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ECONOMIC LIBERALIZATION AND INDUSTRIAL SECTOR PERFORMANCE IN NIGERIA- A MARGINAL IMPACT ANALYSIS

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ABSTRACT: *Given the impact government policies can have on economic variables and activities, it is imperative for policy makers to know how such policy action determine the macroeconomic performance. Applying the marginal impact estimation technique with standard errors corrected for serial correlation on the dummy variable structural break model, this paper found that economic liberalization has a significant impact on performance of the Nigerian manufacturing, mining and quarrying, and power subsectors, respectively and the aggregate industrial sector. The interaction of the policy with trade openness and financial deepening dampened the performance of the manufacturing subsector while its interaction with labour force is growth enhancing. Also the interaction of the policy with energy consumption was negative but financial deepening and energy consumption has dampening effect on the performance of the mining and quarrying subsector. While it has enhancing impact on the aggregate industrial sector and was not significant on mining and quarrying and power subsectors, economic liberalization decreased the performance of the manufacturing subsector. Beside, financial deepening has mix impact on the performance of the industrial sector. While it has increasing impact on the aggregate industrial sector it impact on manufacturing performance is negative.*

KEYWORDS: Economic Liberalization, Industrial sector, Domestic production, Energy consumption, Financial deepening
JEL Classification: E6, F4, G2

INTRODUCTION

The realization that industrialization is a *sine qua non* in a nation's desire to achieve the degree of self-reliance which can guarantee the stability needed for economic development has attracted the interest of governments to laying a solid foundation for the development of the industrial sector. However, to ensure that industrialization leads to beneficial economic and social development, industrial growth has to be regulated and guided through appropriate policies. Towards this end, Nigeria since independence has adopted a number of strategies of industrialization in her development efforts. Some of these strategies include Import Substitution Strategy, Export Promotion Strategy and Local resource-based Strategy. In pursuance of these objectives, the government has initiated a number of incentives aimed at positively influencing the performance and productivity of the industrial sector. Some of these incentives include tax holidays, tariff protection, import duty relief, total ban on certain foreign goods, provision of accelerated depreciation allowance, direct government participation, export incentives, approved user scheme, establishment of special industrial development financial institutions, building of industrial estates (export processing zones) and Industrial Raw Material Research and Development Council (IRMRDC) (Egbon 1995, Egwaikhide, 1997;

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Ayodele, and Falokun, 2003; Udah, 2010). From the above it is glaring that Nigeria's quest to become self reliant and an industrialized economy has resulted to the adoption of liberation policies over the years towards opening it to industrialized world. It is therefore imperative to examine economic liberalization policy implemented in 1986 through the adoption of the structural adjustment programme and the successive reforms aimed at further liberalizing the economy. With the liberalization policy, it is expected that Nigerian economy would be further open to the rest of the world with the attendant economic growth. But the reverse is the case as the country is still faced with epileptic power supply, low manufacturing capacity utilisation, infinitesimal marginal productivity in the agricultural sector and monumental infrastructural decay. More importantly this precarious situation has been in the face of increasing indexes of aggregate industrial production, manufacturing production and mining production. For instance, the index of manufacturing production for the period 1970Q1-1986Q2 increased on the average by more than double from 42.8 percent to 89.31percent. While the indexes of mining production and industrial aggregate grew marginally from 102.08 percent and 100.41 percent to 116.36 percent and 107.24 percent respectively, that of electricity grew by more than double from 49.42 percent to 137.54 percent (CBN 2007;2012). Also, the growth of sectoral GDP shows that the industrial sector recorded negative growth of -3.4 in 2008 and increased dramatically to 5.6 percent in 2010. Thereafter, it declined such that by 2012 its growth was only 1.2 percent in comparism to the agricultural sector which grew at the rate of 6.3 per cent in 2008 and an average of 5.7 percent between 2009 and 2011 (CBN 2012). The above developments have been in the presence of liberalized financial sector and external trade; increased capital accumulation and foreign private investments and importantly, increased efforts by government to further liberalize the economy thus raising puzzles. Although, several studies such as Adenikinju and Chete (2002), Udegbunam (2002), Bakare and Fawehinmi (2011), Tamuno and Edoumiekumo, (2012), among others, have examine the relationship between economic liberalization and Nigerian industrial sector based on straight line regression using aggregated variables, none has accounted for the possible structural break that may have occurred as a result of the policy changes in 1986 and thereafter. This study therefore examines the impact of economic liberalization on performance of the Nigerian industrial sector as a whole, and the various subsectors of manufacturing, mining and quarrying, and power with the aim of accounting for the possible structural break the 1986 policy shift may have caused. This study provides further insight to how various subsectors of the Nigerian real sector fared before liberalization and what the situation is with liberalization, thus justifying the need for future liberalization policy. This study therefore would provide useful information for government and policy makers especially those involved in formulating policies that will enhance industrial performance in the country. This study contributes to existing literature by analyzing the impact and the interaction between economic liberalization and other variables such as foreign direct investment, financial deepening, degree of openness, gross capital formation, energy consumption and labour force growth have enhance or dampen the performance of the Nigerian industrial sector as a whole, and the manufacturing, mining and querying and power subsectors respectively.

