sector was in sharp contrast with the conduct of money supply as an arm of the anchor of monetary policy in Nigeria. For instance, money supply growth has been on the increase for most of the years. The

growth rate of money supply was 5.9 percent in 1981, but grew to 14.02 percent in 1983. It further grew from about 9 percent in 1985 to almost 33 percent in 1988; has maintained a steady growth from 13 percent in 1989 to a peak of almost 64 percent in 1993 and even when it should decline, has continue to maintain a high double digit of almost 20 percent in 1995. From 1996 to the year 2000, money supply jumped from 16 percent to almost 49 percent. Such upward swing was also observed for the years 2003 to 2007 where it grew steadily from 13.5 percent to 65 percent before declining, but maintaining double digits for most of the years up to 11.6 percent in 2016. This high growth of money supply to the economy rightfully reflects the banking system's financial assistance to the industrial sector. Within a ten-year period, the average growth rate of credit to the private sector increases in general as well as the credit assistance to the industrial sector in particular (Table 1.0).

Table 1.0: Financial Assistance to the Industrial Sector

Years	*1981-1990*	*1991-2000*	*2001-2010*	*2011-2016*
Credit Supply to Private Economy	13.7%	23.0%	24.8%	11.1%
Credit Supply to Industrial Sector	8.7%	21.0%	22.5%	21.0%

Source: CBN Statistical Bulletin (various issues)

Private sector credit grew from 13.7 percent between 1981-1990 period to 23 percent between 1991-2000 period on the average. Within the same period, credit advances to the industrial sector grew from 8.7 percent to 21 percent respectively. For the following ten years (2001-2010), the growth rate of private sector credit was 24.8 percent on the average and credit advances to the industrial sector was 22.5 percent, both witnessing a growth rate of 1.8 and 1.5 percent respectively on the average. However, from 2011 to 2016, the average growth rate of credit supply to the private economy and the industrial sector were 11.1 percent and 21.0 percent respectively. Generally, Table 1.0 show that the conduct monetary policy may have generated more credit to the private sector in general (of which the industrial sector is a part) and the industrial sector in particular.

The current mismatched in the flow of financial assistance to the industrial sector and the performance of the sector itself in terms of output growth is a necessary motivation for the study which seeks to investigate the impact of monetary policy shocks on the performance of the industrial sector in Nigeria, and how this affect the general growth performance of the economy in the periods 1980-2018. Consequently, we seek to empirically investigate the impact of monetary policy shocks on the performance of the industrial sector in Nigeria, and how this affect the general growth

performance of the economy in the periods 1980-2018. The extended pass through to the economy has often been the neglected episode in the literature that drives further interest.

2. THEORETICAL REVIEWS

2.1. Conceptual Framework

The conceptual construct of our monetary policy-industrial sector performance follows the traditional behaviour of how money affects the economy. The monetarist showed that monetary policy could affect the economy through the following relations.

$$mv = py \tag{2.1}$$

Where, m is money stock; v is the velocity of money circulation; p is the price level and y is the level of economic activity. Under certain assumptions, for instance the constancy of and , fluctuations in money stock will produce a one for one consequence on the level of economic activity. Monetary policy actions focuses on adjusting to achieve the desired level of prices p (price stability) or the desired level of economic output or real economic activity py. Equation (2.1) is often referred to as Fisher's equation of exchange. Vifials and Valles (2007) argued that equation (2.1) provide sustained relationship of monetary expansion that finances trend growth of output and increase in the general price level. The original fisher's equation concentrated on maintaining price stability on the assertion of money neutrality on real economic activity. However, growing concerns of non-neutrality of money in economic activity, have made the examination of the relationship between m and y a plausible exercise. Sectoral monetary policy impact analysis abstracts from the economic wide relationship of equation (2.1) to show that equation (2.2) is analyzable.

$$mv = pId \tag{2.2}$$

Where Id is industrial sector performance index. Other variables are as already defined.

Mankiw (2010) also showed that monetary policy can affect the economy through an appropriate aggregate demand function of the form;

$$y = \hat{y} + \partial(r_t - p_t) + u_t \tag{2.3a}$$

Where, y is aggregate output and $\partial < 0$. $\hat{y}$ is potential output, r_t is nominal interest rate, p_t is the price level and u_t is other demand shocks. Chavula (2016) extended equation (2.3a) to incorporate an open economy e_t on the argument of global inclusion.

$$y = \hat{y} + \partial(r_t - p_t) + e_t + u_t \tag{2.3b}$$

Monetary policy enters the aggregate demand function according to the Taylor's rule

$$r_t = p_{t-1} + (1-p)(g_\pi \pi_t + g_y y_t) \tag{2.4}$$

Where is nominal interest rate, captures the degree of policy inertia, and measures the response of monetary policy to movements in inflation and the output gap respectively. Accordingly, monetary authorities target the interest rate in the economy through policy adjustment to affect the aggregate demand function (Kwapil and Scharler, 2006).

Again, it is possible to show through abstraction, that what affects the general economy may explicitly affect different sectors of the economy differently, particularly the industrial sector due to its potent impact on the general economy.

2.2. Theoretical Literature Review

The perceived contributions of the industrial sector to enhancing economic growth have prompted many economists to investigate how monetary policy fine tuning impact on industrialization. In what follows, we review these theories.

2.2.1. Keynesian theory on the effect of Monetary Policy on the Economy

Economic theory relied on the quantity theory of money in explaining the effectiveness of monetary policy in the economy. Keynesian economics believed that monetary policy affects real economic activity. They held that changes in money supply can permanently change the levels of interest rate, aggregate demand, the level of economic employment, output and income. Because there is unemployment equilibrium in the economy, an expansionary monetary policy leads to a fall in interest rate. Changes in the rate of interest occur, due to change in the demand for, or the supply of money. Nwoko, Ihemeje and Anumadu (2016) noted that Keynesians believed that interest rate is the key determinant of investment in the economy.

Given the marginal efficiency of capital, this fall in the rate of interest will increase demand for investment funds, and hence, investment. The increased investment will raise effective demand through the multiplier effect thereby increasing income, output and employment. With the monetary policy effect on interest rate the economy can grow through investment, notably investment from the industrial sector that likely will depend on external finance for business expansion.

2.2.2. Monetary theory on the effect of Monetary Policy on the Economy

The monetarist believed on the indirect pass-through of monetary policy to the economy (the interest rate mechanism) and more strongly, on a direct process of citizens portfolio adjustment. The argument is that the public portfolio balance consists of a wide variety of assets such as bonds, equities, bills, shares, commercial papers savings, mortgages, etc. Thus, when the central bank purchases securities in open market, it sets in motion a portfolio disturbance through the substitution and wealth effects on citizens' portfolios. If the portfolio imbalance increases income in the hands of the citizens, they could

spend it on buying liquid assets and near money, which increases their market price. These effects will ultimately increase aggregate money demand and expand output. Onakoya, Ogundajo and Johnson (2017) argued that this course has similar implications for the manufacturing sector, a sub-set of the national economy.

2.3. Review of Empirical Literature

2.3.1. Review on Monetary Policy behaviour and Industrial Sector Performance

Omini, Ogbeba and Okoi (2017) examined the effect of monetary policy shocks on the industrial output of Nigeria from 1970 to 2015. Two sub-sectors of the industrial sector, the manufacturing subsector and the mineral subsector were analyzed using Restricted Vector Error Correction model (VECM) and Granger Causality test techniques. Their outcome revealed a positive response of the manufacturing subsector to monetary policy innovations. However, the mineral subsector had a favourable response to banking system credit. Moreover, monetary policy granger-caused the manufacturing subsector in Nigeria. Based on these findings, they recommended sectoral considerations in monetary policy decisions of the apex bank.

Bakare-Aremu and Osobase (2015) examined the impact of both monetary and fiscal policies on the performance of the industrial sector in Nigeria from 1970 to 2009 using the manufacturing sub-sector as a case study. In their study, lending rate, money supply and exchange rate were used as proxy for monetary policy impact. Utilizing error correction model as technique of analysis, they showed that lowering exchange rate and increasing money supply to the manufacturing sector can grow the sub-sector generally. They thus concluded that effective use of monetary policy as stabilization tool will improve the manufacturing sub-sector all year round.

