FOREIGN EXCHANGE, INTERMEDIATE INPUTS IMPORT AND INDUSTRIALIZATION NEXUS IN NIGERIA

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ABSTRACT
This study investigates the link among exchange rate, importation of key intermediate inputs and industrialization in Nigeria using data covering 1981-2016. It utilizes structural vector autoregressive (SVAR) model based on contractionary devaluation hypothesis. Decomposing the variance of industrialization (measured by share of manufacturing sector in GDP), the results show that oil prices, external reserves and exchange rates are important factors. The impulse of industrialization shows that positive shocks to industrialization come directly from shocks to importation of chemical products, as well as machinery and transport equipment, while shocks to these imported inputs come from shocks to foreign exchange. The study thus recommends the need for foreign exchange easing by providing special exchange rate windows for the importation of chemical and machinery and transport equipment. This will go a long way to enhance the much desired industrialization in Nigeria.

JEL Codes: F31, O14, O24

1. Introduction

ONE of the key prerequisites for industrialization, output growth, and jobs creation is a vibrant manufacturing sector. A strong manufacturing sector also implies an active participation in global values chains—one of the requirements for active engagement in the recent global trade order. Nigeria's manufacturing sector is weak, with contributions to real GDP averaging about 8% annually between 1981 and 2016 (CBN, 2016). Besides, there is a strong link between foreign exchange policies and industrialization dynamics in Nigeria. In the last two years, the manufacturing sector has contracted significantly, given persistent macroeconomic challenges stemming from the fall in crude oil prices, which started in 2014. Specifically, the real GDP growth in the manufacturing sector of about 15% in the first quarter of 2014 nosedived to about -3.36% in the second quarter of 2016 (NBS, 2016). Also, the contribution of manufacturing to GDP of 8.95% in the second quarter of 2016 is lower than the contributions of 9.29% recorded in the corresponding period in 2015. This development is partly traceable to the high operating costs, stemming high costs of intermediate inputs, orchestrated by the associated foreign exchange (forex) policy inconsistency.

For example, forex and capital controls introduced by monetary authorities to moderate the downward pressure on the external value of the naira and to relieved pressure on external reserves were some of the primarily factors responsible for manufacturing sector's contraction in 2015 and 2016. Consequently, a considerably number of small-sized firms reliant on imported raw material reportedly shut down their operations. In addition, capital controls dis-incentivized foreign direct investments into the manufacturing sector during which all components of Nigeria's capital inflows nosedived with the deepest decline of 71.54% to an historic low record of $271.04 million, in the quarter one of 2016 (NBS, 2016).

Indeed, it is apparent that foreign exchange policies and certain restrictions may hinder industrialization potential and eroded investors' confidence in the economy. However, the extent and degree to which forex restriction hinders industrialization via import of intermediate inputs needs to be investigated empirically. Related studies have examined and explore the channels through which exchange rate devaluations can be contractionary (Edwards, 1986; Kamin and Klau, 1998; Bebczuk, Galindo and Panizza, 2010). Some studies are sector-specific, investigating the effect of exchange rate on manufacturing or industrial sector (Roy and Doroodian, 1999; Akinlo and Lawal, 2015; Adekoya and Fagbohun, 2016), while others are firm level analysis examining the impact of exchange rate on sampled firms (Bleakley and Cowan, 2002; Martinez and Werner, 2002; Pratap et al., 2003; Aguiar, 2005; Carranza et al., 2003; Echeverry et al., 2003; Benavente et al., 2003). A few studies focusing directly on the effect of exchange rate on manufacturing sector in Nigeria, such as Akinlo and Lawal (2015) and Adekoya and Fagbohun (2016), did not take cognisance of such impact through import of key intermediate inputs imports but only drew some conclusions in this regards. By investigating the link between foreign exchange and industrialization via importation of fundamental intermediate inputs and raw materials makes, this study fill gaps in the literature.

The main aim of this study is to investigate the link among foreign exchange, importation of key intermediate inputs and industrialization in Nigeria. The analysis of foreign exchange and industrialization nexus helps to address a number of key questions: What are the channels of foreign exchange impact on industrialization? Does trade in intermediate inputs matters? What variations can be observed across intermediate inputs import? The study employs structural vector autoregressive (SVAR) model with annual data covering 1981 to 2016. This is due to data availability for the required variables. The data for the study were sourced mainly from the Central Bank's statistical bulletin (2016), World Bank's development indicators (online database), National Bureau of Statistics database and World Integrated Trade Solution based on UNCOMTRADE database.

The rest of the paper is organised as follows: Section two presents stylised facts focusing of trends of industrialization, foreign exchange and intermediate inputs imports in Nigeria. In section three, literature review is presented, while section four dwells on methodology and data. Section five presents the basic results and section six concludes the study and provided some recommendations.

2. Industrialization, Foreign Exchange and Intermediate Input Imports in Nigeria: Stylised facts

Since industrialization is the process of economic transformation from primarily agricultural to manufacturing sector, one of the standard measures of level of industrialization of any country is the proportion of manufacturing sector in total output. In Nigeria, the process of industrialization has been weak and inconsistent evident from contribution of manufacturing sector to GDP averaging 8.0% between 1981 and 2016 (figure 1). The positive momentum gained by the manufacturing sector between 1984 and 1988 was lost between 1991 and 2003. Likewise, the positive momentum gained between 2004 and 2014 was lost between 2015 and 2016. In terms of the overall capacity utilization of manufacturing sector in Nigeria, the manufacturing capacity utilization presented in figure 2 shows that the proportion of potential economic output that was realized was highest in 1981, recording 73.3%. The manufacturing capacity utilization declined to historic low value of 29.3% in 1995, after which there was unsustainable improvement, as this dropped from 56.5% in 2003 to 51.7% in 2016.

Factors affecting manufacturing sector's performance are numerous ranging from infrastructural deficit to policy inconsistencies and policy incoordination across sectors, specifically between trade and industrial policies. However, there are clear connection between foreign exchange policies and manufacturing sector performance in Nigeria. Between 1991 and 1998 (when the country recorded a full year economic decline of 0.6% and 0.3% in 1991 and 1995, respectively) there was a consistent decline in manufacturing contribution to GDP. Within the same time, exchange rate depreciates from N9.91/$1 in 1991 to about N21.89/$1 in 1998 (figure 3).

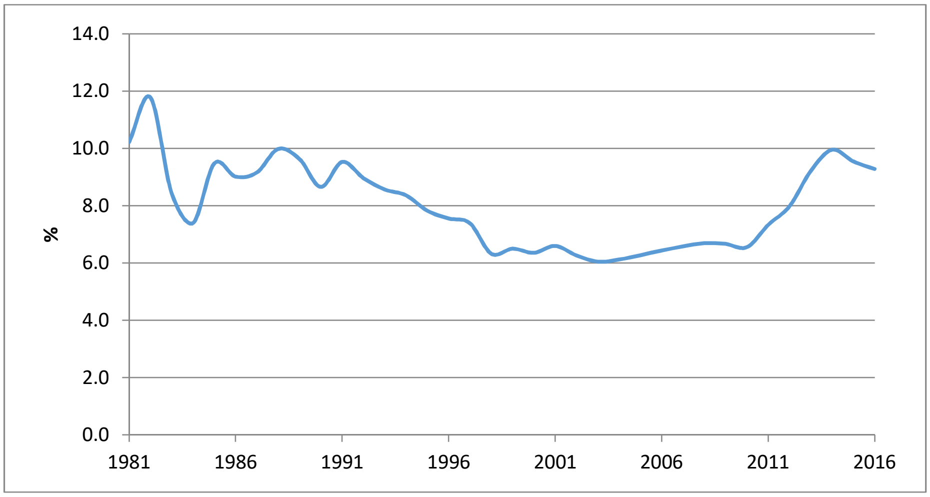

Figure 1: Contribution of manufacturing sector to GDP
Source: CBN (2016) and NBS (2017)

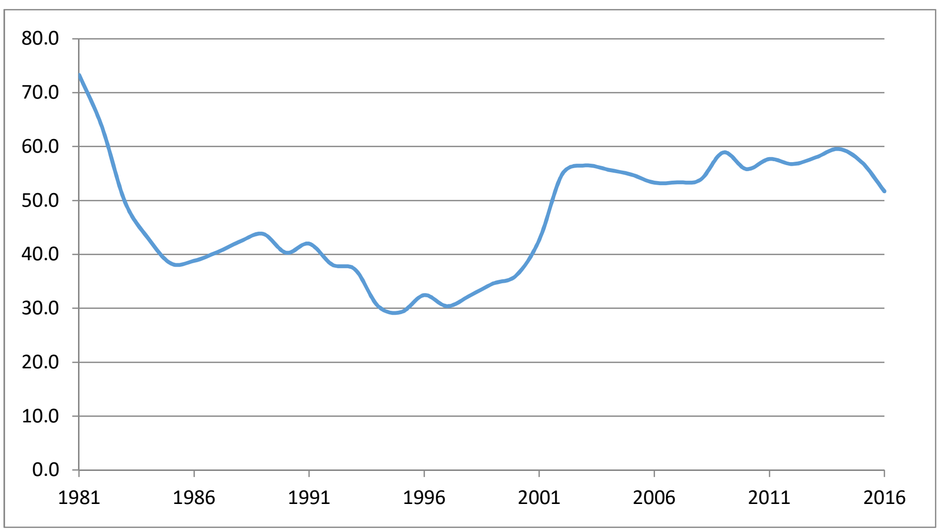

Figure 2: Manufacturing capacity utilization rate (%)
Sources: CBN (2016) and CBN Quarterly Economic Report