REVIEW OF RELATED LITERATURE

Over the years economists have sought ways to explain how countries could gain from opening up their economies to external competition and specialization. As a result, a number of trade theories have evolved. The theory of absolute advantage which is attributed to Adam Smith

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discusses the benefits a country can achieve by actively participating in the international division of labour. This theory advocates that a country that trades internationally should specialize in producing only those goods in which it has absolute advantage. The country can then export a portion of those goods and, import goods that its trading partners produce more cheaply. A number of theses were conducted along with this theory, but for some its non acceptability gave rise to the comparative cost advantage theory, which is credited to David Ricardo. The theory propound that countries can benefit from each other even though one has absolute advantage over the other in the production of both goods. The comparative advantage comes if each trading partner has a product that will bring a better price in another country than it will at home. If each country specializes in producing the goods in which it has a comparative advantage, more goods are produced, and the wealth of both countries increases. It is the belief of many economists that the Heckscher-Ohlin model is an improvement on the Ricardian theory of comparative advantage. Comparative advantage theory is absorbed in the Heckscher-Ohlin model in that it began with the comparative advantage and goes beyond it to link the pattern of international trade to the economic structure of trading nations. Heckscher-Ohlin model was tested by Leontief through a study on the United State. His view was that a country that is rich in capital will export capital intensive goods and import labour intensive goods. He tested his hypothesis using an input-output table for the US in 1947 and concludes that export industries use relatively more labour than import industries. By his result the US tends to export more labour intensive goods than capital intensive goods. Several authors reacted to his conclusion. They argued that the test was done when US trade policy was highly protected and considered it as quirk in nature. Vernon (1966) put forth the product life cycle hypothesis. The theory postulates a dynamic comparative advantage because the country's source of export shifts through the life cycle of the product. First the innovating country exports the product but later displaced by another developed country which in turn is ultimately displaced by developing countries (Egai, 2004). But Haberler's opportunity cost theory is of the view that if a country can produce either of commodities X and Y, the opportunity cost of producing commodity X is the amount of commodity Y that must be given up in order to get one more unit of commodity X. Thus the exchange ratio between the two commodities is expressed in terms of their opportunity costs. The theory was further explained by some studies using the production possibility frontier. They opine that two countries getting involved in trade due to specialisation, more goods will be available for consumption and more income will be generated so long as the prices of the respective commodities were not the same in both countries before trade. The implication is that international trade is able to reduce the loss of efficiency due to domestic monopoly power and also allow an expansion in the number of efficient producers in industries with continuing economies of scale. By expanding the total market therefore, trade is expected to bring about a lower average costs. This is true even in the case of a domestic monopolist confronted with increasing returns: then it may be profitable to export even if the net price that exporters receive from the foreign market is below minimum average cost. By increasing its production, the domestic firm can improve its profits as long as the reduction in profits via the fall in average revenue is smaller than the increase in profits via the reduction in average cost (Basevi, 1970; Frenkel, 1971).

An aspect of international trade is globalization. Theoretically, industrialization is an economic practice that ought to assist developing economics find their feet in the competitive world economy. But Obaseki (2002) sees globalisation as a web of international relationships involving trade in goods and services and financial intermediation using the integration of

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goods and services markets across national boundaries and the integration of financial markets across the globe. But labour markets across the globe are not as integrated. For this reasons, some countries like Nigeria has not benefitted from globalisation owing to the undue dependence on crude oil exports, low manufacturing exports and the under-development of the domestic, financial markets. This is why Onwuka and Eguavoen (2007) posits that the world has witnessed increased interdependence in the last two decades, thus subjecting interdependence subordinates domestic economies to global market conditions and practices. Yet, developed nations are the greatest beneficiaries of globalization as their share of world trade and finance has been expanded at the expense of developing countries. This process has exacerbates inequality between the world's regions and poverty in the developing world In examining the relationship between economic liberalization and industrial output, literature exists in support of the different strands in the theoretical thesis for both developed and developing countries. For instance, Krueger and Tuncer's (1982) study for Turkey used sector level data to support evidence of the efficiency gains. They conclude that periods of greater liberality have coincided with periods of faster growth in total factor productivity. The same conclusions have also been reached by Condon, Corbo and de Melo (1985) for Chile, Page (1984) for India, and Pitt and Lung-Fei (1981) for the Indonesa. On the contrary, Tsao (1985) shows that for Singapore during the 1970s when rapid growth was experienced, productivity growth were either negligible or negative in some sectors of manufacturing. After reviewing studies based on within-country temporal correlations, Havrylyshyn (1990) conclude that there is no strong evidence linking productivity and openness. In this regard, Pack (1988) puts it more succulently when he states that "*comparison of total factor productivity among countries pursuing different international trade orientation does not reveal systematic differences in productivity growth in manufacturing."* In support of the imports restrict market power hypothesis, Lyons (1979) carried out a survey of 23 cross-sectional studies, which related prices, profitability or price–cost margins to various measures of foreign competition. One clear finding was that with importation, a country can no longer restrict its market. But for Canada, the hypothesis was rejected by Caves, Porter and Spence (1980), "that an interaction variable between seller concentration and import share had a decreasing effect on industry profits". Implied here is that concentration accentuates profits significantly only when import competition is low. This is while Pugel (1980) suggest that the influence of import competition should be entered interactively with seller concentration and entry barriers to explain price–cost margins. The influence of exports on domestic competition is much less straightforward.