Onakoya, (2018) explored the effects of macroeconomic performance on the development of the manufacturing sub-sector in Nigeria from 1981 to 2015. Applying Vector Error Correction model, he found that macroeconomic conduct of monetary policy could be damaging to the manufacturing sub-sector, and hence the industrial sector in general. Specifically, interest rate and money supply growth force down manufacturing growth during the period. Thus, he agitated for policy harmonization for sustained manufacturing development in the future. In a similar study, Onakoya, Ogundajo, and Johnson, (20017) using the same method and the same data span found strong evidence of monetary policy in promoting a strong and sustained manufacturing sub-sector in Nigeria within the short and the long run.

Pandit and Vashisht (2011) examined the impact of monetary policy on industrial performance in terms of how their demand for bank credit is affected. Seven emerging countries of Brazil, Chile, India, Korea Republic, Mexico, South Africa and Turkey

were examined in a panel data analysis from 2002 to 2010. Their results showed that changes in monetary policy changes firms demand for credit for investment in emerging countries. They concluded that monetary policy is still a veritable tool for economic smoothening in emerging economies.

Ridhwan, de Groot, Rietveld and Nijkamp (2011) explored the regional impact of monetary policy on the 26 sub regions of Indonesia using quarterly data from 1990 to 2007. Applying Vector Autoregression technique on the data, they found strong evidence of heterogeneous policy effects across to sectoral industry composition particularly the share of manufacturing within the regions. Specifically, they showed that West Java, the country's largest manufacturing-based region was mostly affected by unanticipated changes in monetary policy to the tune of 4.07 per cent maximum. Their result also showed that the channel of monetary policy transmission could be different across regional industries. They concluded that differential monetary policy effect is prevalent in developing economies.

In a bid to investigate the macroeconomic factors influencing the performance of the industrial sector in Ghana using the manufacturing subsector as a case study, Enu and Havi (2014) showed that sectoral effect of monetary policy can be discouraging. Country data collected from 1980 to 2012 and analyzed with Vector Error Correction Model showed that private sector credit and exchange rate as instruments of monetary policy weigh down industrial sector production in Ghana in the short run. This trend can only be reversed if technically oriented policies to stabilize real exchange rate are vigorously pursued, they opined.

Omolade and Ngalawa (2016) examined the relationship between monetary policy and the performance of the manufacturing subsector in Algeria for the period 1980 to 2010. In their analysis, money supply and interest rate were used as monetary policy variables on quarterly basis. Endogenising the variables in structural vector autoregression, they found no evidence of manufacturing sector response to innovations in money supply. Manufacturing sector output was only sensitive to innovations in interest rate. They therefore concluded that interest rate is an important determinant of manufacturing sector growth and the industry at large in Algeria.

Guimarães and Monteiro (2014) showed that regional effects of monetary policy on sectoral output can be symmetrical. In a study of the Brazilian economy from 2002 to 2011using principal component analysis and vector autoregression, they found that monetary policy responses on regional output are majorly homogeneous. They argued for consideration of other relevant theoretical approaches to identify monetary policy shocks for Brazil.

Arguing on the proposition that industrial output are consumed by the citizenry, Inui, Sudo and Yamada (2017) showed that the distributional effect of monetary policy

can trickle down to the household in Japan. Collecting quarterly micro level data on income and consumption of Japanese households from 1981 to 2008, the authors found that monetary policy do not necessarily generate income inequality among Japanese households over the period as a result of consuming industrial output. Such effect is only seen if the household members are secular workers.

Mensah, Ofori-Abebrese and Pickson (2016) examined the impact of macroeconomic factors on the performance of industrial sector in Ghana from 1980 to 2013. In their analysis, they included interest rate to capture the effect of monetary policy on industrial performance. Applying Autoregressive Distributed Lag Model on the variables to investigate the short and long dynamics among the variables, they found that monetary policy proxied by interest rate positively affects industrial performance in Ghana. Interest rate positively grows industrial performance by 0.20 and 1.03 in short and long run respectively. Based on this result, they recommended more government attention on macroeconomic stability for sustained industrial performance.

Ribon (2009) explored the effects of monetary policy on 16 different manufacturing industries in Israel from 1997 to 2006 in an integrated vector autoregression that endogenises interest rate, exchange rate, price, quantity produced and labour cost. His results revealed that a single positive shock on bank of Israel's interest rate produces a declining effect on output of the industrial sector in Israel at different magnitudes, thus confirming the asymmetric influence of monetary policy on industrial performance in Israel.

Arnold (2000) investigated the industry effects of monetary policy and incorporated the welfare effects of changing monetary policies in the United States and Europe. His study showed evidence of differences in industry response to policy shocks across the regions. More than that, the study also showed that welfare effect of monetary policy was stronger in the United States than in the Europe area for reasons of regional structural imbalances.

Tkalec and Vizek (2009) empirically examined the manufacturing response to macroeconomic policies in Croatia for the period 1998 to 2008. Multiple regression analysis was employed on quarterly data obtained from 22 manufacturing industries in the country. Their choice of macroeconomic variables included monetary policy variable like interest rate and exchange rate as well as fiscal policy variables. Their result indicated a weak monetary policy differential on manufacturing output, but a stronger fiscal policy effects on manufacturing output in Croatia.

Vespignani (2012) explored the impact of monetary policy behaviour on industrial output performance of Australia after the country adopts the economic policy that favours inflation targeting from 1990. Employing Structural Vector Autoregression (SVAR) on quarterly data from 1990 to 2008, he found that monetary policy produced

dismal outcome on industrial output in Australia. Manufacturing and construction industries showed significant reduction in gross value added after a one-time shock on the official cash rate of Australia. More than that, the mining industry seems to be unaffected at all by monetary policy shocks.

Duran and Erdem (2014) examined the regional effects of monetary policy in Turkey from 1975 to 2000 taking into consideration the role of spatial placement and spillovers and other geographical factors in the transmission of monetary policy using time series data for 67 Turkish provinces in a vector autoregression system. In their study, they investigated the efficacy of the hypotheses of regional response to monetary policy namely regions with high share of manufacturing, regions that include higher proportion of small-scale firms and banks, and regions which are more open to trade. Proxing interest rate for monetary policy, they found strong evidence of not just differentials response to monetary policy shocks by Turkish provinces, but also symmetric response of provinces with geographic closeness to monetary policy. They recommended that spatial spillovers should be included in monetary policy decisions.

Abuka, Alinda, Minoiu, Peydro and Presbitero (2015) investigated the impact of monetary policy on the real economy of Uganda from 2010 to 2014 using a supervisory dataset of loan applications and granted loans in margin extension. Their results indicated that real effect of monetary policy on the economy exists for Uganda. More than that, they also documented that the impact of monetary policy on real activity across districts depends on the soundness of banking sector.

Fiador (2015), examined the influence of monetary policy transmission across 20 Sub-Saharan countries of Africa for the period 1991 to 2010. Utilizing Generalised Methods of Moments (GMM) in a panel setting, he found evidence of monetary policy across the Sub-Saharan countries being heterogeneous in effect across the region.

Rafiq, (2015) examined the effect of monetary policy transmission on real output and financial stability of Bangladesh using monthly data that runs from November 2002 to November 2013. His model consists of 85 panels of macroeconomic variables sub-divided into groups of sectors. Employing structural vector autoregression on the sub-group of economic activities that included industrial production activities, he found strong evidence of monetary policy pass through on economic channels to the real economy. His result also showed that there are differential impact of monetary policy on the real economy as a whole and the disaggregated units in the same economy. More generally, monetary policy produces sustained positive growth in industrial production through time lag.

