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Industrial Sector Investment and Industrial Growth in Nigeria: A Granger Causality Analysis

Senibi K.Victoria[1], Aiyepeku Ayo[2], Odutola Olayinka[3], Ndaman Israel[4], Eseoghene Olaifa[5] Ogunlusi Temi [6], Eldad Maju[7]

[1,5,6,7] Department of Economics and Development Studies Covenant University Ota, Nigeria
[2,3,4] Department of Banking and Finance Covenant University Ota, Nigeria.

Abstract— *This paper assess the long term effects of industrial sector investment on the industrial growth performance for the Nigerian economy between the periods of 1981-2013. Econometric models were developed to investigate the extent of relationship between the unexplained and explanatory variables using the Johansen Normalized co-integration technique and Granger Causality Approach. The result indicates a negative but strong significant long run relationship between industrial investment and industrial growth implying that growth in the industrial sector depends on industrial investment in previous periods). The Granger Causality also indicates a case of unidirectional causation for the Nigerian economy, arguing that most developing countries are not likely to be endowed with vibrant manufacturing sectors due to poor human capital development allowing us to state that many developing countries are likely to attract investment due to high industrial GDP that can be attributed largely to exports in primary goods e.g. from agriculture and natural resources, making industrial GDP (INDGDP) responsible for high investment inflow to the industrial sector. From the findings of this study, recommendations were made to promote a friendly investment environment to boost the performance of the industrial sector in order to sustain growth.*

Keywords— Industrial Sector Investment, Industrial Sector Growth, Causality and Nigeria.

I. INTRODUCTION

One of the focal objectives of a developing country is to achieve a middle level status in industrial growth in order to attain rapid economic development. Ironically, in many developing countries the primary goods available are agricultural while most goods consumed are industrially produced by foreign economy. A major problem is that agricultural commodities need to be processed industrially before consumption in many developing countries with low level of technology. The industrial sector is therefore important and indispensable in such developing countries like Nigeria. The industrial sector in Nigeria is made up of the primary economic sector which comprises of minerals, mining, electricity, quarrying and water industry; secondary economic sector includes manufacturing and construction industries and the tertiary economic sector comprises of service sector, financial service, education, health, transport, telecommunications and information. The service sector accounts for a tiny proportion of economic activity (6 percent) while the manufacturing sector contributed only 4 percent to GDP in 2011 (CBN bulletin, 2012). Over the years, capital has been devoted to create enabling environment for industrial investment since 1990s till date yet, Nigeria remains solely dependent on foreign industrial goods for survival (Senibi 2015). The Nigerian economy has witnessed a slow pace of industrial growth of less than 5% over the past three decades (Nana, 2004), making both the private sector and foreign investors take a deeper interest in investing particularly into the industrial sector.

Ouyang (2009) applied the two-stage least square (2SLS) fixed effect estimation in the study of the impact of coastal FDI in boosting economic growth in the inland regions in china. Qin *et al*. (2005) employed Augmented Dickey Fuller and Dickey Fuller unit root test, Granger-Causality test, Johanson Co-integration test, VAR model and simplified OLS in the study of investment proxies and GDP in China. Bigten and Soderbom (2011) also study the effect of Industrial Strategies for Economic Recovery and Long-term Growth in Africa. They employed qualitative approach which was associated with the social constructivist paradigm that emphasizes the socially constructed nature of reality. These empirical evidences suggested that the absence or inadequate industrial sector investments could affect economic growth which usually adversely affects the standard of living of people in any economy (Chete, Adeoti, Adeyinka & Ogundele, 2014; Carlin & Mayer, 2000; Noland

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& Pack, 2002); since most goods consumed by the people in these economies comes from manufacturing sector. Hence the key question raised in this study is to what extent does industrial investment lead to industrial growth? In this case specifically the purpose of this research is to examine the relationship between industrial sector investment and industrial growth, considering the fact that the stimulation and sustenance of industrial growth requires persistent huge investment inflows to aid growth performance in the industrial sector for many developing countries like Nigeria. Few studies have tried to investigate specifically the effect of industrial sector investment on industrial sector growth, and its overriding effect on growth as in the case of developing countries (with special emphasis on Nigeria), which is a major contribution that this study attempts to address using the econometrics test (Johansen co-integration), which is employed to examine the long run relationship and effect of industrial sector investment on industrial growth performance while the Granger Causality Test is used to examine the direction of causation existing between industrial sector investment and industrial growth.