\Due to different sets of theoretical alternatives, empirical research did not arrive at the same conclusion. For instance, studies such as Pagoulatos and Sorensen (1976), Neumann, Bobel and Haid, (1979) asserts that exports reduce industrial profitability while others like Geroski (1982) adopted a non-linear specification to show a very significant positive effect of the rate of exports on the profit margin and a negative effect from the rate of imports. More recently, a number of studies have investigated the impact of trade liberalization and market structure on productivity. One such study by Haddad (1993) for Morocco found a strong positive correlation between trade liberalization and productivity. This suggests that an increase in productivity is generated not only through export promotion but by import liberalization as well. In all, trade liberalization seems to have improved productivity in the manufacturing sector. On the one hand, firms with a higher level of exports by facing more competition from abroad have been become more productive. On the other hand, import penetration also put pressure on domestic firms, driving them to increase their efficiency or exit the industry. Harrison (1990) also

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analyze changes in firm behaviour and productivity during trade liberalization in Côte d'Ivoire using a panel of 287 firms to estimate market for two periods and found that price–cost margins fell in a number of sectors following the reform and that when productivity estimates are modified to account for changes in price–cost margin over the period, the positive correlation between trade reform and productivity is strengthened in some sectors and reversed in others. Similarly, Forountan's (1991) study for Turkey found that greater exposure to international competition generally had a beneficial effect on the Turkish industry during the 1980s. The effect of international competition, however, appears to be significant mainly in the private sector, especially in tradable industries. International competition decreased the price–cost margin and increased the rate of growth of productivity in the private sector. In the public sector, higher trade penetration lowered the price-cost margin in the public enterprises that had a higher than average capital intensity but did not affect the productivity performance of the sector. Other studies such as Ajayi (2003) and Mougani (2012) examined the impact of international financial integration on economic activity and macro-economic volatility in African countries and submit that the impact of external capital flows on growth depends mainly on the initial conditions and policies implemented to stabilize foreign investment, increase domestic investment and productivity. A major conclusion arrived at is that although globalization has brought quantum leap in trade, capital flows and income in some regions; it is an uneven process with unequal distribution of benefits and losses Using the ordinary least squares (OLS) method, Afaha and Njogo (2012) equally demonstrate the workings of trade openness on the Nigerian economy over the period 1970-2010 and conclude that economies grow faster when they are open to international competition. Osabuohien (2006) examined the impact of trade openness on the performance of ECOWAS member countries using data for Ghana and Nigeria for the period, 1975-2004 employing cointegration and vector error correction techniques. Although a long-run relationship was established between economic performance, trade openness, real government expenditure, labour force and real capital stock for both countries, the impact of trade openness on economic performance differs from country to country.

To this, Onyeiwu (2009) explains that such difference could be explained by variables such as economic reform, technological capability, investment in education and training. This implies that human capital may be an important source of growth of total factor productivity. On the impact of the neoliberal globalisation on industrial performance in Nigeria, Onyeonoru (2003) found that contrary to expectation, the manufacturing sector performances during the globalisation were negatively affected. Thus, not in agreement with noninterventionist development model of Adams Smith. Udegbunam (2002) examined the implications of trade openness for industrial growth in Nigeria using data for the period 1970-1997and the study opines that trade openness and stock market development are among the key determinants of industrial output growth in Nigeria. Bakare and Fawehinmi (2011) study of the relationship between trade openness and industrial performance did not only found the formal trade openness have a sustainable impact on the non-oil industrial sector of the Nigerian economy, but also that public domestic investment, saving rate, capacity utilization and infrastructure negatively impacted on Nigeria's industrial performance. They suggest that more progress could be achieved if the conditions for a deregulated trade system are properly put in place. In another strand of literature, Tamuno and Edoumiekumo (2012) study on the impact of globalization on the Nigerian industrial sector using the Error Correction Mechanism and Johansen's co-integration test shows that the Nigerian industrial sector has a weak base and

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cannot compete favourably with her foreign counterparts. However, they argue that domestic investment was weak and unreliable, even though a long-run relationship was found between industrial output and the globalisation proxy variables which are degree of openness, foreign direct investment, external debt and nominal exchange rate. In a further study, Olotu and Kaine (2011) show empirically that globalisation does not positively affect demand for labour. Also the impact of the ratio of total trade to non-oil GDP on aggregate employment was negative. They concluded that higher propensity towards openness does not have any meaningful impact on labour absorption contrary to strong theoretical assertion. Mesike, et al (2008) using data for the period 1960-2004 showed that the liberalization of trade has exposed Nigerian rubber industry to the fluctuations in global rubber prices and the instability in the natural rubber prices has been a disincentive for rubber production and exports. Saibu (2011) investigated the relative effectiveness of trade and policy shocks on sectoral output growth in a small open Nigerian economy employong A CVAR model. The effects of monetary policy shocks were positive and significant on manufacturing, service and industrial sector while fiscal policy shock was only significant and positive on agricultural output growth. The result further showed that international oil price shock and trade openness had pronounced negative effects on both sectoral and aggregate outputs. In addition, oil and trade openness' negative effects overwhelmed the positive effects of fiscal and monetary policy shocks. In investigating the relationship between trade liberalization and the market structure and productivity performance of the Nigerian manufacturing sector, Adenikinju and Chete (2002) use firm-level panel data for the three years from 1988-1990 to show that the productivity level of Nigerian manufacturing is generally low. This reflects in part an outcome of years of industrialization strategy that stressed factor accumulation rather than the efficiency with which factors are utilized. The finding of the study shows that sectors with a high component of local raw materials generally performed better than those depending on imported inputs. Beside, foreign ownership has an important bearing on firm performance and foreign-owned firms generate positive spill-over effects on the other firms in the industry.