Singh and Rao (2014) examined the differential effects of monetary policy shocks on some sector and the real economy of India using quarterly data from 1996 to 2013. The sectors included in the analysis were mining and quarrying, transport and

communications, manufacturing, hotel, construction and trade. Incorporating vector autoregression analysis on the variables, they found that sectoral response to monetary policy innovations in India is heterogeneous. Aggregate output also responded differently to monetary policy shocks in India. They also found that both sectoral and economic wide response came from multiple channels of monetary policy transmission.

In examining the Macedonian economy to see if monetary policy can still be effective both sectorally and on the whole economy during periods of surplus financial liquidity, Jovanovic, Krstevska and Popovska-Kamnar (2015) showed that there are differential response of construction sector, industrial sector and trade to monetary policy innovations in Macedonia. Specifically, the construction sector in the Macedonian economy lead in response to changes in monetary policy, while the industrial and trade sectors lagged behind it. When compared with the general economy, differential responses were also seen. They used vector autoregression technique to analyze their data that spanned from 2000 to 2014.

Dhal (2011) investigated a disaggregated analysis of the industry effects of monetary policy conduct in India using monthly data from April 1993 to October 2011. Vector Autoregression (VAR) analysis was used to analyzed the data of five industries. His results revealed that if a contractionary monetary policy stance is innovated, capital goods and consumer durables industries are impacted more compared to intermediate and consumer non-durable goods industries. Based on this outcome he concluded that monetary policy could affect capital and consumer good durables more than other used-based industries in India,

Mehdi and Reza (2011) investigated the impact of monetary policy on industrial performance in Iran using time series data from 1961 to 2007. Key included variables as proxies to monetary policy were interest rate, credit supply to private sector and exchange rate. Employing Auto Regressive Distributed Lag (ARDL) technique on the variables, they found that monetary policy produces positive outliers in the industrial sector of Iran.

Ridhwan (2013) in investigating the Indonesian economy from 1990 to 2007 on quarterly basis found that monetary policy produces heterogeneous effects in manufacturing performance across 26 regions of Indonesia. West Java region had the highest impact of 4.07 percent to one innovative shock on manufacturing industry. His study used Vector Autoregression model.

Jamil and Irfan (2016) examined sectoral response of six sectors in the Pakistani economy using quarterly dataset from 1990 to 2012. Their study also captures sectoral performance response to monetary policy shocks in business cycles. Among the sectors investigated were large scale manufacturing and small-scale manufacturing sub-sectors of the industrial sector. The monetary policy variable was majorly the interest rate

variable (call money rate), although a price variable (inflation) was also included in the model. Utilizing unrestricted Vector Autoregression (VAR) in the analysis, they found that sectoral differentials exist in response to changes in monetary policy in Pakistan. Their results showed that small scale manufacturing sub-sector responded faster and higher (about 1.9 %) than large scale manufacturing sub-sector (about 0.5 %) from the second quarter of the analysis. Their results also confirm that sectoral differences are more persistent to monetary policy shocks in recovery business cycles than in recessions.

The possibility of asymmetric response by sectors of the Jamaican economy was investigated by Serju (2003) from 1990 to 2002. The sub-sectors included in his analysis were Construction, Mining, Agriculture, Distribution, Electricity, Financial Services, Transport, Manufacturing and others lump into Miscellaneous. Applying both unrestricted Vector Autoregression (VAR) and Structural Vector Autoregression (SVAR) on quarterly data obtained from nine sectors of the economy, the author found strong evidence of sectoral asymmetries to one standard deviation innovations in monetary policy. Specifically, the manufacturing sub-sector responded faster than all the other sub-sectors while the electricity sub-sector showed the largest response to monetary policy innovations. These evidences confirm the differential response of Jamaican industries to changes in monetary policy.

Pellényi (2012) investigated sectoral responses of the Hungarian economy to monetary policy fluctuations using 13 sub-industrial sectors. His study utilizes 198 quarterly sectoral and macroeconomic panel variables analysed in a Structural Factor Analysis. His results confirm the existence of asymmetric sectoral response to monetary policy administration in Hungary. Sectors that rely more on foreign finances, notably the industrial sector respond largely in performance than others with healthy balance sheet. He pointed out that a key variable in explaining the source of heterogeneity is the mode of transmission operating in the economy. Earlier Crawford (2007) had found similar evidence for the Australian economy. Earlier Kutu and Ngalawa (2016) had investigated the industrial sector response of South African economy to monetary policy shocks utilizing monthly datasets from 1994 to 2012 in a Structural Vector Autoregression (SVAR) framework. They found that industrial performance responded positively to monetary policy innovations through money supply. What is more important however, is the link created by the industrial sector and other sectors of the economy after policy shock. The industrial sector exerted a symbiotic effect with other sectors of the economy after monetary policy innovations. This may well be a pass-through case of policy effects to the real economy.

Olanrewaju and Temitope (2018) investigated the dynamic impact of monetary policy on industrial sector performance in Nigeria from 1986 to 2015 using quarterly datasets. They employed Autoregressive Distributed Lag (ARDL) model to analyse

their data. Their results indicated that negative monetary policy shocks as well as positive monetary policy shocks dampen industrial performance in Nigeria through-out the study period. Based on their findings, they argued for caution on the use of monetary policy in the country.

2.3.2. Review on Policy Pass Through and Sectoral effect on the Economy

There are ample empirical evidences, of industrial sector contribution to economic growth around the globe. For instance, Hussin and Ching (2013) examined the sectoral contributions to the economies of Malaysia and China using time series data from 1978 to 2007. Three sectors, the agricultural, industrial and the service sectors were included in the analysis. Employing multiple regression technique on the dataset, they found evidence of strong statistical influence of manufacturing sector to economic growth in Malaysia and China. In the case of Malaysia, the manufacturing sector grew the economy by at least 0.16 percent at a single shock whereas in the case of China, a single shock produces a 0.67 percent effects on the economy. They attributed these positive impacts to, among other things, policy and economic transformation the may have included changing faces of monetary policy performance in these economies. This asymmetry in sectoral performance is traced to the structural composition of the general economy for instance in the Lithuanian economy (Lankauskienë and Tvaronavièienë, 2013).

Jelilov, Enwerem and Isik (2016) investigated the impact of industrialization on the growth of Nigerian economy from 2000 to 2013 using secondary dataset. Applying ordinary least squares regression on the variables, they found positive evidence of industrial effects on economic growth of Nigeria. However, such effects can diminish if adequate policies are not in placed to sustain it. This was found when the lagged variables in the study were investigated. The study also included monetary policy effect on output production of industrialization. They therefore stressed policy redirection for a sustained industrial-growth nexus in the long run. Perhaps such diminishing value added to growth made Obioma, Anyanwu and Kalu (2015) concluded that there is poor contribution of industrial sector to economic growth. In their study of the Nigerian economy from 1973 to 2013 using similar approach, showed that although positive evidence is found between industrial output and economic performance, the effect was statistically insignificant, and no less poor. They thus, attributed growth in the economy to strong savings and foreign direct investment achieved in others sectors of the economy, not necessarily the industrial sector. A near similar result was also obtained by Akpan and Eweke (2017) in a VAR model framework.

Dan and Wanjuu (2012) examined the impact of industrialization on the growth of Nigerian economy. In their estimation, they used capital-industrial output ratio and

labour-industrial output ratio as explanatory variables and on per capita output as dependent variable. After confirmation of a long run relationship existing between industrialization and economic growth in Nigeria, they employed vector error correction models and found that both capital-industrial output ratio and labour-industrial output ratio reduces per capita GDP. They interpret this to mean a failure in human capital and income levels to reach the required threshold to make industrial effects reasonably felt in the economy. Based on their findings, they recommend governmental improvement in social and economic infrastructures like electricity, education and transport to reduce the cost of industrial production in Nigeria.