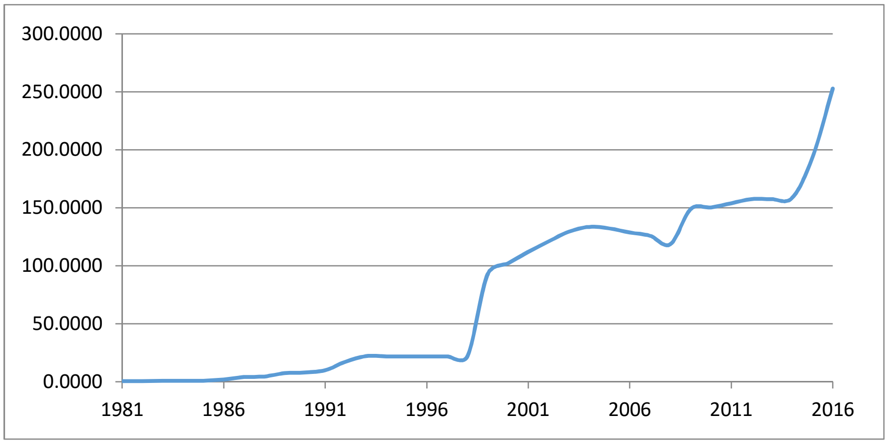

Figure 3: Average official exchange rate of the naira (N/US$1.00)
Source: CBN (2016) and CBN database (2017)

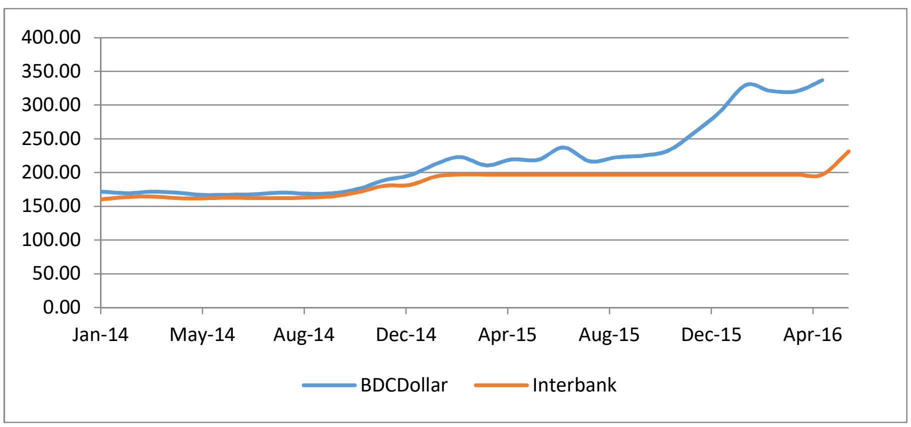

Figure 4: Interbank and bureau de change (BDC) exchange rate (N/US$1.00)
Source: CBN database (2017).

Often, Nigeria foreign exchange policies are tied with crude oil price and external reserves movements with significant effect on manufacturing sector. For instance, during the recession of 1991 when crude oil prices fell, on the average, from $19.37 per barrel to about $13.07 per barrel in 1998 (figure 5), external reserves declined, exchange rate depreciated, manufacturing sector contribution to GDP declined within the same period. Recently, crude oil price nosedived between 2014 and 2016 with observed decline in external reserves, depreciated exchange rate, and significant decrease in manufacturing contribution to GDP (figures 1, 3 and 5). To buttress on the recent recession, the continuous depreciation in exchange rate due to fall in oil prices prompted the government to fix the currency in February 2015 (figure 4). However, as oil revenue and dollars receipt from oil continued to fall, it became difficult for government to execute its basic projects and manage naira using external reserves. The dollars scarcity, coupled with Central Bank's policy restriction on domiciliary accounts and banning of certain 41 items from assessing official forex market (by June 2016), led to the development of a parallel dollar market that worsened the shortage of dollars in the formal market —the development which further contributed to the woes of Nigerian manufacturers and other investors who need to import basic inputs and meet payment of dollars commitments.

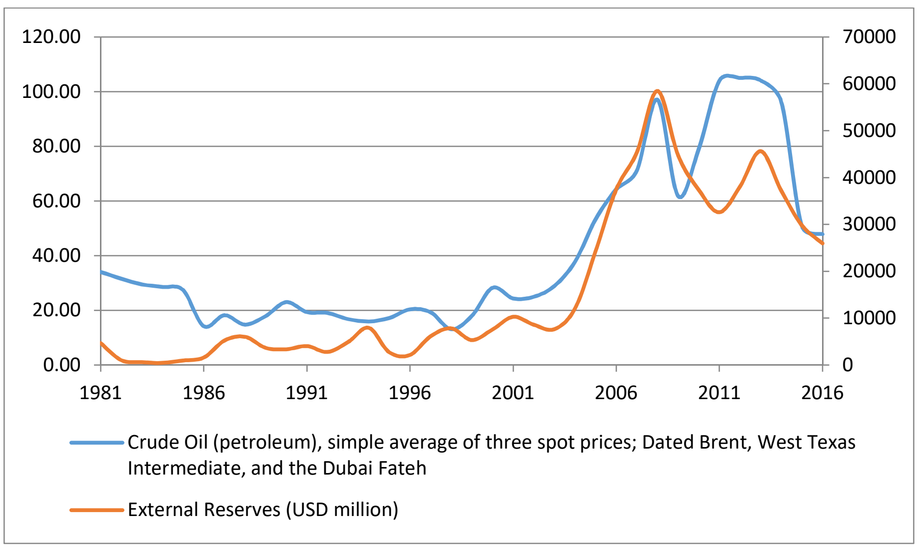

Figure 5: Crude oil (petroleum) price per barrel (USD) and external reserves
Source: IMF commodities database and CBN (2016)

The dollar scarcity, coupled with Central Bank's policy restriction on domiciliary accounts and banning of certain items from assessing official forex market, led to the development of a parallel dollar market that worsened the shortage of dollars in the formal market. This further puts pressure on parallel market exchange rate, widening the gap between official and parallel markets (figure 4). The effects of this development in 2016 are fall in manufacturing contribution to GDP (figure 1), decline in manufacturing capacity utilization (figure 2) and reduction in imported intermediate inputs (figure 8). The structure of Nigeria manufacturing sector presented in figure 6 shows that four subsectors including oil refining; cement; food, beverages and tobacco; textile, apparel and footwear; and wood and wood products account for average of 89.78% of total manufacturing activities in Nigeria between 1981 and 2016 (figure 6). More specifically, only food, beverages and tobacco accounts for 61.0%, which shows the importance of the subsectors to manufacturing activities in Nigeria. Following food, beverages and tobacco accounts are textile, apparel and footwear and cement accounting for 11.3% and 10.0% between 1981 and 2016, respectively. The trend in the subsectors contribution to manufacturing sector shows that the share of food, beverages and tobacco has reduced while that of the textile, apparel and footwear has improved relatively in the recent time.

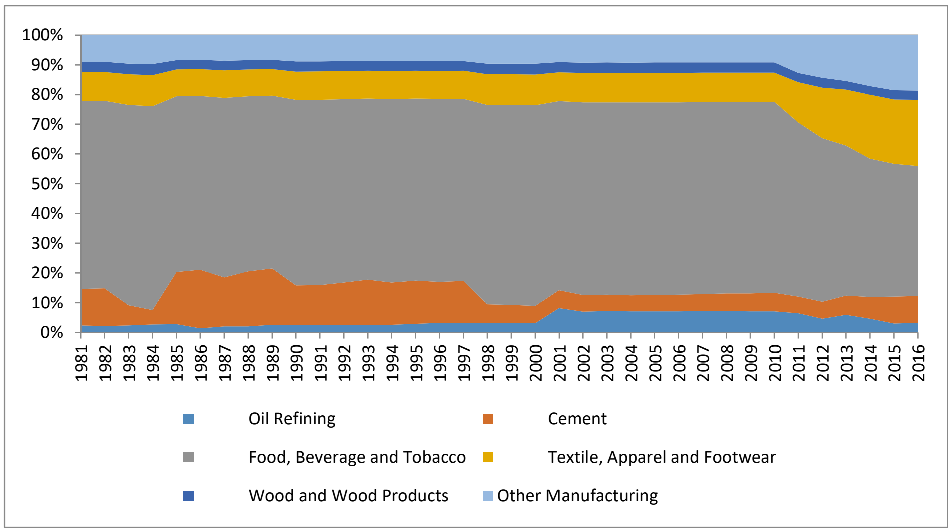

Figure 6: Structure of manufacturing sector in Nigeria
Source: CBN (2016) and NBS (2017)

The major imported commodities in Nigeria can be categorised as final consumer goods, intermediate inputs and raw materials. Commodities such as manufactured goods and beverages and tobacco imports can be classified as final consumer goods, while food and live animals as well as animal and vegetable oils, fats and waxes can final goods as well as important raw materials in the food and beverages industry. Also, chemicals and related products are important intermediate inputs in cement and paint and plastic production. In addition, machinery and transport equipment are important intermediate inputs cutting across all sectors, while miscellaneous manufactured articles are more relevant intermediate inputs in the building and construction industry.