METHODOLOGICAL FRAMEWORK

The production function model for industrial growth depends on the quantity of factor inputs and factor productivities. Analogously, industrialization involves two sets of variables, the quantity of inputs of factor services and the quality or productivity of these factors. The more of factor inputs employed for productive activities, it is expected that national output will increase. Similarly the more productive these factors are, the greater the growth of industrial output. This technical relationship between quantity of inputs and quantity of output of industrial sector can therefore be specified in functional form as:

$$Q = f(X_1, X_2, X_3, X_4....X_n,) \quad \text{.....} \quad (1)$$

where Q = quantity of output; $X_1, X_2, X_3, X_4....X_n$=quantities of inputs.
For empirical analysis, different forms of the production function have been used to fit the relationship between factor inputs and output. Such production functions include the Linear Production Function, Quadratic Production Function, Square-root Production Function, Cobb-Douglas (Power) Production Function, and the various generalization of the Cobb-Douglas, including the transcendental, Zellner-Revankar, Nerlove-Ringstad, constant elasticity of substitution, and the translog production functions. But in recent years, the Cobb-Douglas

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production function has been widely used because of its desirable properties. Due to the peculiarity of the data for this study, the Cobb-Douglas (power) production or constant elasticity model is adopted.

The Cobb Douglas power function could be expressed as follows:

$Q = b_0 X_1^{a}{}_1 X_2^{a}{}_2 \ldots\ldots\ldots\ldots Xn^{an}$ ..... (2)

The partial derivatives of Q with respect to x_1 and x_2, keeping other variables constant is respectively derived as:

$\frac{\partial Q}{\partial x_i} = a_1 [b_0 X_1^{a1} X_2 {}^{a2} X_n^{bn}] X_1^{-1}$ ..... (3)

$= a_1[Q] X_1^{-1}$ ..... (4)

$= a_1 Q/X_1$ ..... (5)

Also, $\frac{\partial Q}{\partial x_2} = a_2[b_0 X_1^{a1} X_2 {}^{a2} X_n^{bn}] X_2^{-1}$ ..... (6)

$= a_2[Q] X_2^{-1}$ ..... (7)

$= a_2 Q/X_2$ ..... (8)

The algebraic form of this function with n input variable(s) gives:

$$Q = Ax_1^{a_1} x_2^{a_2} \ldots x_n^{a_n} = A \prod_{i=1}^{n} x_i^{a_i} e^{u}, i = 1,2, \ldots, n \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

where Q and x_i (i=1,2,…,n) are the levels of output and inputs respectively, and A the technological efficiency parameter. The constant a_0 and a_i ($i=1,2,\ldots,n$) represent the efficiency parameter and the production elasticities of the respective input variables. For purpose of estimation we take the logarithmic transformation of the equations to obtain

$$logQ = a_0 + \sum_{i=1}^{n} a_i log x_i + u \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (10)$$

where $a_0 = logA$

For concavity, the second order partial derivatives from equation (10) will be negative as required if a_is are each < 1, that is,

$$\frac{\partial^2 Q}{\partial x_i^2} = a_i(a_i - 1) * \frac{Q}{x_i^2} < 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (11)$$

Applying the marginal analysis, the marginal impact of an input could be derived given specific levels of other variable inputs as:

$$\frac{\partial Q}{\partial x_i} = MP_i = a_i x_i^{a_i - 1} a_0 x_1^{a_1} x_2^{a_2} \ldots x_{i-1}^{a_{i-1}} x_{i+1}^{a_{i+1}} \ldots x_n^{a_n}$$

$$= a_i x_i^{-1} A x_1^{a_1} x_2^{a_2} \ldots x_n^{a_n} = a_i x_i^{-1} Q = \frac{a_i Q}{x_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

Equation (12) indicates that MP_i is a function of x_i. For a common case of diminishing returns to factor input X_i, $\partial^2 Q/\partial x_i^2$ must be negative, implying that $0 < a_i < 1$. As such, MP_i must always

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be non-negative and decreasing. Consequently, this function allows constant, increasing or decreasing marginal productivity, and not all the three or even any two at the same time.
The elasticity of production function with respect to any variable input, say, X_i, can be derived as:

$$E_{pi} = \frac{\partial Q}{\partial x_i} * \frac{x_i}{y} = \frac{a_i y}{x_i} * \frac{x_i}{y} = a_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12a)$$

From equation (12) E_{pi} can also be obtained as:

$$E_{pi} = \frac{logQ}{logx_i} = a_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12b)$$

Thus it can be observed that the power of the respective variable input directly gives the elasticity of production with respect to it. The elasticity coefficients in relation to each variable input are therefore constant irrespective of the input or output levels.