II. STYLIZED FACTS ON NIGERIAN'S INDUSTRIAL INVESTMENT AND GROWTH

The industrial sector in Nigeria has continued to experience dwindling growth after the introduction of the Structural Adjustment Programme (SAP) introduced in 1986. Unimpressively, the highest contribution of industrial sector to the nations GDP was noticed in 1995. Within that year the sectors contribution to GDP stood at 45.83%, while manufacturing sub-sector and non-oil export contribution to GDP was 7.44 and 1.14% respectively. Ikeze, Soludo and Elekwa (2011) observed that industrialization in Nigeria ascended during the oil boom era (1973-1981, with manufacturing share of GDP reaching 11%). This performance was not however sustained as the sector experience abrupt decline to 5% in 2000 (less than the proportion at independence in 1960). In 2000, manufacturing export was barely 0.4% of exports, while imports of manufactured goods were about 15% of GDP or more than 60% of total import (Ikepeze, 2012). More than 50% of the gross domestic product (GDP) is accounted for by the primary sector with agriculture continuing to play an important role. By contrast, the oil and gas sector shrank in importance during 2006-2010 as its share of GDP declined from about 25 percent in 2005 to about 16 percent in 2010. With an average annual real growth rate of -3 percent, the sector's contribution to GDP growth was negative between 2005 and 2009. It however had a positive growth rate in 2010 as normalcy returned to the Niger Delta region. Manufacturing sector's contribution to real GDP growth which declined from over 5 percent in 2005 to about 3.96 percent in 2009, however edged up to 4.14 % in 2010. This is despite policy effort over the last 50years and more recently, which has attempted to facilitate the industrialization process through investment, but the industrial sector has failed to record appreciable growth improvement afterwards.

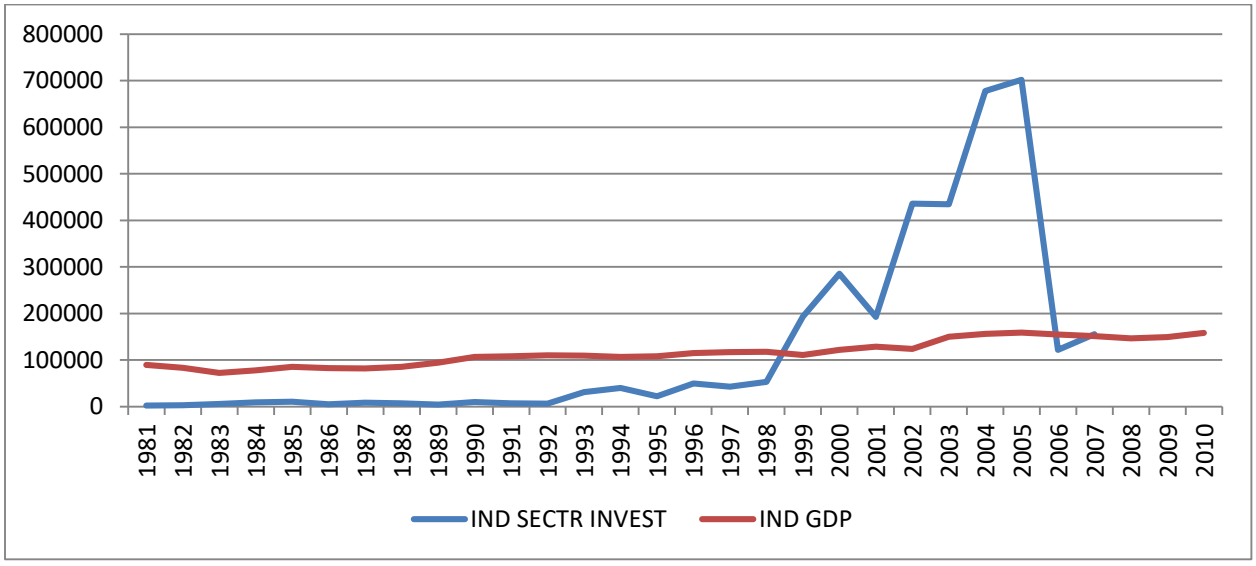

Fig.1: Graphical representation of trends of industrial sector investment and industrial GDP in Nigeria (1981 – 2010).