Isiksal and Chimezie (2016) investigated the impact of industrialization in Nigeria using quarterly data from 1997 to 2012. Their analysis used information from three sectors, the agricultural sector, the service sector and the industrial sector. Their results revealed a feedback synthesis between industries and the growth of Nigerian economy. As the industrial sector grows the economy, the concurrent effect of other sectors in the economy also fed back on the industrial sector for growth. Kutu and Ngalawa (2016) had investigated the industrial sector response of South African economy to monetary policy shocks utilizing monthly datasets from 1994 to 2012 in a Structural Vector Autoregression (SVAR) framework. After confirming the sectoral heterogeneity to monetary policy shocks, they extended the arguments further by identifying a link created by the industrial sector and other sectors of the economy after policy shock. The industrial sector exerted a symbiotic effect with other sectors of the economy after monetary policy innovations. This may well be a pass-through case of policy effects to the real economy.

While several studies have showed the industrial performance-economic growth led frontiers, Moreno-Brid (2007) showed a rather weak evidence of economic growth-industrial sector performance in the Mexican economy. His studies confirmed that economic development produces a backward linkage effect on industrial performance that should not be ignored. Thus, there is a dual-led relationship between industrial performance and economic growth.

Egbulonu and Nwokoro (2016) investigated the contributions of industrial sector to economic development in Nigeria from 1985 to 2015. Applying ordinary least squares regression on times series data obtained for the purpose they found that industrial performance produces positive effects on economic growth of Nigeria.

As at the time of this study, the only study that discusses policy pass through from the industrial sector to the economy in Nigeria on counter cyclicality was that by Saibu and Musbaudeen (2018). In their study, they applied fully modified Ordinary Least Square (FMOLS) and Pairwise Granger Causality Test on policy and non-policy variables of the industrial sector and the economy for the period 1981-2015. Their result confirms

a statistically significant procyclical pass through of monetary policy from the industry of over 61 percent to the economy. However, the direct impact of industries on the economy was insignificantly negative. Bhanumurthy, Das and Bose (2012) showed that industry effect can pass through policy to the macro economy. Investigating the effects of oil price shocks on, among other channels, the fiscal policy channel found in their simulated results that a one-time oil shock has an adverse policy impact of 0.6 percent on the general growth of the economy and inflation in the current year of shock and diffuses slowly over time to other years and a full pass-through impact of 0.9 percent ultimately. Their results reinforce the notion that pass-through impacts could have a feedback process. Still on the pass through of policies to the real economy from the industrial sector, Aghion, Hémous and Kharroubi (2014) showed, using difference to difference methodology for 15 OECD countries that fiscal policies can affect real economic outcomes via the industrial sector. The industry value added and the labour productivity of the industries improve leading to declining unemployment rate in the real economy.

3. THE METHODOLOGICAL DESIGN

There are increasing attention on the sectoral effects of monetary policy given differential responses of sectors to monetary policy shocks. As noted by CBN (2014), this has serious implications for the general economic management as monetary authorities have to weigh the consequences of their actions on various sectors of the economy. The industrial sector, which houses the basic productive activities in the economy should be in the fore front. Hence, the general relationship of the monetary policy-industrial sector nexus is of the form;

$$InD_t = \partial_0 + \partial_1 Mpr_t + \partial_2 M2_t + \partial_3 Tbr_t + \partial_4 Cred_t + \partial_5 \pi_t + \mu_t \quad (3.1.1)$$

Where InD_t is an index of industrial output; Mpr_t is monetary policy rate; $M2_t$ is money supply to the domestic economy; Tbr_t is Treasury Bill Rate; $Cred_t$ is Credit supply to the Industrial sector; π_t is inflation that serves as a control variable in the system; μ_t is the white noise component; t is the time subscript and; $\partial_{0,1,2,3,4,5}$ are parameters coefficients. Apriori, we expect $\partial_1 < 0$ due to the theoretical investment-interest rate relationship; $\partial_2, \partial_4 > 0$ for the theoretical stance of money and finance in production; $\partial_5 > 0$ given that higher prices induces further production. Theory has no explicit explanation for the behaviour of Tbr_t on production other than checking excesses of money supply and inflation. Therefore, we expect $0 \leq \partial_3 \geq 0$. The model is examined in a vector autoregression (VAR) framework. Traditionally, a VAR is of the form

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \ldots + A_q y_{t-q} + Bx_t + \varepsilon_t \quad (3.1.2)$$

where y_t is a vector of endogenous variables, x_t is a vector of exogenous variables, A is a matrix of size (n, n) representing the relations of simultaneity between variables in y_t . ε_t is the vector of structural innovations, which are assumed to be normally, independently and identically distributed, $B$is a matrix of size (n, n) representing the relations of simultaneity between variables in x_t. They are also orthogonal. Historically, VAR models have been widely employed in sectoral monetary policy analysis (CBN, 2014; Vespignani, 2012; Ribon, 2009; Alam and Waheed, 2006).

Using the VAR framework, Equation 3.1.1[1] becomes;

$$InD_t = \propto_1 + \sum_{j=1}^{n} \beta_j InD_{t-j} + \sum_{j=1}^{n} \rho_j Mpr_{t-j} + \sum_{j=1}^{n} \delta_j Ms_{t-j} + \sum_{j=1}^{n} \varphi_j Tbr_{t-j} + \sum_{j=1}^{n} \omega_j Cred_{t-j} + \sum_{j=1}^{n} \alpha_j \pi_{t-j} + \varepsilon_{1t} \quad (3.1.3)$$

An important issue relating to the estimation strategy consists of selecting the appropriate specification of the VARs (Alam and Waheed, 2006). This involves the appropriate VAR methods to employ for the study. The decision rest on the statistical properties of the variables in the study. If the variables in a VAR are not stationary and not cointegrated, the VAR may be specified in pure unrestrictive recursive form. As pointed out by Sims (1980), and Sims, Stock and Watson (1990), the variables should not be differenced even if the variables are nonstationary. Ramaswamy and Slok (1998) stressed that the impulse response functions generated from differenced VAR tend to imply that monetary impulses produce permanent impact on output performance which may not necessarily be the case. If the variables are integrated of the same order and are cointegrated as well, then vector error correction may be applied on the data. Since the point of interest lies in the dynamic interrelationships among the economic variables in the system, our VARs will be estimated in levels to avoid losing innovative information rooted in the variables.

3.1. The Neglected Pass through to the Economy

The basic generalization in development literature is of the opinion that the strength of monetary policy as a tool for economic smoothening is influenced to a larger extent by the strength and reliability of the linkage between instruments of monetary policy and the target economic variable (Fiador, 2015; Opolot, Nampewo, Ntumwa and Nyanzi, 2013). Based on this perception, we want to consider the pass-through of polices to the real economy from the industrial sector. Sectoral pass-through effect of this nature is not new in the financial literature (see Arnold, (2001) for the case of policy pass-through from the industry mix to the real economy; Fiador (2015) for the case of

policy pass-through from the financial sector; Ozdagli and Weber (2017) for the case of policy transmission from the productive sector (production network) to the real economy). Following Fiador (2015) our pass-through model is of the form

$$y_t = \varphi_0 + \varphi_1 Mp_t + \varphi_2 Mp_t * InD_t + \varphi_3 K_t + \varphi_4 gcf_t + \mu_t \quad (3.1.4)$$

Where, y_t is output growth rate; Mp_t is monetary policy instruments (money supply growth rate and monetary policy rate); K_t is nominal exchange rate; InD_t is index of industrial production; gcf_t is gross capital formation; μ_t is stochastic white noise. $\varphi_{0,1,2,3,4}$ are the elastic parameters to be estimated. $Mp*InD_t$ is an interaction term that captures monetary policy-industrial pass-through. The intuition here is that if industrial development influences the pass-through of monetary policy, then $\varphi_2 \neq 0$. In general, the total pass-through effect is $\varphi_1 + \varphi_2$. Fiador (2015) argued that inclusion of the industrial index (InD_t) itself in the model will serve as robustness check to ensure that any no-zero effect from the interaction term does not flow from an inappropriately specified equation. Thus,

$$y_t = \varphi_0 + \varphi_1 Mp_t + \varphi_2 InD_t + \varphi_3 Mp_t * InD_t + \varphi_4 K_t + \varphi_5 gcf_t + \mu_t \quad (3.1.5)$$

is actually estimated. As Wooldridge (2009) noted, estimating equation 3.1.5 may under value the parameters φ_1 and φ_3 without appropriate weight from the industrial index. He suggested the weights to include the mean and median since the partial effect of Mp_t on y_t in equation 3.1.4 is actually $\varphi_1 + \varphi_2 InD_t$.