In terms of structure of imports, machinery and transport equipment accounts for the bulk of imports in Nigeria between 1981 and 2016 representing about 38.56%. This is followed by manufactured goods classified chiefly by material and chemicals and related products which accounts for about 17.57% and 12.39% respectively within the same period. Also, food and live animal accounts for 27% of imports in Nigeria between 1981 and 2016, while mineral fuels, lubricants and related materials accounts for 9.24% within the same time. Moreover, the share of machinery and transport equipment in total import has reduced in the recent time while that of mineral fuels, lubricants and related materials has increased. The reason for rising import of mineral fuels, lubricants and related materials may be rooted in increase in domestic demand for refined petroleum products without adequate functioning domestic refineries. The share of miscellaneous manufactured articles import has also increase especially between 2012 and 2016. This may be due to rising contribution of building and construction subsectors to the Nigerian economy. Also, the rising share of chemical products imports between 2013 and 2016 may be due to marginal rising contribution of cement industry to manufacturing sector within the same period (figure 6).

Figure 8 shows the trend in the major intermediate and raw materials imports. The positive momentum gained in imports of these commodities between 2000 and 2014 was lost in 2015 and 2016. This is traceable to the recent economic challenge and management of its currency, which has led to depreciation, thus making imports more expensive.

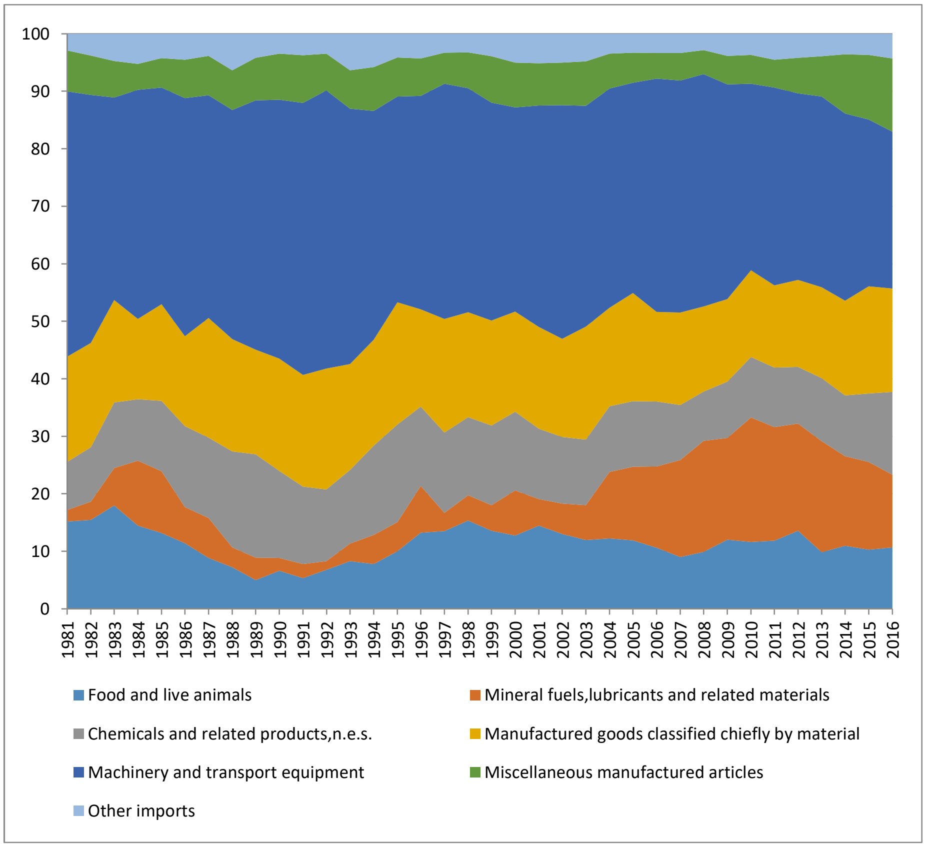

Figure 7: Structure of import groups by SITC sections (%)
Source: World Integrated Trade Solutions database (based on UN Comtrade)

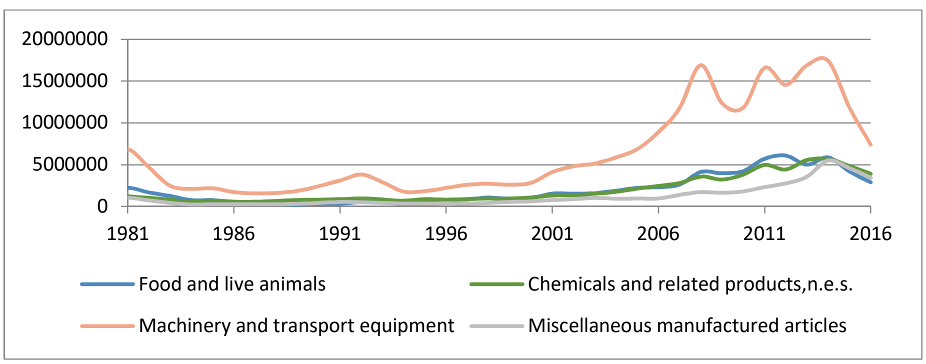

Figure 8: Major intermediate inputs imports ('000 USD)
Source: World Integrated Trade Solutions database (based on UN Comtrade)

3. Literature Review

Foreign exchange controls are restrictions the government put in place to limit the exchange of one currency for the others. Some of the foreign exchange controls include rationing of foreign currency (controlling the amount of foreign currency available for exchange), exchange rate pegging/fixed exchange rate, blocking accounts (enacting regulations preventing foreigners and domestic residence from withdrawing from or depositing funds to local bank accounts), and multiple exchange rates. Foreign exchange control is often used when currency is weak and where there is significant demand for foreign currencies among citizens. Hence, the Central Bank, in order to preserve a currency, often engages in foreign exchange rate control. However, this is not costless because foreign reserves is often use by Central Banks to manage currencies, especially in pegging/fixed exchange or managed floating exchange rate regimes.

It is important to note that foreign exchange control is not bad if it does not have contractionary attribute and does not have a negative impact on international trade. In most cases, foreign exchange control is a distortion which creates potential for flourishing parallel market and rent seeking behaviour leading to disparities between the official and parallel market exchange rates. The ultimate impact of this will be depreciation of exchange rate, especially when foreign reserves are limited to manage a currency. However, if foreign exchange controls or restrictions are not contractionary and does not significantly affect international trade negatively it can be claimed there is foreign exchange easing.

The real effect of foreign exchange movement on industrialization can be viewed from two key channels including trade and financial channels. With trade channels for instance, depreciated exchange rate creates a condition in which exportable producing firms' exports become relatively cheaper in terms of foreign currencies. However, exportable firm's imported intermediate goods import becomes expensive. Hence, the net effect of depreciated exchange rate on exportable firms depends on the extent of their dependency on foreign sourced intermediate inputs and ability to supply foreign countries. In most developing countries, it is a case of contractionary depreciation or devaluation because the exportable goods are often less competitive to fully leverage on the gains of depreciation while there are limited domestic substitute for the imported intermediate inputs.

The contractionary devaluation hypothesis is well explored in the study of Diaz-Alejandro (1965) and Krugman and Taylor (1978), while Lizondo and Montiel (1988) and Larrain and Sachs (1986) are in-depth explorations within this framework. Contractionary devaluation leverages on Marshall (1923)-Lerner (1944) conditions. However, the Marshall (1923)-Lerner (1944) conditions are often less satisfied in developing countries because one of the conditions to be satisfied for devaluation to improve trade balance is that exportable producers should be better off after the devaluation. In order words, not only does supply of exports increases after devaluation but also a depressed aggregate demand for imports for consumption and investment purposes ensues. In the case of the non-tradable producing firms, they are worse-off in terms of export and imports.

With financial channels similar effect is noticed between tradable and non-tradable firms following depreciation. In this case, the value of gross assets increases with positive impact on the performance of tradable and non-tradable sector. There is a lag effect in this regards. In the countries that have suffered huge capital flight in the past due to unfavourable foreign exchange policies, the current gross assets owned by firms and households may be high. However, gross debt increases with negative effect on performance of tradable and non-tradable sector. This is due to two reasons; first, when the domestic dollarized and second, when bulk of domestic debt is dollar denominated instruments (Bebczuk, Galindo and Panizza, 2010)

The effect of exchange rate on the economy has stimulated a substantial empirical research effort. While some investigated the issue from economic wide perspectives, some focuses on manufacturing sector specifically. For instance, Bebczuk, Galindo and Panizza (2010) explore the channels through which devaluations can be contractionary, in particular the study explores if investment and consumption decisions are negatively affected by exchange rate devaluations under currency mismatches. Some of the basic results are that in countries with no external dollarization, a real devaluation increases per capita GDP growth and as dollarization increases, the expansionary effect of devaluations diminishes. However, in countries where the external dollarization measure is higher currency devaluations become contractionary. Similarly, Edwards (1986) finds a moderate short-run effect and no long-run effect of exchange rate depreciations on GDP for a panel of 12 developing countries, while related finding of Kamin and Klau (1998) established contractionary devaluation for a sample of 27 developing and industrialized countries.