Note: The above figure shows the trend of investment inflow into Nigeria for the period of 1981 to 2010

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III. THEORETICAL FRAMEWORK AND METHODOLOGY

Industrial growth is theoretically and empirically established to be dependent on capital accumulation and investment; this study therefore adopts the accelerator model which postulates the role of change of output to raise the rate of investment in industries which is a way of linking industrial growth with investment. The accelerator principle suggests that increases in output leads to increase in industrial investment (relative to investment GDP), that is if there is rise in stock of capital goods there will be an investment boom which translates to real GDP in that economy; this principle explains the reason for a slowdown in the growth of GDP causing a negative growth in subsequent period through investment spending thus this study form its model from theoretical framework as indicated by Accelerator principle theory (Keynes theory) establishing in growth context that increases in industrial output leads to rise in industrial investment for any economy.

Previous studies already indicates that industrial production has the ability to increase GDP Adebiyi (2001), Babatope-Obasa (2004), Babawale et al (1996) and Chimobi (2010).

Other studies also find out that FDI has a negative effect on growth in primary industrial sector but a positive effect on growth in the secondary industrial sector Alfaro (2003).It has also been found that the industrial sector remains the main engine and driver of growth Chimobi (2010). Blonigen and Wang (2005), also state that such investment can only benefit growth if the business climate is right (by right they mean political stability and trade friendly). Most studies have concentrated on FDI as measure of investment with little emphasis on public and other private investment inflows on growth (the study by Blonigen and Wang (2005), and Chimobi (2010) focus on FDI).

Few studies have tried to investigate industrial investment on industrial sector growth in developing countries, (using Nigeria as its case study) which is a major contribution that this study attempts to address. This study engages a four step procedure in order to determine and explain the long term causal relationship existing between industrial investment and industrial growth in Nigeria. This includes: Unit Root test, Johansen Co-integration technique, Granger Causality test and Vector Error Correction Model using, STATA 10.

IV. DATA SOURCES AND MEASUREMENT

This research adopts different approaches to investment theory in order to test the relationship between industrial investments and industrial growth. In this regard, using secondary time series data on investment from 1981 to 2013; the choice of time frame was informed by the availability of data and the desire to capture the period of the economic translation from regulation to deregulation. The data is obtained from the Central Bank of Nigeria publications, CBN statistical bulletin, the NBS (National Bureau of Statistics), specialized journals from NDIC, the internet (websites), EVIEWS (unit root test analysis) AND STATA was used for the regression analysis.

Table.4.1: Variables Description

Variables	Identifier	Measurement of Variables
Industrial Sector Growth	INDGDP	INDGDP is measured in terms of industrial contribution to RGDP based on Nigerian National Product at 1990 constant prices from CBN Statistical Bulletin.
Industrial Sector Investment	INDINVT	INDINVT is measured in terms of investment inflow from the industrial sector based on the Nigerian Bureau of Statistics Bulletin.

Source: Author's Compilation from CBN 2013

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Model Specification

This consist of empirical method used to examine the relationship between industrial sector investment and Nigerian industrial growth from 1981-2013, data on industrial sector investment and industrial GDP will be produced. In specifying this sectorial model, we can assume linearity between the share of industrial GDP and explanatory variables. Industrial sector investment is the independent/explanatory variable also known as the regressors, while industrial growth or INDGDP is the explained/dependent variable or the regressant explains the overall economic ability of industrial investment as it responds to industrial sector growth performance. The model formulation is thus:

The general model (i.e. mathematical form) can be stated as:

Indgdp= F (Indinv, Realir, Dominf, Rexr, Monrate, Crdpriv, Trdop)…….. (1)

This study adopts the Cob-Douglass production function structure which states that $Y_t=AL^{\alpha}K^{\beta}.e$

This can be written in a transformed manner as: Log Y_t = Log A + α Log L + β Log K + E_t

Hence the non-linear form of this model is expressed as:

$Indgdp_t = Indinvt_t^{\beta 1}. Realir_t^{\beta 2}. Dominf_t^{\beta 3}. Rexr_t^{\beta 4}. Monrate_t^{\beta 5}. Crdpriv_t^{\beta 6}. Trdop_t^{\beta 7}. e_t$ ……(2)

The explicit form of this model becomes:

LogIndgdp=β_1LogIndinvt + β_2LogRealir + β_3LogDominf. +β_4LogRexr + β_5LogMonrate+ β_6LogCrdpriv + β_7LogTrdop…… (3)

From the above model the variables used are seven: INDGDP (gross domestic product or Y), industrial investment (INDINVT or β_1), real interest rate (REALIR or β_2), domestic inflation (DOMINF or β_3), real exchange rate (REALEXR or β_4), monetary policy rate (MONRATE or β_5), credit to private sector (CRDPRIV or β_6), trade openness (TRDOP or β_7).