The model suggested by Wooldridge (2009) that we estimate is;

$$y_t = \varphi_0 + \varphi_1 Mp_t + \varphi_2 InD_t + \varphi_3 (Mp_t - \vartheta_t)(InD_t - \rho_t) + \varphi_4 K_t + \varphi_5 gcf_t + \mu_t \quad (3.1.6)$$

Where ϑ_t and ρ_t are the population means of Mp_t and InD_t respectively.

Due to the perceived correlation that may be present between the errors of Mp and InD_t or between the errors of the interaction term $Mp * InD_t$ and InD_t, equation 3.1.5 is estimated using Generalized Method of Moments (GMM). A key assumption in GMM estimation is the equality of parameters (K) and instruments (L). Though over identification of instruments is possible, optimality must not be traded for bias estimates. This will be checked with the J-statistic.

3.2. Data and Sources

Dependent variables: The dependent variable for the general economy is gross domestic product (y_t). This measure the general economic performance. Index of industrial sector value added (InD_t) serves as the dependent variable for industrial sector performance. Industrial valued added is the contribution of the entire industrial sector to GDP (industrial net output).

According to the CBN (2016), the industrial sector activities in Nigeria is divided into three major sub-sectors namely, Crude Petroleum and Natural Gas sub-sector, Solid Minerals sub-sector and the Manufacturing sub-sector. The Solid Minerals sub-sector includes the activity of Coal Mining, Metal Ore Mining and Quarrying. The Manufacturing sub-sector includes the activities of Oil refining; Cement; Food, Beverage and Tobacco; Textile, Apparel and Footwear; Wood and Wood products; Pulp, Paper and Paper products; Chemical and Pharmaceutical products; Non-Metallic products; Plastic and Rubber products; Electrical and Electronics; Basic Metal, Iron and Steel; Motor Vehicles and Assembly and; Other Manufacturing. Sub-sector's effect of monetary policy will also be considered. We assumed all these to be the industrial sector as a whole.

Monetary Policy measure: This reflects how the monetary authorities steer the economy to their desired direction. Monetary policy conduct could be proxied by monetary aggregates or by their instruments. Our study adopts the instrument position on the premise that it better x-rayed the inner intentions of policy makers. The instruments include money supply ($M2_t$), monetary policy rate (Mpr_t) (known before 2006 as prime lending rate or minimum rediscount rate), Treasury bill rate (Tbr_t) and Credit to the private real sector ($Cred_t$). As noted by Agu (2011), the primary means of achieving monetary policy objective in Nigeria rests on setting aggregate money supply targets and on open market operations (OMO) and other policy instruments.

Control variables: We include the gross fixed capital formation (gcf_t) and exchange rate as our control variables. We believe that while both the general economy and the industrial sector will deliver tantamount to the working of exchange rate and inflation (π_t), the general economy will adjust to (gcf_t) fluctuations. These variables were obtained from the Central Bank of Nigeria statistical bulletin.

All our dataset for the study runs from 1980 to 2018 and were obtained from the Central Bank of Nigeria data base.

3.3. Unit Root Test

All variables in the analysis will be tested for unit roots. However, the variables used for VAR estimation will not be tested for unit roots. This study adopts the Phillip-Perron (PP) tests for stationarity developed by Perron (1997), a modified Dickey-Fuller (DF) test, adjusted on a generalized least squares (GLS) detrending series known as the DF-GLS test proposed by Elliot, Rothenberg and Stock (1996) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test in its unit root tests. There is wider acceptability in the literature that the PP test evaluates the time series properties of the variables in the presence of structural changes at unknown points in time and thus endogenises these structural breaks, an advancement from the traditional augmented dickey fuller test of stationarity. The PP test is specified as:

$$\theta_{\alpha}^{*} = \theta_{\alpha}\left[\frac{\gamma_{\circ}}{\omega_{\circ}}\right]^{\frac{1}{2}} - \frac{T(\omega^{\circ} - \gamma^{\circ})[se(\varphi)]}{2\omega_{\circ}\frac{1}{2}s} \quad (3.7.1)$$

Where, φ is the estimate, and θ_{α} is the t-ratio of φ, *se*(φ) is the coefficient standard error, and s is the standard error of the regression equation. ω° and γ° are the residual spectrum at zero frequency and consistent estimate of the error variance respectively. The PP test is applied especially to test the unit roots in our economic regime switch analysis.

However, the PP test is not infallible. The test is susceptible to low power statistic and size distortion problems. Hence, to get rid of these challenges in our data, we also employ the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, which is believed to possess these challenges at a minimal rate. A more clearly seen difference between the KPSS test and the PP test is in the statement of the null. In the KPSS, the null hypothesis is that the variable in question is stationary and the decision criteria is to accept the null only if the absolute value of the calculated statistic is below the critical value at the accepted level of significance (Ekong and Ekong, 2017).The test statistic are obtained by regressing the residuals of a regression on the independent variables of the original regression and is given as:

$$KPSS = \frac{1}{T^{2}} . \frac{\sum_{t=1}^{T} S_{t}^{2}}{\varpi_{\infty}^{2}} \quad (3.7.2)$$

Where, $S_t = \sum_{s=1}^{t} \hat{e}_s$ is a partial sum

ϖ_{∞}^{2} is the HAC estimator of the variance of $\hat{e}_t$

T is the Sample size

The DF-GLS test also possess good size and power properties (Elliot.Rothenberg and Stock, 1996; Aziakpono and Wilson, 2013). The t statistic is generated from the parameters gotten from the following equation;

$$\Delta y_{t}^{d} = \vartheta y_{t-1}^{d} + \delta_{1}\Delta y_{t-1}^{d} + \ldots . + \delta_{p}\Delta y_{t-p}^{d} + \mu_{t} \quad (3.7.3)$$

Where, y_{d}^{t} is the detrended data series; is the difference operator; ϑ, δ_1, ϑ*p* are parameters to be estimated and μ_t is the error term.

4. TREND ANALYSIS OF MONETARY POLICY RATE, INDUSTRIAL SECTOR PERFORMANCE AND GROWTH OF THE NIGERIAN ECONOMY

Figure 4.1 shows the trend analysis of the conduct of monetary policy, industrial sector performance and other growth indicators of the Nigerian economy. As the figure shows,

monetary policy rate (mpr) grew from a single digit of 6.0 percent in 1980 to 10.0 percent in 1986. From 1986, mpr further grew steadily to 18.5 percent in 1990. The steady rise of monetarypolicy rate (MPR) from 6% in 1980 to 18.5% in 1990 may have been a possible accounting factor after smoothening economic activities to positive growth from 1988 to 1994. MPR however fell, after reaching a peak of 26% in 1993 to 14.31% in 2001. From 2002, MPR declined from 19% continuously to 6.13 in 2010, before accelerating again to 14% in 2018.