3.2 Model Specification

Drawing from Geroski (1982) the relationship between the dependent and independent variables can be stated in simultaneous equation models as:

IOP = f(GCF, FDI, DOP, FIND,POP, ENC, LIB) . . . *(13)*
IMP = f(GCF, FDI, DOP, FIND, POP, ENC, LIB) . . . *(14)*
ELEC = f(GCF, FDI, DOP, FIND, POP, ENC,LIB) . . . *(15)*
INQ = f(GCF, FDI, DOP, FIND, POP, ENG,LIB) . . . *(16)*

In line with our methodological framework, equations (13) - (16) respectively can be re-written in constant elasticity model to give:

$$IOP = A_1(GCF)^{\alpha_1}(FDI)^{\alpha_2}(DOP)^{\alpha_3}(FIND)^{\alpha_4}(POP)^{\alpha_5}(ENC)^{\alpha_6}(LIB)^{\eta_0}(LIB * GCF)^{\eta_1}(LIB * FDI)^{\eta_2}(LIB * DOP)^{\eta_3}(LIB * FIND)^{\eta_4}(LIB * POP)^{\eta_5}(LIB * ENC)^{\eta_6}e^{u_{1t}} \quad (17)$$

$$IMP = A_2(GCF)^{\beta_1}(FDI)^{\beta_2}(DOP)^{\beta_3}(FIND)^{\beta_4}(POP)^{\beta_5}(ENC)^{\beta_6}(LIB)^{\varphi_0}(LIB * GCF)^{\varphi_1}(LIB * FDI)^{\varphi_2}(LIB * DOP)^{\varphi_3}(LIB * FIND)^{\varphi_4}(LIB * POP)^{\varphi_5}(LIB * ENC)^{\varphi_6}e^{u_{2t}} \quad (18)$$

$$ELEC = A_3(GCF)^{\gamma_1}(FDI)^{\gamma_2}(DOP)^{\gamma_3}(FIND)^{\gamma_4}(POP)^{\gamma_5}(ENC)^{\gamma_6}(LIB)^{\theta_0}(LIB * CGF)^{\theta_1}(LIB * FDI)^{\theta_2}(LIB * DOP)^{\theta_3}(LIB * FIND)^{\theta_4}(LIB * POP)^{\theta_5}(LIB * ENC)^{\theta_6}e^{u_{3t}} \quad (19)$$

$$INQ = A_4(GCF)^{\delta_1}(FDI)^{\delta_2}(DOP)^{\delta_3}(FIND)^{\delta_4}(POP)^{\delta_5}(ENC)^{\delta_6}(LIB)^{\pi_0}(LIB * CGF)^{\pi_1}(LIB * FDI)^{\pi_2}(LIB * DOP)^{\pi_3}(LIB * FIND)^{\pi_4}(LIB * POP)^{\pi_5}(LIB * ENC)^{\pi_6}e^{u_{3t}} \quad (20)$$

For purpose of estimation, equations (17) to (20) can be transformed into log-linear models. Consequently, the equations can be specified as:

$$log(IOP) = a_1 + \alpha_1 log(GCF) + \alpha_2 log(FDI) + \alpha_3 log(DOP) + \alpha_4 log(FIND) + \alpha_5 log(POP) + \alpha_5 log(ENC) + \eta_0 logLIB + \eta_1 log(LIB*GCF) + \eta_2 log(LIB*FDI) + \eta_3 log(LIB*DOP) + \eta_4 log(LIB*FIND) + \eta_5 log(LIB*POP) + \eta_6 log(LIB*ENC) + u_{1t} \quad (21)$$

$$log(IMP) = a_2 + \beta_1 log(GCF) + \beta_2 log(FDI) + \beta_3 log(DOP) + \beta_4 log(FIND) + \beta_5 log(POP) + \beta_6 log(ENC) + \varphi_0 logLIB + \varphi_1 log(LIB*GCF) + \varphi_2 log(LIB*FDI) + \varphi_3 log(LIB*DOP) + \varphi_4 log(LIB*FIND) + \varphi_5 log(LIB*POP) + \varphi_6 log(LIB*ENC) + u_{2t} \quad (22)$$

$$log(ELEC) = a_3 + \gamma_1 log(GCF) + \gamma_2 log(FDI) + \gamma_3 log(DOP) + \gamma_4 log(FIND) + \gamma_5 log(POP) + \gamma_6 log(ENC) + \theta_0 logLIB + \theta_1 log(LIB*GCF) + \theta_2 log(LIB*FDI) + \theta_3 log(LIB*DOP) +$$

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$\theta_4 log(LIB*FIND) + \theta_5 log(LIB*POP) + \theta_6 log(LIB*ENC) + u_{3t}$

..... (23)

$log(INQ) = a_4 + \delta_1 log(GCF) + \delta_2 log(FDI) + \delta_3 log(DOP) + \delta_4 log(FIND) + \delta_5 log(POP) + \delta_6 log(ENC) + \pi_0 logLIB + \pi_1 log(LIB*GCF) + \pi_2 log(LIB*FDI) + \pi_3 log(LIB*DOP) + \pi_4 log(LIB*FIND) + \pi_5 log(LIB*POP) + \pi_6 log(LIB*ENC) + u_4$

..... (24)