Estimation of Results and Discussion

Unit Root Test-this test is crucial because it determines whether each time series variables used in this study are stationary in the long run; the results obtained from ADF and PP tests @ 5% level of significance by comparing the observed values with critical values (in absolute terms). The result revealed that all variables became stationary at first difference, i.e. they are integrated of the same order I(1).

Table.4.2: Augmented Dickey Fuller Unit root test @ 5% level of significance

Variables	ADF t-Statistic Value	5% Critical Value	Lag Length	Remarks	Decision
LINDGDP	-6.2072	-2.9604	1	Stationary	I(1)
LINDINVT	-5.9183	-2.9604	1	Stationary	I(1)
LREALIR	-6.9024	-2.9604	1	Stationary	I(1)
LDOMINF	-3.7874	-2.9604	1	Stationary	I(1)
LREXR	-5.1715	-2.9604	1	Stationary	I(1)
LMONRATE	-5.8488	-2.9604	1	Stationary	I(1)
LCRDPRIV	-4.9160	-2.9604	1	Stationary	I(1)
LTRDOP	7.3542	-2.9604	1	Stationary	I(1)

Source: Author's computation using STATA 10.

This test is crucial because it determine whether our time series data are stationary in the long run, as regressing non stationary series on each other yielding spurious regression results; this involves testing for stationary of individual coefficients and determining their order of integration using the Augmented Dickey Fuller (ADF) test to detect the existence of unit root in each of the time series.

The results of ADF test @ 5% level of significance with intercept reported in the Table 4.2 shows that all the variables became stationary at first difference, i.e. they are integrated of the same order I (1) series.

Johansen Maximum Likelihood Test of Co-integration

The main aim of this test is to find out if a linear combination of the integrated variables becomes stationary in the long run period; if this holds then co-integration exists among the variables (i.e. long run relationship among the variables). The two types of Johansen test; Trace test and Maximum Eigenvalue are used to determine number of integrating ranks and vectors. The results are shown below:

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Table.4.3: Johansen Tests for Co-integration

Trend: Constant **Sample: 1983 – 2013**			**Number of obs = 31** **Lags = 2**		
Maximum rank	Parms	LL	Eigen value	Trace Statistics	5% Critical Value
0	72	-1509.3771	0.95124	277.7928	156.00
1	87	-1462.5534	0.87273	184.1454	124.24
2	100	-1430.6011	0.76793	120.2408	94.15
3	111	-1407.9599	0.71261	74.9584	68.52
4	120	-1388.6329	0.51134	36.3044	47.21
5	127	-1377.5337	0.20726	14.1059	29.68
6	132	-1373.9337	0.18111	6.9059	15.41
7	135	-1370.8366	0.02270	0.7118	3.76
8	136	-1370.4807			

Source: Authors compilation computed using STATA 10.

The decision rule states that if the values of trace statistics or maximum eigenvalue are greater than the critical values at 5% then the null hypothesis of no co-integration is rejected, the alternative hypothesis is accepted which depicts co-integration among variables implying a long run equilibrium relationship.

Vector Error Correction Model

The Vector Error Correction Model is an approach taken to examine the speed of adjustment of the estimate coefficient from period of short run dynamics to long run; indicating how fast the system adjusts to restore equilibrium over time by capturing the estimates coefficient from the position of disequilibrium to the period of equilibrium.

Table.4.4: Vector Error Correction Model

Sample: 1983 – 2013		No. of Obs = 31				
Alpha	Coef.	Std Err.	Z	P>/Z/	95% Conf. interval	
D (INDGDP).L1	-0.01067	0.07152	-0.15	0.081	-0.1509	0.1295
D (INDINV).L1	0.67695	1056.6	0.64	0.522	-1393.92	2747.8
D (REALIR).L1	0.2816	0.1307	2.15	0.031	0.02545	0.5378
D (REXR).L1	-0.3775	0.5993	-0.63	0.529	-1.5222	0.7972
D (DOMINF).L1	16.0528	3.0130	5.33	0.000	10.1474	21.9582
D (CRDPRIV).L1	-0.0421	0.1244	-0.34	0.735	-0.2858	0.2017
D (TRDOP).L1	2.9099	13.8740	0.21	0.834	-24.2827	30.1026
D (MONRATE).L1	0.5379	0.0270	2.00	0.046	0.0010	0.1066