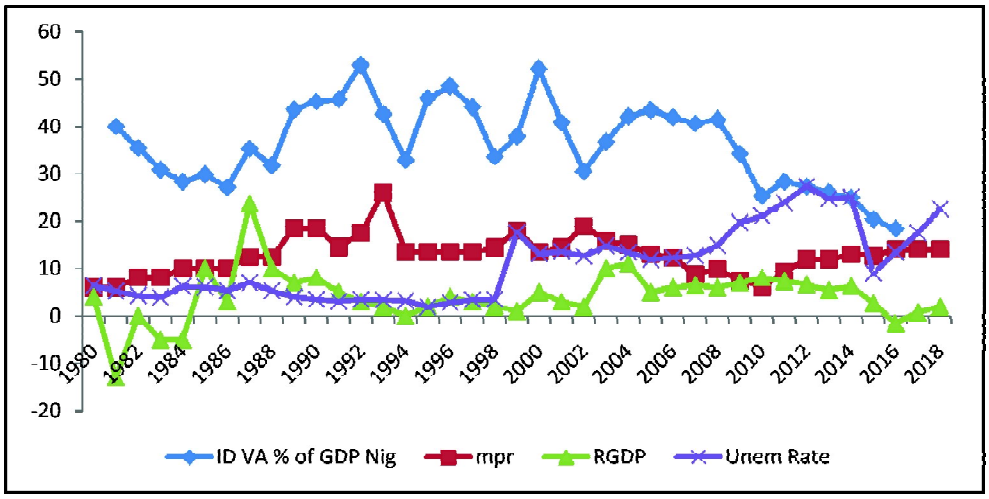

Figure 4.1: Monetary policy rate, Industrial sector value added, GDP growth rate and Unemployment in Nigeria, 1980-2018

Source: Researchers

Within the period, industrial sector value added (IVA) to the economy fluctuates widely. For instance, from 1980 IVA declined from 39 percent to 27 percent in 1986. It however followed a sluggish growth from there to a height of 45 percent in 1990 and peaked at 53 percent in 1992. From 53 percent in 1992, IVA further dipped to 32.9 percent in 1994. In 1997, IVA grew from 44 percent to 52 percent in year 2000. This must have enjoyed a much steady movement of MPR of 13.5 percent in nearly throughout these periods. Beyond year 2000, IVA have averaged almost 40 percent from 2002 to 2008 believed to have been triggered by the decline of MPR from 19% in 2002 to 6.13 in 2010. From 2009, IVA has taken a steady decline from 34.2 percent to as low as 18.4 percent in 2016. This is attributed to the steady rise of MPR also in the period from 6.1 percent from 2010 to 14 percent in 2016.

At the inception of the analysis in 1980, the growth rate of gross domestic product (GPD) declined from 4 percent to -13 percent in 1981 as MPR remained unchanged at

6 percent. However, as MPR grew from 6.0 percent to 10 percent in 1986, GDP growth has grown to 10 percent in 1985. It further grew sharply to 23.7 percent in 1987. Beyond 1987 however, the growth rate of GDP dipped recedingly from 10.0 percent in 1988 to 0.0 percent in 1994 even as MPR was undulating in double digits. From 0.0 growth rate in 1994, GDP rise and remained positive to 11.0 percent in 2004 and MPR remained high in double digits. This positive correlation may suggest that higher real interest rates favours higher growth in the economy. From 2005 to 2014, the average growth rate of the economy was 6.0 percent, when MPR has taken on declining growth for most of the years. In 2015, the positive GDP growth rate of 2.5 percent soon dipped to a negative (-1.5 percent) in 2016, widely acclaimed for economic recession and had since been struggling to maintain a positive growth rate of 1.9 percent as monetary policy stabilizes at 14 percent in 2018.

Within the period of the interplay between monetary policy rate, industrial sector performance and growth of the Nigerian economy, unemployment rate (UNR), as an important indicator of growth and development witnessed minimal growth of not above 7 percent between 1980 and 1987. In fact, UNR was growing in a declining rate within the 7 years. As figure 4.1 shows, UNR continue to fell from 5.3 percent in 1988 to 3.2 percent in 1994. The UNR that was 1.9 percent in 1995 soon rise to 3.5 percent again in 1998 but still in single digit. It appears the correlations between monetary policy rate, industrial sector performance and economic growth was able to keep UNR down at a rate adjudge to be economically beneficial (plus 3 percent) between 1980 and 1995. Beyond 1995, UNR grew sharply into double digit of 17.5 percent in 1996 and grew at a declining rate to 13.4 percent in 2004. It further grew from 11.9 percent in 2005 undisturbed to 27.4 percent in 2012. Form 27.4 percent in 2012, it fell again to 25.1 in 2014. The NUR that was 9 percent in 2015 soon grew to 22.6 percent in 2018. This figurative evidence suggests that the correlations between monetary policy rate, industrial sector performance and growth of the Nigerian economy did not really reduce UNR in the years 1996 and 2018 in Nigeria. It further suggests the inability of this correlation (between monetary policy rate, industrial sector performance and growth of the Nigerian economy) to keep NUR down for too long (and indeed other real economic variables) without consistent fine tuning to continue to receive higher economic benefits in the country.

5. DATA ANALYSIS

5.1. Descriptive Properties

The descriptive properties of the variables are presented at Table 5.1. Table 5.1 shows that all the variables in the analysis were multivariate normal with favorable probabilities.

All variables were positively skewed with money supply and monetary policy rate producing the highest and the lowest skewness respectively. The variables also have acceptable peaks of not less than three basis points.

Table 5.1: Descriptive properties of the variables of Monetary Policy-Industrial Performance analysis

	InD_t	*mpr*	*MS*	*Cred*	*tbr*	π
Mean	4868.563	12.79316	6482.963	4239.943	11.89500	20.18895
Median	1242.816	13.00000	558.5500	391.5623	12.00000	13.10000
Maximum	20526.46	26.00000	80008.20	22290.66	26.90000	76.80000
Minimum	37.01540	6.000000	13.04000	6.940000	3.720000	3.600000
Std. Dev.	6485.513	4.121914	14110.50	6856.602	4.852792	18.00856
Skewness	1.187334	0.669271	3.951684	1.482639	0.702449	1.710326
Kurtosis	2.910228	4.248652	20.62692	3.730898	3.858774	4.873867
Jarque-Bera	8.941256	5.305476	590.8547	14.76789	4.292782	24.08604
Probability	0.011440	0.070458	0.000000	0.000621	0.116905	0.000006
Sum	185005.4	486.1400	246352.6	161117.8	452.0100	767.1800
Sum Sq. Dev.	1.5609	628.637	7.3709	1.7409	871.335	11999.0
Observations	38	38	38	38	38	38

Source: Researchers

5.2. Correlation Analysis

Next, we examine the correlation relationships of the variables and report the result in Table 5.2. The correlation matrix shows that key policy variables were well-behaved theoretically. While some, notably monetary policy rate and treasury bill rate maintained expected negative relationships with the industrial sector, others such as money supply growth and credit assistance to the private sector delivers positive relationships with industrial sectors' performance.

Table 5.2: Correlation Matrix of Monetary Policy-Industrial Performance analysis

	InD_t	*mpr*	*MS*	*Cred*	*tbr*	π
InD_t	1.000000	-0.162057	0.548026	0.958138	-0.075717	-0.336714
mpr	-0.162057	1.000000	-0.169373	-0.136113	0.885883	0.328680
MS	0.548026	-0.169373	1.000000	0.550831	-0.154983	-0.210157
Cred	0.958138	-0.136113	0.550831	1.000000	-0.022524	-0.277533
tbr	-0.075717	0.885883	-0.154983	-0.022524	1.000000	0.383420
Π	-0.336714	0.328680	-0.210157	-0.277533	0.383420	1.000000

Source: Researchers

5.3. Unit Root Test

We tested our variables for unit roots. We adopted three unit root techniques namely the Phillip-Perron (PP) tests; Dickey-Fuller (DF) generalized least squares (GLS) (the DF-GLS test) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. These tests procedures were selected for various strength from structural breaks adjustments to size and power strengths. We present our unit root test results in Table 5.3. Our unit root results in Table 5.3 shows that our variables were stationary at various level of significance not exceeding order two.