A country specific study such as Roy and Doroodian (1999) examines the effects of Peso devaluation on manufacturing, export and tropical forests in Mexico utilizing a CGE model. The basic finding is that the Peso devaluation would adversely affect many manufacturing sectors which will in turn force low skilled workers to the countryside thereby increasing agricultural production at the expense of land now covered by tropical forests leading to a negative impact on the size, quality, and value of tropical forests.

The Nigerian sector specific studies such as such as Adekoya and Fagbohun (2016) investigates the impact of currency devaluation on manufacturing output growth in Nigeria between 1980 and 2014 employing ordinary least square for long-run estimate and Granger causality test for causal relationships. The result suggests the need for currency appreciation rather than depreciation as the manufacturing sector depends heavily on the importation of equipment's, machineries as well as most of its raw materials. The study therefore concludes that both monetary and exchange rate policies have not been successful in driving the desired industrialization in Nigeria. Similarly, Akinlo and Lawal (2015) examines the impact of exchange rate on industrial production in Nigeria over the period 1986-2010 using the Vector Error Correction Model (VECM). The results confirm the existence of long run relationship between industrial production index, exchange rate, money supply and inflation rate. Moreover, exchange rate depreciation had no perceptible impact on industrial production in the short run but had positive impact in the long run. The study concludes that money supply explained a very large proportion of variation in industrial production in Nigeria.

Also, many empirical studies have used micro-level data to assess the impact of real exchange rate depreciations. For instance, Bleakley and Cowan (2002) use a sample or 480 firms from five Latin American countries including Argentina, Brazil, Chile, Colombia and Mexico) between 1991 and 1999, to test if real exchange rate devaluations have influenced investment decisions. The study does not find conclusive evidence regarding a contractionary effect of exchange rate depreciations on firms' investment. However, Martinez and Werner (2002), Pratap et al. (2003) and Aguiar (2005) and finds that exchange rate depreciations have a negative effect on firm performance among Mexican firms. Similar results were obtained for Peru, Argentina, Colombia and Chile by Carranza et al. (2003), Echeverry et al. (2003) and Benavente et al. (2003), respectively.

Despite a growing concerns of importance of foreign exchange on manufacturing sector performance, few empirical studies exit on it in Nigeria. While the few existing studies focus directly on the effect of exchange rate on manufacturing sector in Nigeria, they did not take cognisance of such impact through import of key intermediate input imports but only drew some conclusions in this regards. Inadequate empirical studies in this regards deprives policymakers of robust evidence based for informed decision-making. Hence, the main thrust of this paper is to access the impact exchange rate on industrialization via importation of fundamental intermediate inputs and raw materials. With this, the study bridges the gaps in the literature.

4. Methodology

To examine the impact of exchange rate on industrialization through import of intermediate inputs, this study modelled industrialization in Nigeria employing SVAR based on contractionary devaluation hypothesis. Unlike the vector autoregressive (VAR) models, SVAR is theoretic-dependent. Hence, SVAR is an extension which provides theoretical justification for the use of the VAR framework by imposing restrictions on the VAR framework. The study presents the set-up of the SVAR model which is an extension of the VAR framework by imposing restrictions based on economic theory. The underlying structural equation is in the form:

$$Ay_t = C(L)y_t + Bu_t \qquad 1$$

Where the stochastic error u_t is normally distributed i.e. $u_t \sim N(0,I)$. Equation 1 cannot be estimated directly due to identification issues; hence, the study estimated an unrestricted VAR of the form:

$$y_t = A^{-1}C(L)y_t + A^{-1}Bu_t \qquad 2$$

Matrices A, B and C are not separately observable. To recover equation 1 and 2 the study imposed restrictions on our VAR to identify an underlying structure. The contractionary devaluation hypothesis informed the restrictions imposed on the VAR. These restrictions are based on causal ordering of shock propagation such as Cholesky decomposition. The study imposed short run restrictions on equation 2 and estimated the random stochastic residual $A^{-1}Bu_t$ from the residual e_t of the estimated unrestricted VAR:

$$A^{-1}Bu_t = e_t \qquad 3$$

Reformulating equation 3 yields $A^{-1}Bu_tu_t'B'A'^{-1} = e_te_t'$, and since $u_tu_t' = I$, it generates:

$$A^{-1}BB'A'^{-1} = e_te_t' \qquad 4$$

Equation 4 implies that if there are k variables, the symmetry property above imposes *k(k+1)/2* restrictions on the $2k^2$ unknown elements in matrices A and B. Hence, an additional *k(3k-1)/2* restrictions must be imposed. Hence, the restriction schemes are in the form:

$$Ae_t = Bu_t \qquad 5$$

Imposing a structure on matrices A and B implies imposing restrictions on the structural VAR in equation 5. Thus, the link between the reduced-form errors and the structural disturbance is given subsequently with imposed restrictions using the Cholesky decomposition identification scheme as:

$$z^t = (OILP_t RES_t ER_t IIM_t IND_t) \qquad 6$$

where OILP, RES, ER, IIM, IND is oil price, reserves, exchange rate, intermediate inputs imports, and a measure of industrialization, respectively.

The study employed the standard identification approach which imposes a recursive structure of the VAR with the ordering of the variables in equation 6 given as:

$$A = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{vmatrix}, B = \begin{vmatrix} a_{11} & 0 & 0 & 0 & 0 \\ 0 & a_{22} & 0 & 0 & 0 \\ 0 & 0 & a_{33} & 0 & 0 \\ 0 & 0 & 0 & a_{44} & 0 \\ 0 & 0 & 0 & 0 & a_{55} \end{vmatrix} \qquad 7$$

Hence,

$$\begin{pmatrix} OILP \\ RES \\ ER \\ IIM \\ IND \end{pmatrix} = \begin{vmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{vmatrix} \begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \end{pmatrix} \qquad (10)$$

OILP is taken as exogenous variable. There are two reasons for this. First, the price of crude oil price is exogenously determined in the international market and not subjected to endogenous domestic factors. Second, crude oil price is significant to Nigeria economic performance in terms of export earnings and source of foreign reserves. The endogenous variables are RES, ER, IIM (This represents import of basic intermediate inputs in the manufacturing process, such as chemical and chemical products and machinery and transport equipment) and IND (A measure of industrialization proxy with manufacturing share in GDP). The first equation suggests that oil price does not respond to any other variable in the model, the second equation restricts foreign reserves to responds to oil price, the third equation restricts exchange rate to respond to oil price and foreign reserves, the forth equation restricts intermediate inputs import to respond to oil, price, foreign reserves and exchange rate movement, and finally the fifth equation restrict industrialization to respond to all the other variables. Hence, it is assumed that shocks or innovations are propagated in the order indicated in equations 6 and 10. The standard optimal lag length tests of Akaike Information Criterion, Schwarz Information Criterion, Hannan–Quinn Information Criterion and the Final Predictor Error are used to determine the optimal lag length of the VAR. The analysis focuses on chemical and chemical products and machinery and transport equipment imports. This is because they represent the key imported intermediate inputs in major manufacturing activities in Nigeria.

Furthermore, the study used annual data covering 1981–2016. The data used included oil price, share of manufacturing sector in GDP, chemical and chemical products, machinery and transport equipment and food and live animals import, naira/dollar nominal exchange rate. While trade variables are measures in thousand US dollars (sourced from *World Integrated Trade Solution database*), the share of manufacturing sector in GDP is sourced from the CBN statistical bulletin and NBS database and external reserves (measures in million USD) is also sourced from CBN statistical bulletin The crude oil price is obtained from the

IMF commodities database measured in US dollars. All variables are logged except share of measure of industrialization.

5. Empirical Results

5.1 Unit root and cointegration tests

Table 1: Unit root test result

Intermediate ADF test results at level					*Intermediate ADF test results at first difference*				
Series	*Prob.*	*Lag*	*Max Lag*	*Obs*	*Series*	*Prob.*	*Lag*	*Max Lag*	*Obs*
CHEMM	0.9553	0	8	35	D(CHEMM)	0.0002	0	8	34
EXR	0.3124	0	8	35	D(EXR)	0.0002	0	8	34
EXRES	0.5378	4	8	31	D(EXRES)	0.0138	3	8	31
MACHINERY	0.5153	1	8	34	D(MACHINERY)	0.0166	0	8	34
OILP	0.7156	0	8	35	D(OILP)	0.0000	0	8	34
SMGDP	0.2673	0	8	35	D(SMGDP)	0.0000	0	8	34

Source: Computed by authors

Table 2: Unrestricted cointegration rank test (trace)

Hypothesized No. of CE(s)	*Eigenvalue*	*Trace Statistic*	*0.05 Critical Value*	*Prob.***
		(1)		
None *	0.683	97.423	69.819	0.000
At most 1 *	0.597	58.330	47.856	0.004
At most 2	0.388	27.409	29.797	0.092
At most 3	0.244	10.698	15.495	0.231
At most 4	0.034	1.190	3.841	0.275
		(2)		
None *	0.729	111.985	69.819	0.000
At most 1 *	0.608	67.636	47.856	0.000
At most 2 *	0.439	35.836	29.797	0.009
At most 3 *	0.318	16.190	15.495	0.039
At most 4	0.089	3.160	3.841	0.076

Source: Computed by Authors

Note: Trace test indicates 2 and 4 cointegrating equations at the 0.05 level in model (1) and (2), respectively. * denotes rejection of the hypothesis at the 0.05 level, **MacKinnon-Haug-Michelis (1999) p-values. Also, 1 indicates the SVAR model with Chemical and Chemical imports as inputs and 2 indicates SVAR model with machinery and transport equipment import as inputs.