.where IOP = index of manufacturing production proxy for manufacturing subsector's performance; IMP = index of mining and quarrying production proxy for mining and quarrying subsector's performance; ELEC = index of electricity consumption proxy for power sector performance; INQ = aggregate index of industrial production proxy for the overall industrial sector's performance; GCF = gross capital formation proxy for domestic investment; FDI = foreign direct investment proxy for foreign private investment; DOP = degree of openness (the ratio of total trade to GDP); FIND = financial deepening (the ratio of total credit to private sector to M_2); POP = Population growth proxy for labour force growth; ENC = index of energy consumption; LIB = liberalization dummy which takes the value of 1 for periods before 1986Q3 and 10 for periods beginning from 1986Q3; μ_{it} = error terms; i = (1, 2, 3, 4), α_i's, η_i's ,β_i, t φ_i's, γ_i's, θ_i's, π_i's = the differential elaticities of industrial production with respect to the various input variables between the period before and with economic liberalization policy. From equations (21) – (24), we can determine the performance of different sectors performance before economic liberalization (1970Q1-1986Q2) and with economic liberalization policy (1986Q3-2012Q4). For instance, the performance of the manufacturing subsector before economic liberalization policy ($1970Q_1 – 1986Q_{2)}$ and with economic liberalization (1986Q3 – 2012Q4) can be deduced respectively as:

$E[log(IOP)|GCF, FDI, DOP, FIND,POP, ENC, LIB=1] = a_1 + \alpha_1 log(GCF) + \alpha_2 log(FDI) + \alpha_3 log(DOP) + \alpha_4 log(FIND) + \alpha_5 log(POP) + \alpha_6 log(ENC)$ . . . (25a)

$E[log(IOP)|GCF, FDI, DOP, FIND,POP, ENG, LIB=10] = (a_1+\eta_0) + (\alpha_1+\eta_1)log(GCF) + (\alpha_2+\eta_2)log(FDI) + (\alpha_3+\eta_3)log(DOP) + (\alpha_4+\eta_4)log(FIND) + (\alpha_5+\eta_5)log(POP) + (\alpha_6+\eta_6)log(ENC)$ ------ . . . (25b)

Similarly, for performance of the mining and querying subsector before liberalization ($1970Q_1 – 1986Q_2$) and with liberalization, $1986Q_3$-$2012Q_4$ can be measured as:

$E[log(IMP)|GCF, FDI, DOP, FIND,POP, ENC, LIB=1] = a_2 + \beta_1 log(GCF) + \beta_2 log(FDI) + \beta_3 log(DOP) + \beta_4 log(FIND) + \beta_5 log(POP) + \beta_6 log(ENGY)$ . .(26a)

$E[log(IMP)|GCF, FDI, DOP, FIND,POP, ENC, LIB=10] = (a_2+\varphi_0) + (\beta_1+\varphi_1)log(GCF) + (\beta_2+\varphi_2)log(FDI) + \beta_3+\varphi_3)log(DOP) + (\beta_4+\varphi_4)log(FIND) + (\beta_5+\varphi_5)log(POP) + (\beta_6+\varphi_6)log(ENC)$ .... (26b)

To measure the performance of the power subsector before economic liberalization policy ($1970Q_1$-$1986Q_2$) and with liberalization ($1986Q_3$-$2012Q_4$), we have:

$E[log(ELEC)|GCF,FDI,DOP,FIND,POP,ENC,LIB=1] = a_3 + \gamma_1 log(GCF) + \gamma_2 log(FDI) + \gamma_3 log(DOP) + \gamma_4 log(FIND) + \gamma_5 log(POP) + \gamma_6 log(ENGY)$ . . (27a)

$E[log(ELEC)|GCF, FDI, DOP, FIND,POP, ENG, LIB=10]$

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$= (a_3+\theta_0)+(\gamma_1+\theta_1)log(GCF)+(\gamma_2+\theta_2)log(FDI)+(\gamma_3+\theta_3)log(DOP)+(\gamma_4+\theta_4)log(FIND)+(\gamma_5+\theta_5)log(POP)+(\gamma_6+\theta_6)log(ENC)$ .... (27b)

For performance of the aggregate industrial sector before liberalization the two sub periods ($1970Q_1 – 1986Q_2$) and ($1986Q_3 – 2012Q_4$):

E[log(INQ)|GCF, FDI, DOP, FIND,POP, ENC, LIB=1]

$= a_4+\delta_1log(GCF)+\delta_2log(FDI)+ \delta_3log(DOP)+\delta_4log(FIND)+\delta_5log(POP)+\delta_6log(ENC)$ . . (28a)

E[log(INQ)|GCF, FDI, DOP, FIND,POP, ENC, lib=10] $= (a_4+\pi_0)+(\delta_1+\pi_1)log(GCF)+(\delta_2+\pi_2)log(FDI)+(\delta_3+\pi_3)log(DOP)+(\delta_4+\pi_4)log(FIND)+(\delta_5+\pi_5)log(POP)+(\delta_6+\pi_6)log(ENC)$

..... (28b)

Data Estimation Technique

The ordinary least squares (OLS) technique is employed as the estimation technique. The OLS technique is favoured because it is the Best Linear and Unbiased Estimator (BLUE). However, to avoid the problem of spurious regression, the estimated model is tested for specification bias using the Ramsey Regression Specification Error test before employing the Breusch-Godfrey Langrage Multiplier test for autocorrelation and finally the standard errors corrected for autocorrelation using robust standard errors.