Table 5.3: Unit Root Test Results

	PP	*DF-GLS*	*KPSS*
gdp_t	7.0946	0.1704	0.6118**
$\Delta\Delta gdp_t$	-8.5407***	-7.5775***	
InD_t	2.3949	-1.2173	0.6125**
ΔInD_t	-3.2315**	-1.7039*	
mpr	-2.9021*	-2.3162**	0.1470
Δ*mpr*	-7.8329***		0.3571**
M2	-4.5009***	-4.4347***	0.6096**
Cred	4.3847	-0.8591	0.5618**
Δ*Cred*	-3.0878**	-1.9391*	
tbr	-2.6775*	-2.2860**	0.1248
Δ*tbr*	-7.1896***		0.3497*
K_t	1.9314	1.3204	0.7399***
ΔK_t	-3.2645**	-3.3447***	
π	-2.9925**	-1.2799	0.3172
Δ π		5.7748***	0.5000**
gcf_t	-2.5932*	-3.3152***	0.2288
Δgcf_t	-9.1547***		0.5000**

Note: *,**,*** indicates significance at 10, 5 and 1 percent
Δ indicates the difference operator

Source: Researchers

5.4. Impact of Monetary Policy Shocks on the Performance of the Industrial Sector in Nigeria

The results of the impact of monetary policy shocks on industrial sector performance in Nigeria is presented in Figure 5.1 and Tables 5.4. Our interest is to investigate the reaction of industrial sector output to a one-time monetary policy shock, so we generate the impulse response functions from VAR which traces all such reactions to a one

standard deviation shocks from monetary policy. Thereafter, the variance decomposition traces the magnitude of the dynamic impact of policy shocks on industrial sector output. The literature is in agreement with this line of thought (Jamil and Irfan, 2016). As shown in figure 5.1, a one-time shock on monetary policy rate (policy tightening) produces falling impact on industrial sector output that is consistent with no sign of convergence throughout the period. The estimated maximum decline of industrial production occurs at the end of the third period. Generally, this reinforces the negative interest rate-investment nexus in the economy. Also, any unanticipated change in money supply (M2) produces un-persistent impact in industrial sector output that bottoms out

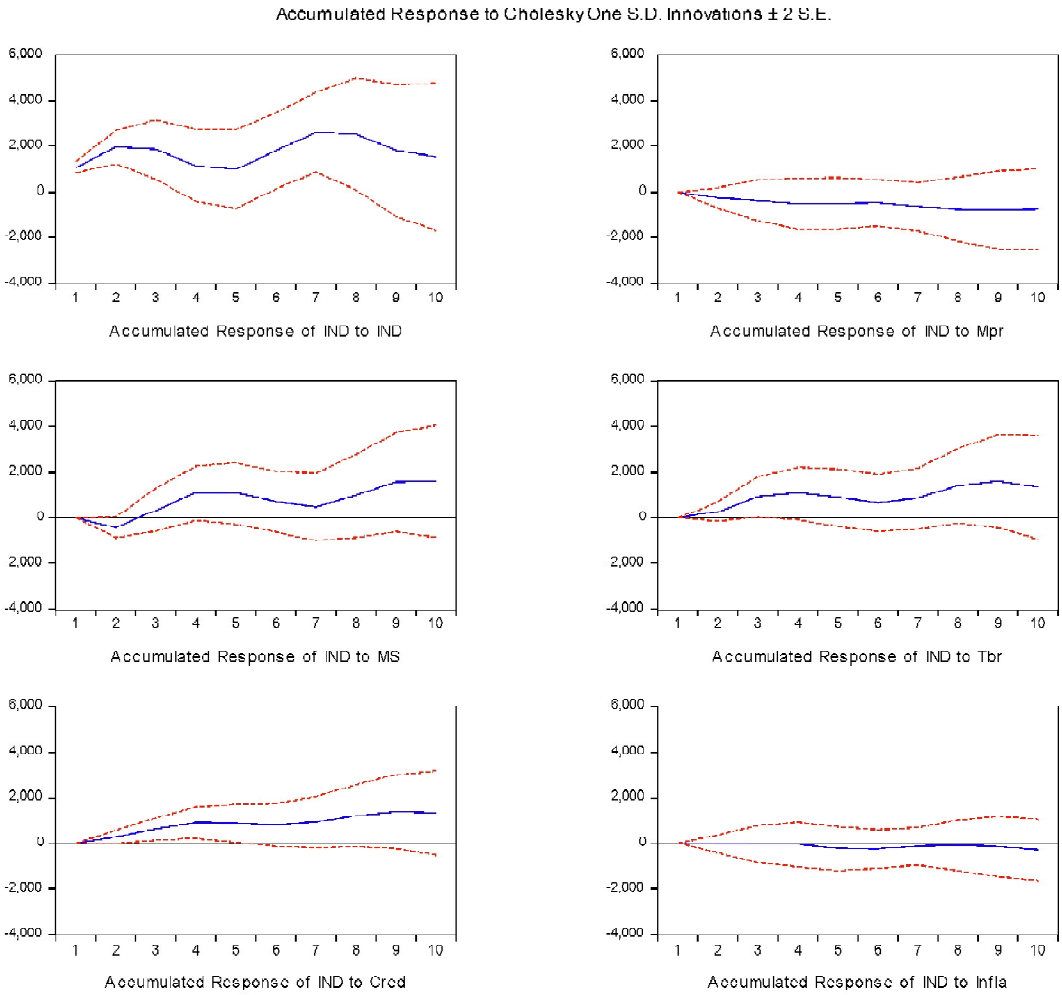

Figure 5.1: Impulse Response of Industrial Sector to Monetary Policy Shocks

Source: Researchers

around the third period. Beyond the third period, industrial sector output grew positively up to the tenth period. This is an indication of time lag in policy effectiveness. An unexpected change in credit assistance to the industrial sector produces positive growth in output from period one to the tenth period. However, beyond the fifth period, output growth was undulating. A shock on treasury bill rate also accelerates growth in industrial sector output from period one to the last period.

The Variance Decomposition of Industrial Sector to Monetary Policy Shocks on Table 5.4 shows that the largest magnitude of impact of monetary policy on industrial sector output was from money supply with more than 27 percent high. Monetary policy rate contributed at most 4 percent approximately to variations in industrial sector output during the period. However, credit assistance to the industrial sector ensures that not less than 7 percent and not more than 13 percent output growth is realized within the period and treasury bill rate contributes only 4 percent to output growth in the industry.

Table 5.4: Variance Decomposition of Industrial Sector to Monetary Policy Shocks

Period	*S.E.*	*InD_t*	*Mpr*	*MS*	*Tbr*	*Cred*	*Infla*
1	1086.255	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	1532.024	83.28833	2.285787	6.695221	0.003614	7.671300	0.055743
3	1857.350	56.92467	3.881254	21.13803	4.395035	13.42019	0.240820
4	2150.034	53.28059	2.971823	27.92282	3.311766	12.33324	0.179766
5	2171.413	52.79934	2.984039	27.37983	3.527524	12.24196	1.067309
6	2357.664	56.52852	2.756862	25.58765	3.447749	10.73752	0.941698
7	2523.545	59.87876	2.695794	23.03218	3.009508	10.18424	1.199518
8	2646.236	54.55037	3.456538	24.23749	4.221952	12.19351	1.340139
9	2821.298	54.59033	3.098194	25.74545	3.977666	11.38527	1.203080
10	2851.246	54.35954	3.217879	25.22932	4.195272	11.36806	1.629926

Cholesky Ordering: InD_t, MS, Tbr, Cred, Infla, Mpr
Source: Researchers

5.4.1. Monetary Policy pass-through to the Economy

Growing insight in financial development literature is that the strength of monetary policy as a tool for economic smoothening depends to a larger extent on the strength and reliability of the link between instruments of monetary policy and the target economic variable (Fiador, 2015; Opolot, Nampewo, Ntumwa, and Nyanzi, 2013). Based on this perception, sectoral policy pass-through to the real economy begins to gain empirical relevance. As pointed out by Cottarelli and Kourelis (1994), the effectiveness of monetary policy rested on a "set of structural parameters not directly controlled by central banks", notably the behavioral and structural characteristics of economic sectors.

Beyond this, Beckworth (2016) and Otero (2017) showed that Structural changes in the economy, seem to be important factor in explaining changes in the propagation of monetary policy shocks. We show such evidence for the Nigerian economy from the industrial sector. Our policy pass-through result is presented in Table 5.5.