The unit root test results in table1 shows that all the series are non-stationary processes and are integrated of order one, denoted I(1). Hence, the null hypothesis that the series are stationary at level is rejected at 5% level and the study concludes that the series are differenced stationary. This calls for the need to test whether a long run relationship exist among the variables utilizing Johansen cointegration. The cointegration test result in table 2 suggests the presence of a long-run relationship with two cointegrating vectors in model 1 (model of chemical and chemical intermediate imports) and 4 in model 2 (model of machinery and transport equipment imports). This implies that besides the short run analysis, these models can be used for prediction industrialization in the long-run.

5.2 Estimation results for structural VAR models

Pre-estimation Diagnosis

SVAR modelling is an extension of the VAR approach which requires the need to determine the optimal lag length. Hence, the standard information criteria for lags selection which are the Akaike information criterion (AIC), Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ) are presented in table 3. From the results, the optimal lag length of three is supported by the entire lag selection criteria, except SC, in both models. Hence, lag length three gives the best and optimal SVAR outcomes.

Table 3: Lag length selection criteria test

		(1)				
Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	66.19683	NA	1.88e-08	-3.599814	-3.375349*	-3.523265*
1	94.32680	46.33171*	1.59e-08*	-3.783930*	-2.437141	-3.324636
0	71.59489	NA	1.22e-08	-4.036054	-3.809310*	-3.959762*
1	101.5393	48.99990*	9.19e-09*	-4.335714*	-2.975252	-3.87796
2	120.4207	25.17517	1.49e-08	-3.964888	-1.470709	-3.125672
0	72.83267	NA	9.92e-09	-4.239542	-4.010521*	-4.163628
1	102.5189	48.24019	7.57e-09	-4.532434	-3.158306	-4.076949
2	121.6772	25.14527	1.23e-08	-4.167328	-1.648094	-3.332273
3	172.3172	50.63999*	3.52e-09*	-5.769827*	-2.105487	-4.555202*
0	75.02643	NA	7.51e-09	-4.517834	-4.286546*	-4.44244
1	102.3706	44.10345	6.62e-09	-4.669069	-3.281339	-4.216704
2	125.8952	30.35437	8.34e-09	-4.573884	-2.029713	-3.744548
3	167.1665	39.93999*	4.30e-09	-5.623647	-1.923035	-4.41734
4	223.0912	36.08046	1.47e-09*	-7.618790*	-2.761736	-6.035511*

		(2)				
0	47.95773	NA	5.50e-08	-2.526925	-2.302460*	-2.450376*
1	75.33963	45.09959*	4.87e-08*	-2.667037*	-1.320248	-2.207743
0	55.43147	NA	3.24e-08*	-3.056453*	-2.829709*	-2.980160*
1	79.31853	39.08792*	3.54e-08	-2.989002	-1.628541	-2.531248
2	100.8535	28.71332	4.88e-08	-2.779001	-0.284822	-1.939786
0	53.22348	NA	3.38e-08	-3.013967	-2.784946*	-2.938053
1	78.00404	40.26841	3.50e-08	-3.000252	-1.626125	-2.544768
2	102.7596	32.49172	4.02e-08	-2.984977	-0.465743	-2.149922
3	154.0436	51.28394*	1.10e-08*	-4.627723*	-0.963384	-3.413098*
0	55.88786	NA	2.58e-08	-3.283088	-3.051799*	-3.207693
1	80.73670	40.07877	2.67e-08	-3.273335	-1.885606	-2.82097
2	107.5438	34.58982	2.73e-08	-3.389923	-0.845753	-2.560587
3	152.1735	43.19003*	1.13e-08	-4.656356	-0.955744	-3.450048
4	209.3474	36.88639	3.56e-09*	-6.732092*	-1.875038	-5.148813*

Source: Computed by authors

Note: * indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Contemporaneous Restrictions and SVAR Estimates

As previously indicated, this study examines the effect of exchange rate on industrialization via importation of fundamental intermediate inputs and raw materials. Tables 4 and 5 present the restrictions imposed as shown in equation (9) and (10), without which the SVAR cannot be identified. Table 5 shows that, oil price is restricted not to be affected by any variable in the model, while external reserves is restricted to be affected by oil price. This continues until the last restriction imposed on the share of manufacturing sector in GDP which is restricted to be affected by all the other variables in the models. But the focus of this study is mainly on what happens to industrialization as importation of chemical products and machinery and transport equipment import changes as well as the feedback effects. Tables 4 and 5 present SVAR estimates based on these restrictions.

The SVAR shows that all the variables respond positively and significantly to their own shocks indicated in matrix B captured by C1, C3, C6, C10 and C15 in table 6. However, there are mixed responses of variables to one another as indicated by parameters C2, C4, C5, C7, C8, C9, C11, C12, C13 and C14 in table 6. In the model 1, the VAR estimates shows that external reserves responds positively to oil prices (C2) shocks, while exchange rate respond negatively to both oil prices and external reserves shocks (C4 and C5). However, response of exchange rates to oil prices shocks is not significantly different from zero. This implies that shocks to oil prices does not directly influence exchange rates but through to external reserves shocks. Thus, positive shocks to external reserves will lead to appreciation of naira. This is expected since external reserves are often used to manage naira. Further, chemical and chemical products importation respond positively, negatively and positively to oil prices (C7), external reserves (C8) and exchange rates (C9) shocks, respectively.

Table 4: Contemporaneous restrictions (matric A)

			(1)		
	OILP	*EXRES*	*EXR*	*CHEMM*	*SMGDP*
OILP	1	0	0	0	0
EXRES	(C2)	1	0	0	0
EXR	C(4)	C(5)	1	0	0
CHEMM	C(7)	C(8)	C(9)	1	0
SMGDP	C(11)	C(12)	C(13)	C(14)	1
			(2)		
	OILP	*EXRES*	*EXR*	*MACHINERY*	*SMGDP*
OILP	1	0	0	0	0
EXRES	(C2)	1	0	0	0
EXR	C(4)	C(5)	1	0	0
MACHINERY	C(7)	C(8)	C(9)	1	0
SMGDP	C(11)	C(12)	C(13)	C(14)	1

Table 5: Contemporaneous restrictions (Matric B)

			(1)		
	OILP	*EXRES*	*EXR*	*CHEMM*	*SMGDP*
OILP	C1	0	0	0	0
EXRES	0	C3	0	0	0
EXR	0	0	C6	0	0
CHEMM	0	0	0	C10	0
SMGDP	0	0	0	0	C15
			(2)		
	OILP	*EXRES*	*EXR*	*MACHINERY*	*SMGDP*
OILP	C1	0	0	0	0
EXRES	0	C3	0	0	0
EXR	0	0	C6	0	0
MACHINERY	0	0	0	C10	0
SMGDP	0	0	0	0	C15

Source: Authors' Computation

However, chemical and chemical products importation is found to respond significantly only to oil prices shocks. Overall, industrialization responds significantly positive to shocks to reserves (C12) and exchange rate (C13). This shows that foreign exchange easing that permits importation of chemical and chemical products inputs will produce expected improvement in industrialization.

Table 6: Structural VAR estimates

(1)			(2)		
Parameters	*Coefficient*	*z-Statistic*	*Parameters*	*Coefficient*	*z-Statistic*
C(2)	0.595935	3.547994***	C(2)	0.637041	2.909248***
C(4)	-0.00613	-0.03765	C(4)	0.147163	0.807915
C(5)	-0.30473	-2.09783**	C(5)	-0.20527	-1.5697
C(7)	0.367173	4.866455***	C(7)	0.724682	6.243549***
C(8)	-0.02019	-0.28139	C(8)	-0.23215	-2.71179***
C(9)	0.031233	0.381518	C(9)	-0.08032	-0.72025
C(11)	1.615223	1.703110*	C(11)	1.610714	1.475638
C(12)	1.516163	2.214920**	C(12)	1.159864	1.934843*
C(13)	2.588790	3.311017***	C(13)	2.291222	3.227963**
C(14)	0.533621	0.316781	C(14)	-0.10283	-0.09212
C(1)	0.118415	8.000000***	C(1)	0.109725	8.000000***
C(3)	0.112511	8.000000***	C(3)	0.135915	8.000000***
C(6)	0.092452	8.000000***	C(6)	0.100544	8.000000***
C(10)	0.042815	8.000000***	C(10)	0.063424	8.000000***
C(15)	0.407982	8.000000***	C(15)	0.400476	8.000000***

Source: Authors' Computation
Notes: *, **, *** denote significance at 1%, 5% and 1% level, respectively.