Data Sources, Nature and Transformation

Data for this study are industrial sector as a whole, the manufacturing subsector, mining and quarrying subsector and the power subsector respectively by incorporating various components of investment capital-both domestic (gross capital formation (GCF)) and foreign (foreign direct investment (FDI)); the degree of openness, DOP (total trade to GDP ratio) and financial deepening (FIND) to capture the effects of trade openness and the ability of the industrial sector to absorb new capital respectively. Other variables are population growth rate (POP) and index of energy consumption (ENC) to capture the effects of labour force growth and energy consumption respectively. The dataset are annual time series generated from the Central Bank of Nigeria Statistical Bulletin, and Annual Reports and Statement of Accounts, various years. The dataset covers the period 1970-2012. However, because the study anticipates degree of freedom problem that may arise due to the inclusion of dummy variables and their interaction terms with the explanatory variables in the various models the study interpolates the annual series to quarterly time series using the moving average. The STATA 11 econometric package was employed for data estimation

EMPIRICAL RESULTS AND DISCUSSION

The result of the multicollinearity test in Table 1 shows the variance inflation factor (VIF) of each of the explanatory variables for the models. The VIFs of logGCF and LogFDI were found to be 73.5294 and 33.2226, respectively which are very large compared to the benchmark of 10 as recommended in the literature. Therefore logGCF and LogFDI were dropped and the VIFs re-estimated for the remaining variables for which results are presented in Table 2. The new VIFs were all less than 10, implying that multicollinearity will not pose serious problem

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in a regression with LogPOP, LogENC, LogDOP and LogFIND. Therefore, the models capturing the various objectives were estimated with them.

From the results on table 3 the equations for the performance of the manufacturing subsector for periods before liberalization, 1970Q1-1986Q2 and with liberalization, 1986Q3-2012Q4 were derived and presented based on equations (25a) and (25b) respectively as.

$$logIOP = 0.8756 + 0.1079logDOP + 0.0824logFIND - 0.0701logPOP + 0.8399ENC$$

$$logIOP = -2.8645 + 0.0209logDOP + 0.0272logFIND + 0.4461logPOP + 0.4231logENC$$

The results reveal that all the variables for period before economic liberalization policy are positive except logPOP which was negative but became positive with the liberalization policy. Specifically, the results showed that, all things being equal a percentage increase in openness, financial deepening and energy increases the index of manufacturing production by 10.79, 8.24 and 83.99 percent respectively prior to the economic liberalization policy and a percentage increase in POP dampens the index of manufacturing production by 7.01 percent. But the economic liberalization policy which began in 1986Q3 had a dampening effect on performance of the Nigeria manufacturing subsector through its interaction with openness, financial deepening and energy and an enhancing impact through its interaction with population growth. With the economic liberalization policy the impact of openness, financial deepening and energy on manufacturing production declined by 8.7, 5.52 and 41.68 percent, respectively while that of POP increased by 51.62 percent. However, there is little we can say about the impact of energy on industrial performance since both the common and differential slopes were statistically not significant.

With regard to the mining and quarrying sector, the estimation results, after correction for arbitrary level of autocorrelation are presented on table 4 and the results for period before economic liberalization policy; 1970Q1-1986Q2 and period with economic liberalization policy are derived and presented respectively as.

$$logIMP = 5.4479 + 0.2009logDOP - 0.3771logFIND - 0.0463logPOP + 0.2588logENC$$

$$logIMP = -0.5462 + 0.0991logDOP - 0.3227logFIND + 0.4824logPOP + 0.1679logENC$$

For period before economic liberalization policy, the results revealed that a percentage increase in openness and energy increased minning and quarrying output by 0.2 and 0.26 percent, respectively. But with the economic liberalization policy these impacts were dampened by 0.10 and 0.9 percent, respectively so that a percentage increase in openness and Energy now called forth 0.099 and 0.16 percent mining and quarrying, respectively

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To examine the impact of economic liberalization policy on performance of the Nigerian power subsector, the log of index of electricity consumption, LogELEC was regressed on the log of degree of openness, LogDOP and its interaction with the liberalization dummy, LogLIB*DOP; financial deepening, LogFIND and its interaction with the liberalization dummy, LogLIB*FIND; labour force size, LogPOP and its interaction with the liberalization dummy, LogLIB*POP; and index of energy consumption, LogENC and its interaction with the liberalization dummy, LogLIB*ENG. The estimation results, after correcting for arbitrary level of autocorrelation are presented on table 5 and the equations for period before economic liberalization policy, 1970Q1-1986Q2 and period with economic liberalization policy, 1986Q3-2012Q4. The result shows that with the economic liberalization policy the impact of

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openness on electricity consumption increased by 0.022 percent as indicated by the differential slope coefficient which is significant at the 10 percent level.

$$logELEC = 1.0442 - 0.0252logDOP + 0.0529logFIND - 0.0275logPOP + 0.7049logENC \quad .$$

$$logELEC = -1.7029 - 0.0028logDOP + 0.0882logFIND + 0.3257logPOP + 0.4496logENC$$

However, with the implementation of the policy the impact of POP on performance of the Nigerian power subsector increased by 0.035 percent as indicated by the differential slope coefficient which is statistically significant at 1 percent level thus, with the policy a percentage increase in POP increased ELEC by 0.33 percent.