Table 5.5: Results of policy pass-through
Dependent Variable: gdp

Regressands	*Coefficients*	*Probs*	
Mp_t	13.677**	0.0372	
InD_t	5.125***	0.0000	
$Mp_t * InD_t$	0.2965***	0.0007	
K_t	13.694	0.6083	
gcf_t	-8.7085**	0.0189	
	Diagnostics		
R^2 0.94		DW	2.0475
R^2 adjusted 0.93		Rank	8
J-statistics 4.6240			
Prob(J-stat) 0.2014			
Weak Instrument Test (Cragg Donald) F-stat		3.0888	
Endogeneity test	1.1546 (0.9492)		
Redundant Variable test	163.7375 (0.0000)		

Note: ***, ** indicates significance at 1% and 5% respectively
Method: Generalized Method of Moments (GMM)
Source: Researchers

As Table 5.5 shows, monetary policy pass-through from the industrial sector to the real economy was positive and statistically significant at one percent level of significance. At least 30 percent of output growth in the economy is attributed to monetary policy pass-through from the industrial sector. The cumulative partial pass-through effect of monetary policy on economic growth is 14.0 basis point, suggesting that there could be an enhancement of pass-through of policy in a developed industrial sector. This means that any unanticipated change in monetary policy rate pass through the industrial sector and affect the real sector by 14 basis point. Our study also shows that the pass-through is incomplete. This has implications for the economy. Given the empirical evidence in favor of a limited long-run pass-through, any reduction in output volatility that is due to liquidity smoothing by the banking sectors is likely to be accompanied by a more volatile inflation rate. The effect of exchange rate on the pass-through mechanism was positive but statistically insignificant; while gross capital

formation dampens the policy transmission process and hence economic output growth. Interestingly, monetary policy rate and industrial sector development (industrial output growth), exhibited positive pass-through effects on the growth performance of the economy at different levels of statistical significance. For instance, from 1994 the monetary policy rate has been positive (13.5) but declining to as low as 6.13 percent in 2010 to have kept output growth on a positive trajectory from 1999 (1percent) to above 6 percent in 2014 (see figure 5.2). Within the same period also, industrial sector value added grew from 30.2 percent in 2002 to 34.5 percent in 2009 in the economy. Otero (2017) found similar empirical evidence for some Latin American countries whose policy transmission channels were mostly interest rate dependent.

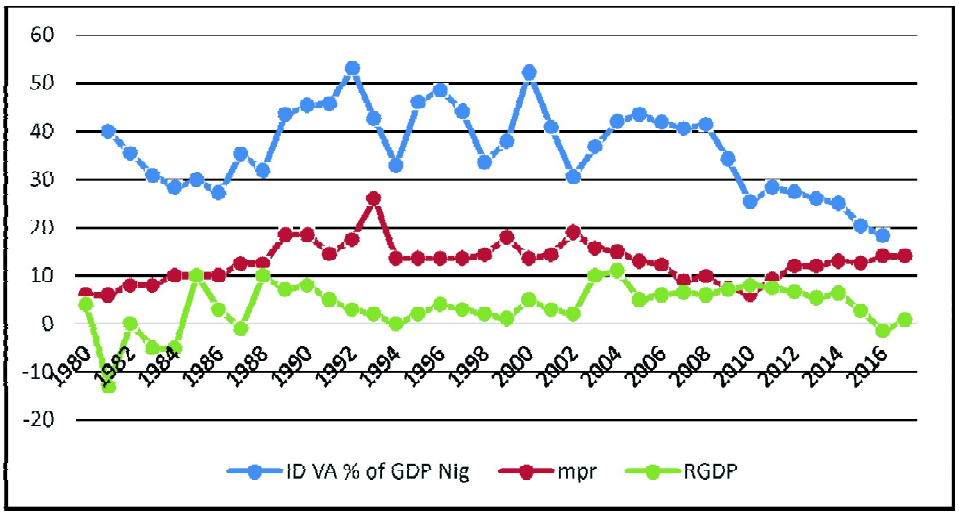

Figure 5.2: Monetary Policy, Industrial Value Added and Growth Performance in Nigeria 1980 – 2017

Source: Researchers

5.5. Model Diagnostics

The diagnostics tests of our policy pass-through analysis are also reported in Table 5.5. From Table 5.5, our result was autocorrelation-free with D.W of 2.05. The probability of our Redundant Variable test was significant at one percent level of significance. Thus, the null hypothesis of jointly insignificant explanatory variables was rejected. Our J-statistics probability of 0.2 was significant at 5 percent level of significance. Thus, we accept the hypothesis that the over-identifying restrictions of our instrumental variables are valid. The Cragg Donald F-stat of 3.0888 enables us to reject the null hypothesis of weak identification problem for our model at 5 percent level of

significance. We however fail to reject the null hypothesis that our explanatory variables were treated as exogenous variables. Overall, the model explains over 93 percent variations in the system, thus confirming the stability of our results.

5.6. DISCUSSION OF MAJOR FINDINGS

Our analysis reveals evidence of declining policy impact on the performance of industrial sector. While there was positive economic-wide impact of policy innovations from many studies (Omotor, 2007; Chuku, 2009 and Obadeyi, Okhiria and Afolabi, 2016), we saw falling negative impact of policy innovations on the industrial sector generally. Onakoya, (2018) who explored the effects of macroeconomic performance on the development of the manufacturing sub-sector in Nigeria from 1981 to 2015 also found that macroeconomic conduct of monetary policy could be damaging to the manufacturing sub-sector, and hence the industrial sector in general. Ribon (2009) equally derived similar result for the Israeli economy.

However, the industrial sector performance was shown to follow a-time lagged behaviour to monetary policy shocks. Shocks to money supply generate short time negative impact up to the third period before stabilizing to progressive positive impact on industrial performance. This may well signaled the role of policy timing and size for smooth and continuous single effect on either sectoral performance or the economy generally. The CBN (2014) has hinted that this knowledge is important for fine-tuning policy initiatives towards stabilizing the macroeconomic performance and sectoral growth in particular.

We also found that there was significant policy pass-through from the industrial sector to the economy in the reviewed period. The cumulative partial pass-through effect of monetary policy on economic growth was 14.0 basis points, suggesting the gains of an enhanced and developed industrial sector on the economy. The economics here is that any unanticipated change in monetary policy rate is likely to pass through the industrial sector and affect the real sector by at least 14 basis points.

6. CONCLUSION

The study investigated majorly the impact of monetary policy on industrial sector performance in Nigeria and the pass-through effects to the general economy between 1980 and 2018. The finding suggests that any unanticipated shock to monetary policy rate produces falling industrial output performance that is consistent throughout the subsectors of the industry in the study period. Only credit supply shocks and treasury bill shocks produces accumulated positive response that is systemic throughout the subsectors of the industry. Empirical evidence of strong positive monetary policy pass-through to the real economy from the industrial sector was also established. A cumulative

partial pass-through effect of monetary policy to the economy was 14.0 basis points. This raised the industrial sector value added growth rate from 30.2 percent in 2002 to 34.5 percent in 2009 in the economy. We therefore proffer the following suggestions for improved policy link-industrial sector performance in years following the study.

6.1. Policy Recommendations

1. The industrial sector provides a conduit for effective policy pass-through to the general economy. Therefore, we recommend strengthening the institutional, legal and the operational capabilities of the sector to continue to maintain such positive pass-through evidence if monetary policies are to deepen its impact on sectoral and economic-wide smoothening that it is designed to achieve. The governments can act as facilitators and partners in strengthening domestic productive capabilities, accommodate production structures and other complementary institutions in line with expected shifts. The introduction of industrial policy instruments—especially subsidies and non-tariff barriers to industrialization is likely to expand the industrial base of the economy and bridge the gap of policy ineffectiveness.
2. Following empirical evidence of statistically significant policy pass-through from the industrial sector to the economy, we recommend sectoral structural buildup for even monetary policy impact on the economy.
3. The positive pass-through impact of policy to the economy also engenders the need for improved channels of monetary policy to the private sector. Thus, stock market development, bond market development and other credit channels that easily linked policy to the private sector should be enhanced for seamless policy transmission.
4. Timing and size impact knowledge of monetary policy is suggested for smooth and sustained growth of industrial sector in Nigeria in years proceding the study given the timing and size characteristics response of the sector to policy innovations.

Note

1. This is an endogenous equation in six variables

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