Similar results were obtained in model 2 except that exchange rate does not significantly respond to shocks to oil prices and external reserves (C4 and C5, model 2). The difference in model 1 and 2 in this regards may be attributed to multiple exchange rate regimes which permit certain economic activities to have more access to foreign exchange than others. Another exception is that machinery and transport equipment importation is found to respond significantly negative to external reserves shocks (C8) in addition to positive response to shocks in oil prices unlike what obtains in model 1. This further buttress the fact that external reserves may not be used to support (through a preferential exchange rate window) importation of machinery and transport equipment unlike chemical and chemical products. This may be justified on the ground that machinery and transport equipment are not significant vital inputs in manufacturing process, especially the transport equipment component. However, positive shocks to oil prices that that increases external reserves (C2, model 2) will minimize foreign exchange rationing and lead to increase in importation of machinery and transport equipment. Finally, industrialization responds significantly positive only to shocks in exchange rate (C13). This further confirms that foreign exchange easing that permits importation of machinery and transport equipment inputs will produce expected improvement in industrialization.

Table 7: VAR residual LM and heteroskedasticity tests

	(1)			*(2)*	
Lags	*LM-Stat*	*Prob*	*Lags*	*LM-Stat*	*Prob*
1	31.13252	0.1847	1	27.67826	0.3229
1	31.13252	0.1847	1	27.67826	0.3229
2	27.94925	0.3102	2	28.38789	0.2903
1	31.13252	0.1847	1	27.67826	0.3229
2	27.94925	0.3102	2	28.38789	0.2903
3	34.42216	0.0992	3	27.71094	0.3213
1	31.13252	0.1847	1	27.67826	0.3229
2	27.94925	0.3102	2	28.38789	0.2903
3	34.42216	0.0992	3	27.71094	0.3213
4	24.14359	0.5111	4	19.65421	0.7647
Heteroskedasticity (Joint Chi-sq)	457.56 (0.3925)			468.72 (0.2619)	

Source: Authors' Computation
Note: Probabilities from chi-square with 25 df. Probability of joint chi-square of heteroskedasticity test is in parentheses.

Also, serial correlation test is conducted, as shown in table 7. The four lags are insignificant at 5%, indicating that the null hypothesis of no serial correlation cannot be rejected. At the chosen lag length of three, not only do the almost all the selection criteria agreed (table 3); there is also no problem of serial correlation (table 7). Besides, the key existence of heteroscedasticity is a major concern in the application of regression analysis especially in the analysis of variance. The existence of heteroscedasticity invalidates statistical test of significance that assume that the modelling errors are uncorrelated and uniform. Inability to account for heteroscedasticity, therefore, undermines inefficiency because the true variance and covariance are underestimated. The results of the heteroscedasticity test are also presented in table 7. Given this results, the null hypothesis of no heteroscedasticity is not rejected. Hence, modelling errors are uncorrelated and uniform; their variances do not vary with the effects being modelled.

The sizes and adjustment speed of the estimated structural shocks can be inferred by analysing the impulse response functions. The impulse response function is used to examine the dynamic responses of the variables to various shocks within the system which is measured by the standard deviations of the corresponding orthogonal errors obtained from the SVAR model. Focusing on industrialization measure and chemical products inputs, the response of industrialization to oil prices shocks is highest in the first period (table 8) but decline afterwards to increase in period 5 after which it declined to improve marginally up to period 10. Following oil prices is exchange rate chocks. However, the response of industrialization to exchange rate shocks is inconsistent. This may be attributed to some of the noticed inconsistency in exchange rate policy. Relating to chemical and chemical products imports, its response to oil prices shocks is not only the highest but also decline consistently afterwards (figure A1). However, its response to exchange rate shocks rose marginally over the time horizon. This implies that the impact of exchange rate on chemical products importation is more relevant over the time horizon than oil prices. This is an indication that efficient exchange rate policies will enhance importation of chemical products.

Decomposing the variances of industrialization measure, oil prices and exchange rates account for the significant variance of industrialization in Nigeria. However, chemical importation contributes little to the variances but it rises over time horizon (table 9). The channel of transmission shows that industrialization is through chemical imports and exchange rate. While the measure of industrialisation responds positively to shocks to chemical import, chemical import responds to exchange rate shocks. The small contribution of chemical imports to variance of industrialization suggests that others factors, besides oil prices and exchange rates, such as adequate infrastructure and complimentary fiscal incentives are keys to industrialization in Nigeria.

Table 8: Response of industrialization measure to other variables (model 1)

		Response of D(SMGDP)			
Period	D(OILP)	D(EXRES)	D(EXR)	D(CHEMM)	D(SMGDP)
1	0.263	0.080	0.241	0.023	0.408
2	0.192	-0.084	0.076	-0.057	0.099
3	0.014	-0.055	0.109	-0.020	-0.012
4	0.010	0.061	-0.120	0.049	0.112
5	0.129	-0.048	0.037	-0.013	0.014
6	0.009	-0.021	-0.027	-0.119	0.039
7	0.060	0.001	0.026	0.107	0.039
8	0.047	0.017	-0.019	-0.017	0.017
9	0.011	-0.007	0.069	0.008	0.000
10	0.052	0.003	-0.013	0.042	0.010

Source: Authors' Computation with Eviews 9
Note: Cholesky Ordering: D(OILP) D(EXRES) D(EXR) D(CHEMM) D(SMGDP)

Table 9: Decomposition of variance of industrialization measure (model 1)

			Variance decomposition of D (SMGDP)			
Period	*S.E.*	*D(OILP)*	*D(EXRES)*	*D(EXR)*	*D(CHEMM)*	*D(SMGDP)*
1	0.548137	22.98271	2.132438	19.31179	0.173730	55.39933
2	0.602631	29.14945	3.686892	17.57264	1.053003	48.53801
3	0.615477	27.99890	4.331520	19.98143	1.118817	46.56933
4	0.641759	25.77809	4.888450	21.85154	1.601769	45.88015
5	0.657601	28.38166	5.183657	21.12739	1.567516	43.73977
6	0.670414	27.32719	5.089062	20.48836	4.676373	42.41902
7	0.683134	27.09297	4.901549	19.87706	6.943630	41.18479
8	0.685677	27.36942	4.924696	19.80491	6.956430	40.94454
9	0.689294	27.10947	4.884028	20.59433	6.896175	40.51600
10	0.692733	27.39871	4.837562	20.42491	7.202409	40.13641

Source: Authors' Computation with Eviews 9
Note: Cholesky Ordering: D(OILP) D(EXRES) D(EXR) D(CHEMM) D(SMGDP)

Similar results are obtained taking machinery and transport equipment import as intermediate input except that both the response and the variance of exchange rate is highest in industrialization (tables 10 and 11). Related to chemical products imports, the variance of imported machinery and transport equipment also rose marginally in industrialization's (table 11 and figure A4). The channel of transmission, in this case shows that industrialization is equally through imports of machinery and transport equipment, exchange rate and external reserves. That is, while the measure of industrialisation responds positively to shocks to machinery and transport equipment imports, import machinery and transport equipment responds to exchange rate shocks and exchange rate responds to external reserves.

Table 10: Response of industrialization measure to other variables (model 2)

			Response of D(SMGDP)		
Period	*D(OILP)*	*D(EXRES)*	*D(EXR)*	*D(MACHINERY)*	*D(SMGDP)*
1	0.255438	0.096733	0.231198	-0.006522	0.400476
2	0.123148	-0.09651	0.116990	-0.03713	0.058325
3	0.055165	0.048642	0.136777	-0.114653	-0.00771
4	-0.03473	0.039026	-0.15088	-0.026537	0.097042
5	0.088582	0.012200	-0.01457	-0.031435	0.035222
6	-0.02801	-0.0206	0.000586	-0.049945	0.002307
7	0.115073	0.003164	0.020398	-0.040045	0.106022
8	0.029967	-0.01994	0.016954	-0.009069	0.031242
9	0.042323	0.023978	0.026850	-0.019306	0.008293
10	0.054601	-0.00674	0.018121	0.026081	0.031392

Source: Authors' Computation with Eviews 9
Note: Cholesky Ordering: D(OILP) D(EXRES) D(EXR) D(MACHINERY) D(SMGDP)

The results obtained in this study are consistent with contractionary devaluation hypothesis which states that devaluation can be contractionary if a country depends significantly on imported intermediate inputs. In this case, devaluation increases the cost of production through imported inputs leading to decline in output or imported inflation, all other things being equal. Also, the results are consistent with previous studies on Nigeria, such as Adekoya and Fagbohun (2016), which recommend currency appreciation to improve manufacturing sector in Nigeria. Also, it is consistent with Akinlo and Lawal (2015), who show the existence of long run relationship between industrial production index and exchange rate in the long run. The results also align with Roy and Doroodian (1999), Martinez and Werner (2002), Pratap et al. (2003) and Aguiar (2005) who found that exchange rate depreciations have a negative effect on firm performance among Mexican firms. However, it contradicts Bleakley and Cowan (2002) who did not find conclusive evidence regarding a contractionary effect of exchange rate depreciations on firms' investment in five Latin American countries. In addition to previous empirical results, this study finds that industrialization responds significantly positive to shocks to reserves and exchange rate, while importation of vital inputs such as chemical products and machinery and transport equipment have marginal incremental impact on industrialization.