Source: Author's computation using STATA 10

The P-values shows that the VECM for INDGDP, REALIR, DOMINF and MONRATE is statistically significant and the speed of adjustment coefficient for LINDGDP is -0.081 at 10%, LDOMINF is 0.000 at 1%, LMONRATE is 0.046 and LREALIR is 0.031 at 5% depicting the VECM to be correctly signed in terms of magnitude and lines between 0 and 1; satisfying these criteria denotes that the model has the capacity to correct errors generated in immediate periods as it approaches its long run equilibrium. The error correction model in this equation states that 81% of errors for INDGDP, 46% of errors for MONRATE and 31% of errors for REALIR generated between each period are correlated in subsequent periods making long relationship obtained sustainable and reliable.

Granger Causality test

Granger causality test is used to determine the cause and effect of two variables by investigating whether the lagged values of one variable affect the other variable since a long run relationship exist between these variables.

Table.4.5: Granger Causality Test

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Variables	INDGDP	INDINV
LINDGDP	0.91*** (0.08)	576.5 (9.46)
LINDINV	1.49 (1.11)	0.71*** (0.15)
Constant	10.82 (7.95)	-27.37 (1.05)
Observations	32	32
R-Squared	0.907	0.594
Standard errors in parenthesis *** p<0.01, ** p<0.05, *p<0.1		

Source: Authors compilation computed using STATA 10

Interpretation of Granger Causality Test Results
H_0: INDINV does not Granger-cause INDGDP
H_1: INDINV Granger cause INDGDP
H_0: INDGDP does not Granger cause INDINV
H1: INDGDP Granger cause INDINV

From the table above, the null hypothesis was rejected that industrial investment does not granger cause GDP (with coefficient 1.49) and that GDP does not granger cause industrial investment respectively (with coefficient 576.5) therefore a case of bidirectional causation was established concluding that GDP has a causal effect on industrial investment and vice versa.

However in this study we make a case of unidirectional causation for developing countries (i.e. industrial GDP granger cause industrial investment for the Nigerian economy) arguing that most developing countries are not likely to be endowed with vibrant manufacturing sectors due to poor human capital development allowing us to state that many developing countries are likely to attract investment due to high GDP that can be attributed largely to exports in primary goods e.g. from agriculture and natural resources, making GDP to be responsible for high investment inflow to the industrial sector.

This is likely to be true since many investors will likely want to cite industrial capacities near raw materials and in the case of Nigeria and china in countries with strong domestic consumption depicting their recognition of the role of market potential in investment inflow to countries.

Economic Implication of Results

The Behaviour of individual's variables in the model is discussed based on the Johansen normalized co-integrating coefficients using the P-values; Industrial investment (D_INDGDP), real interest rate (D_REALIR), credit to private sector (D_CRDPRIV), and monetary policy rate (D_MONRATE) shows a negative but elastic relationship with industrial growth at 1% level of significance; (for real exchange rate at 5% level of significance) implying that a proportional change in these variables will bring about a strong significant change in industrial growth. Contrary to a priori expectation industrial sector investment on industrial growth is negative but strongly significant for the case of Nigeria implying that industrial sector investment is not sufficient enough to induce growth in the industrial sector as a result of certain constraints that hinders the performance of industrial sector; they include:

Real exchange rate and trade openness coefficients shows a positive and elastic relationship with industrial output implying that a proportional change in real exchange rate (D_REXR) will bring about 3.5% change in industrial growth. Also a proportional change in trade openness will result in 2.2% change in industrial growth but domestic inflation co-integrating coefficient indicates a negative and inelastic relationship with industrial growth which implies that a proportional change in domestic inflation will bring about no significant effect on industrial growth.

Evidence based on the Johansen normalized co-integration results using P-values shows that there exists a long run relationship between industrial investment and industrial growth at 1% level indicating a strong significant relationship between industrial sector investment and industrial growth thus H_0 is rejected while accepting H_1 which states there is long run relationship between industrial sector investment and industrial growth.