Table 11: Decomposition of variance of industrialization measure (model 2)

			Variance decomposition of D(SMGDP)			
Period	*S.E.*	*D(OILP)*	*D(EXRES)*	*D(EXR)*	*D(MACHINERY)*	*D(SMGDP)*
1	0.537105	22.61787	3.243600	18.52896	0.014744	55.59483
2	0.575699	24.26281	5.633631	20.25757	0.428809	49.41718
3	0.607249	22.63239	5.705071	23.28061	3.950234	44.43169
4	0.635899	20.93716	5.579227	26.86010	3.776458	42.84705
5	0.644053	22.30206	5.474734	26.23545	3.919659	42.06810
6	0.646926	22.29190	5.527624	26.00300	4.480954	41.69652
7	0.667102	23.93940	5.200569	24.54738	4.574337	41.73832
8	0.669079	23.99874	5.258712	24.46675	4.565720	41.71008
9	0.671711	24.20806	5.345017	24.43518	4.612620	41.39912
10	0.675438	24.59513	5.296149	24.23825	4.710960	41.15952

Source: Authors' Computation with Eviews 9
Note: Cholesky Ordering: D(OILP) D(EXRES) D(EXR) D(MACHINERY) D(SMGDP)

6. Conclusion and Recommendations

This study investigates the link between exchange rate and industrialization via importation of key intermediate inputs and raw materials in Nigeria using data spanning from 1981 to 2016. The study employed SVAR based on contractionary devaluation hypothesis. The key result is that major variance of industrialization comes from oil prices, external reserves and exchange rates, while importation of vital inputs such as chemical products and machinery and transport equipment have marginal but incremental variances. The small variances of intermediate inputs on industrialization imply that other factors such as adequate infrastructure and complimentary fiscal incentives are relevant to drive desired industrialization in Nigeria. However, major positive shocks (from the impulse responses results) to industrialization come from importation of chemical products, machinery and transport equipment and exchange rate.

Given the outcomes of this study, in the short term, the government needs to provide special exchange rate windows especially for the importations of chemical products and machinery and transport equipment because these commodities represent the major positive shocks to industrialization in Nigeria and foreign exchange represents major shocks to these commodities. This can be effectively achieved by putting in place necessary monitoring mechanisms to ensure the foreign exchange demanded by manufacturers are used for importation these vital imported inputs. There is also a need to have a complimentary fiscal incentives and policies that minimises the effect of other infrastructural bottlenecks on manufacturing activities. In the medium term, there is a need for export diversification to other primary commodities in which Nigeria is well endowed, besides oil. This will generate more sustainable external reserves that will minimise exchange rate depreciation and enhance ability of monetary authority to manage naira. Finally, there is need to intensify effort at sourcing intermediate inputs domestically, in the medium term, since domestic substitutability of these commodities may not be possible in the short term. This will help significantly to minimize the impact of exogenous factors such as oil prices fluctuations and unfavourable exchange rates movement on industrialization potentials in Nigeria.

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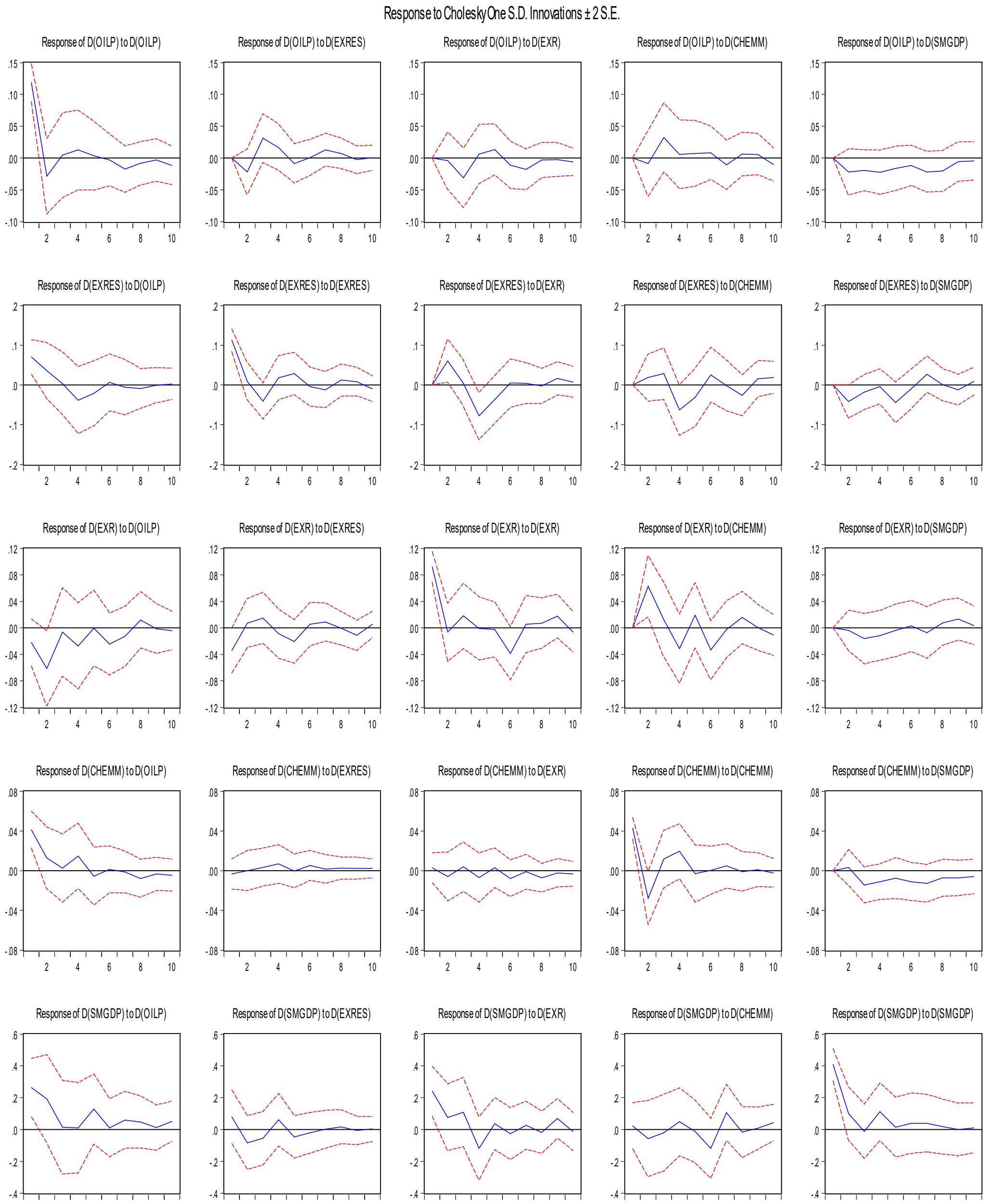
Appendix

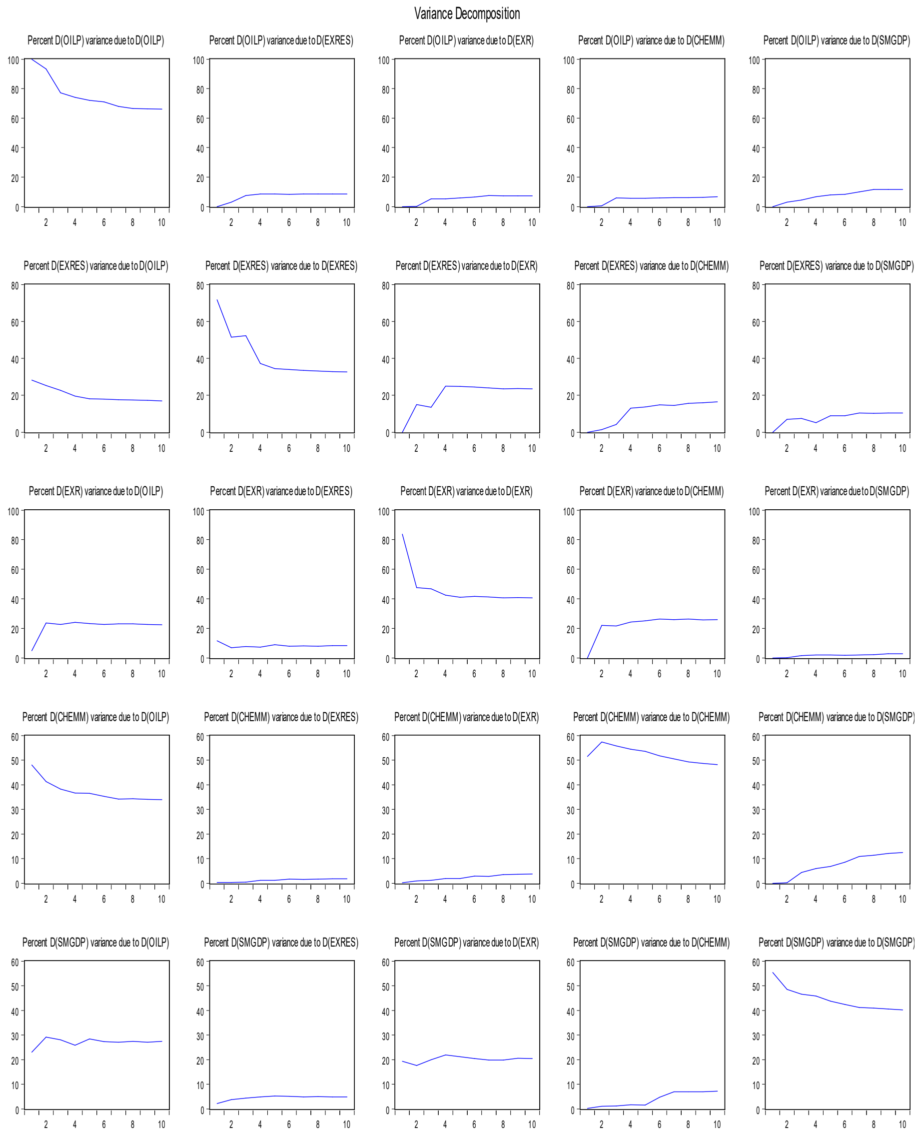
Figure A1: Impulse Response of Chemical and Chemical imports as inputs