Bigten and Soderbom (2011) argued that substantive manufacturing driven economic growth will be hard to achieve without breaking into the international market. Acemoglu *et al*. (2011), states that manufacturing exports help create a middle class that demands good institutions which in turn spur growth. In this study, the Johansen normalized co-integration technique is employed to ascertain a negative but strong significant relationship between industrial growth and industrial sector investment at 1% level (P-value) indicating that the industrial sector (i.e. manufacturing and service sector) is not sufficiently contributing to the Nation's real GDP currently, since it is not yet well transformed and developed; implying that investment in the industrial sector is not sufficient enough to drive industrial growth. Also Granger causality test indicates that a case of unidirectional causation which states that INDGDP granger causes INDINV for developing countries arguing that most developing countries are not likely to be

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endowed with vibrant manufacturing sectors due to poor human capital development allowing us to state that many developing countries are likely to attract investment currently as a result of high GDP that can be attributed largely to exports in primary goods e.g. from agriculture and natural resources, making GDP to be responsible for high investment inflow to the industrial sector.

V. CONCLUSION AND POLICY RECOMMENDATION

An attempt has been made in this work to investigate the relationship and long term effect of industrial sector investment on industrial growth performance using Nigeria as its case study. This study review past literatures and form its model from theoretical framework as indicated by Accelerator principle theory (Keynes theory) establishing in growth context that increases in industrial investment leads to industrial output which translates to GDP for the economy and also explains the reasons for a slowdown in the growth process for subsequent period through investment spending. The Augmented Dickey-Fuller (ADF) test reveals all the variables became stationary at first difference at 5% level of significance.

Johansen Normalized co-integration technique was employed to test the sensitivity of each co-integrating coefficient in relation to the unexplained variable (D_INDGDP) which reveals that Industrial investment (D_INDINV), real interest rate (D_REALIR), real exchange rate (D_REXR), credit to private sector (D_CRDPRIV), monetary policy rate (D_MONRATE) and trade openness ()D_TRDOP) shows negative elastic relationship with industrial output implying that a proportional change in these variables bring about a significant change or effect on industrial growth. Although result generated for domestic inflation indicated a negative inelastic relationship with industrial growth which implies that a proportional change in domestic inflation does not bring about any significant effect on industrial growth.

Also since the co-integrating coefficients are lagged (differenced) using STATA this means that industrial growth depends on previous industrial sector investment. Nigeria is a country that is blessed with a lot of natural varying from agriculture, oil, gas and solid mineral which is confirmed to exist in commercial quantities and also Nigeria has enormous electric power resources with a large human population although certain constraints hinders the performance of industrial sector growth reducing expected returns on firm's investment, they include: slow technological progress which impedes the manufacturing base making goods of very poor quality, low demand for goods as a result of low purchasing power, inflation and high cost of operations. The problem of scarcity of fuel, diesel, and epileptic electric supply from the National Electric Power Authority (NEPA) is also responsible as the manufacturing and service sector cannot survive without adequate electricity, multiple taxation, smuggling banned goods into the country among many other constraints.

Policy Recommendations

Considering Nigeria's abundant resources, the country could compete effectively in the global market. However, to achieve this, there is need for creating an enabling environment for the country to achieve its full potentials in terms of growth by generating the sufficient level of investment required to boost industrial growth for the Nigerian economy. Given the outcome of our regression results, policies recommended are:

Investment risks can be reduced in Nigeria for potential investors through the maintenance of macroeconomic stability, thus the Nigerian government should ensure friendly robust economic policies and a healthy competitive business environment in order to attract both domestic and foreign investors within the economy to encourage inflows of FDI and exportation of home products which shapes the investment climate increasing the level of investors' confidence to promotes future returns on current investment.

To achieve macroeconomic stability, maintenance of stable foreign exchange rate policy, establishment of price stability, political stability and good governance, fiscal prudence, transparency and accountability of investment fund is mandatory.

In addition, Improvement of infrastructural facilities such as electricity, roads, water, transportation etc. are highly needed to aid the manufacturing and service sectors for industrialization process for effective utilization of raw materials to stimulate high demand for goods and services within the economy and abroad.

Government policies should be geared towards increasing the wage level of workers as a means of stimulating demand for industrial produce in order to strengthen the production base of the industrial sector making it more competitive and efficient.

Industrial policies and strategy should be focused on promoting the growth of small and medium enterprises because it is the main drive for growth in the development of the industrial sector by creating employment opportunities and effective utilization of local raw materials (natural resources).

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Conclusively, Domestic competition in all sectors of the economy goes a long way in improving efficiency of the industrial sector which is achieved by liberalizing the labour market to give investors the free hands to hire their workers in a competitive environment.

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