Source: Authors' Computation with Eviews 9

Note: Cholesky Ordering: D(OILP) D(EXRES) D(EXR) D(CHEMM) D(SMGDP)

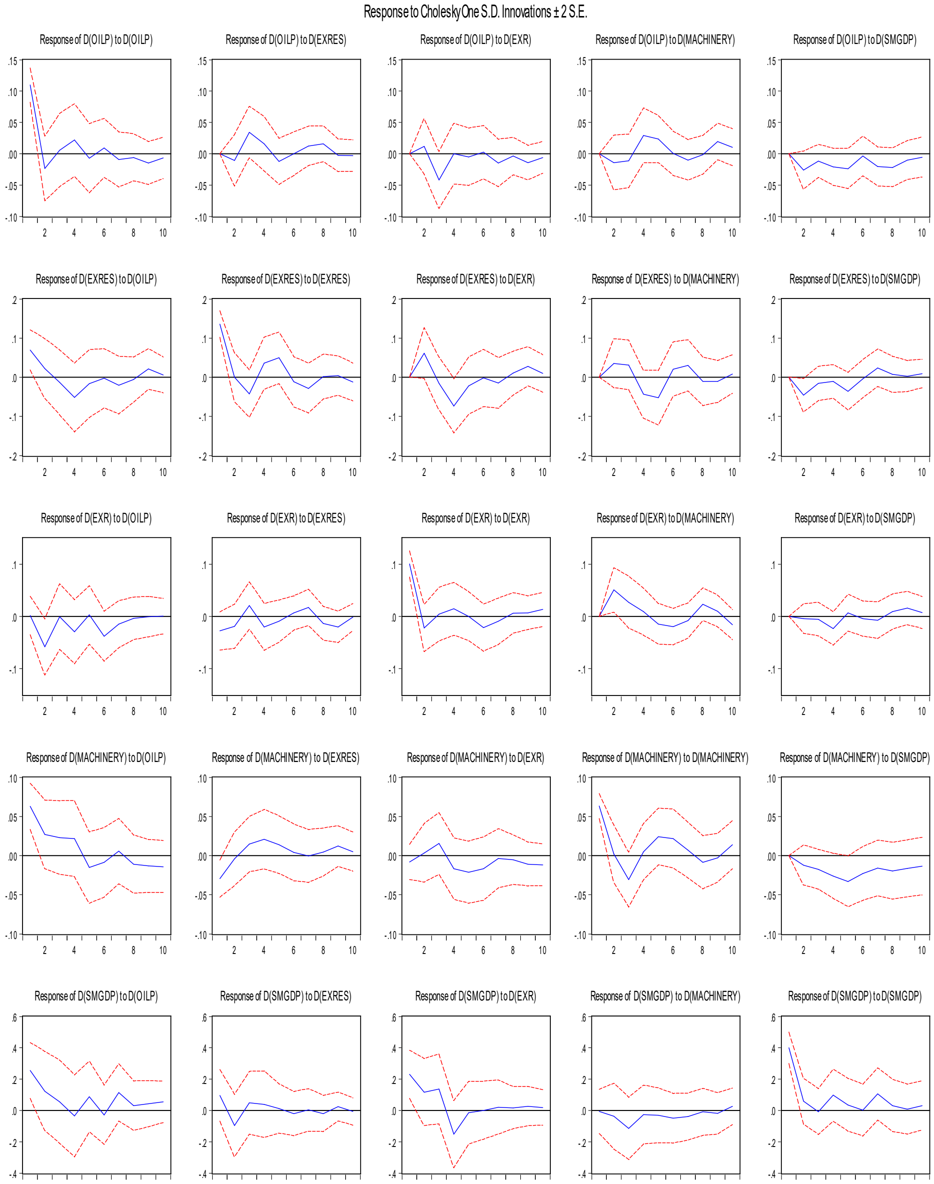
Figure A2. Variance Decomposition of Chemical and Chemical imports as inputs



Source: Authors' Computation with Eviews 9

Note: Cholesky Ordering: D(OILP) D(EXRES) D(EXR) D(CHEMM) D(SMGDP)

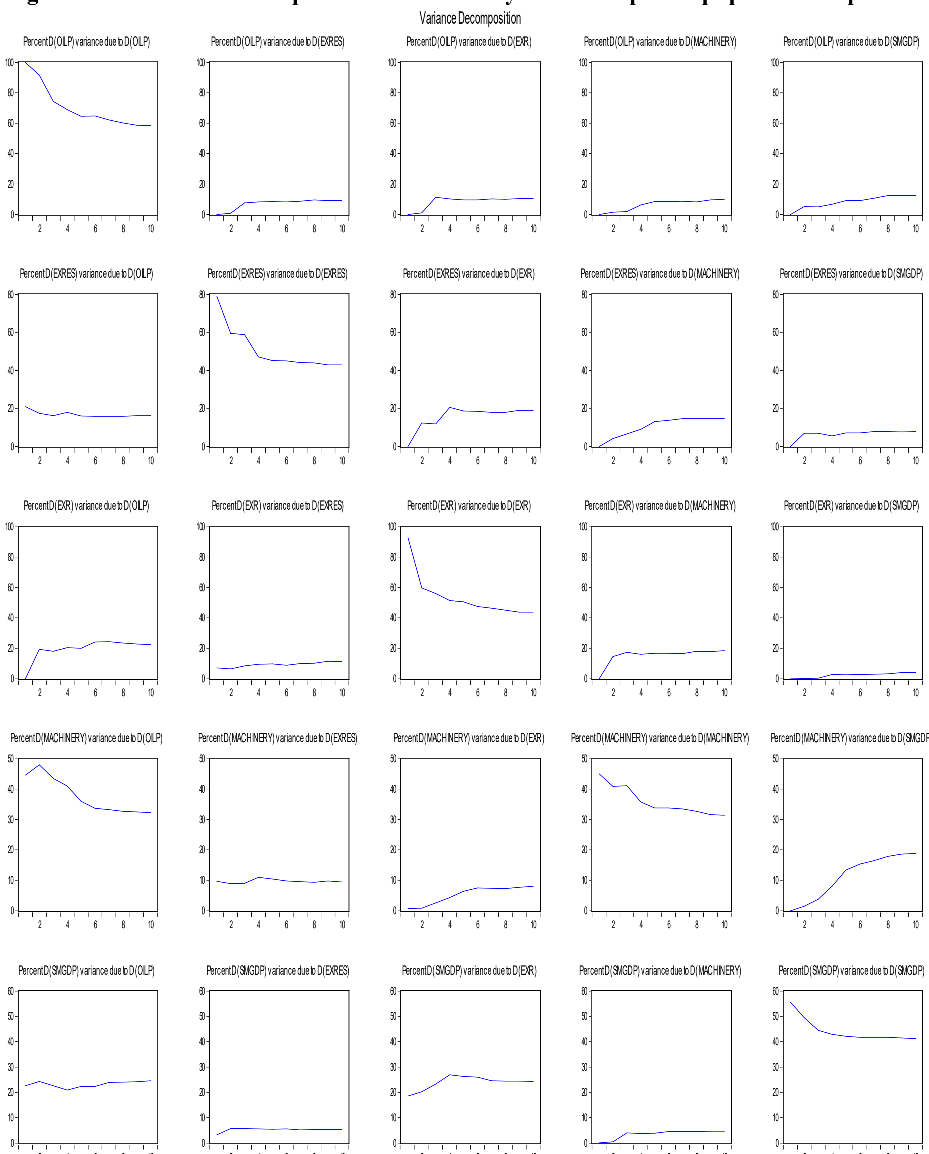
Figure A3: Impulse Response of Machinery and Transport Equipment as inputs.



Source: Authors' Computation with Eviews 9

Note: Cholesky Ordering: D(OILP) D(EXRES) D(EXR) D(MACHINERY) D(SMGDP)

Figure A4: Variance Decomposition of Machinery and Transport Equipment as inputs



Source: Authors' Computation with Eviews 9

Note: Cholesky Ordering: D(OILP) D(EXRES) D(EXR) D(MACHINERY) D(SMGDP)