This study also examined the impact of economic liberalization on performance of the Nigerian aggregate industrial sector and the results, after correcting for arbitrary level of autocorrelation are presented as:

$$logINQ = 3.7023 + 0.1059logDOP - 0.3016logFIND - 0.1014logPOP + 0.6509logENC$$

$$logINQ = -1.0808 + 0.0377logDOP - 0.2116logFIND + 0.4023logPOP + 0.3659logENC$$

In specific terms, the results depicts that before economic liberalization a percentage increase in openness and energy increased the aggregate index of industrial production by 0.106 and 0.651 percent respectively, but a percentage increase in financial deepening and population growth retarded the aggregate index of industrial production by 0.302 and 0.101 percent respectively. Economic liberalization which began in 1986Q3 retarded the impact of DOP and energy on performance of the aggregate industrial sector by 0.068 and 0.285 percent, respectively. However, the impact of FIND and POP were enhanced by 0.09 and 0.504 percent, respectively. These results showed that the impact of the economic liberalization policy which began in 1986Q3 on performance of the aggregate industrial sector is mix, while it interacts to enhance the impact of the Nigerian financial sector development and labour force productivity on performance of the aggregate industrial sector, respectively it interacts to retard the impact of trade openness and energy consumption.

CONCLUSION

This study examined the impact of economic liberalization on industrial performance in Nigeria with attention on the subsectors of manufacturing, mining and quarrying and power, and the aggregate industrial sector. Using the dummy variable structural break model the study found that the economic liberalization has impacted significantly on performance of the Nigerian industrial sector. Specifically, economic liberalization has a significant impact on performance of the Nigerian manufacturing, mining and quarrying, and power subsectors, respectively and the aggregate industrial sector. While the interaction of the policy with trade openness and financial deepening dampened the performance of the manufacturing subsector its interaction with labour force is growth enhancing. Also the interaction of the policy with energy consumption was negative but its interaction with financial deepening and energy consumption has dampening effect on the performance of the mining and quarrying subsector. While it has enhancing impact on the aggregate industrial sector and was not significant on mining and quarrying and power subsectors, economic liberalization decreased the performance of the manufacturing subsector. Beside, financial deepening has mix impact on

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the performance of the industrial sector. While it has increasing impact on the aggregate industrial sector, its impact on manufacturing performance is negative.

On the basis of the above findings, the study recommends that trade openness should be encouraged but its implementation should be handled in line with the peculiarities of the country concerned. Arising from the above, attention should be more on increasing and diversifying the export base of the economy. Government should encourage financial sector development but with care. For this reason therefore, more credit created should be channelled to the private sector for they are the drivers of economic development. Beside, efforts toward further economic liberalization should be one that encourages development and utilization of the abundant energy resources in the economy.

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APPENDIX

Table 1: **Variance Inflation Factor (VIF) with all variables**

Variable	R^2	Tolerance Factor (1-R^2)	VIF = 1/(1-R^2)
LogGCF	0.9864	0.0136	73.5294
LogFDI	0.9699	0.0301	33.2226
LogDOP	0.9591	0.0409	24.4499
Log Energy	0.8650	0.1350	7.4074
LogPOP	0.7391	0.2609	3.8329
LogFIND	0.7323	0.2677	3.7355

Source: Authors Computation

Table 2: **Variance Inflation Factor (VIF) after dropping LogGCF and LogFDI**

Variable	R^2	Tolerance Factor (1-R^2)	VIF = 1/(1-R^2)
LogEnergy	0.8353	0.1647	6.0716
LogPOP	0.7186	0.2814	3.5537
LogFIND	0.6988	0.3012	3.3201
LogDOP	0.5571	0.4429	2.2578

Source: Authors Computation

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Table 3: **Results for the Manufacturing Sector with Robust Standard Errors**

LogIMQ	**Coefficient**	**Robust Stand Error**	**t-stat**	**p-value**
LogDOP	0.1079	0.0281	3.84	0.000
LogLIB*DOP	-0.0870	0.0131	-6.65	0.000
LogFIND	0.0824	0.1501	0.55	0.548
LogLIB*FIND	-0.0552	0.0671	-0.82	0.412
LogPOP	-0.0701	0.0288	-2.43	0.016
LogLIB*POP	0.5162	0.0341	15.13	0.000
LogEnergy	0.8399	0.1002	8.38	0.000
LogLIB*Energy	-0.4168	0.0461	-9.05	0.000
LogLIB	-3.7401	0.3450	-10.84	0.000
Constant	0.8756	0.3152	2.78	0.006
R^2		0.963		
F-statistic (probability)		949.72 (0.0000)		
Durbin-Watson statistic (10, 172)		0.9393		
Breusch-Godfrey LM Chi-square Statistic		48.36 (0.0000)		
Ramsey RESET F-stat (3, 159)		0.90 (0.4426)		
Variable Deletion F-stat (5, 162)		139.41 (0.0000)		

Source: Authors computation

Table 4: **Estimation Results for the Mining Sector with Robust Standard Errors**

LogINMQ	**Coefficient**	**Robust Std Error**	**t-stat**	**p-value**
LogDOP	0.2009	0.0214	9.39	0.000
LogLIB*DOP	-0.1018	0.0094	-10.74	0.000
LogFIND	-0.3771	0.1000	-3.77	0.000
LogLIB*FIND	0.0544	0.0439	1.24	0.217
LogPOP	-0.0463	0.0290	-1.60	0.112
LogLIB*POP	0.5287	0.0220	24.08	0.000
LogEnergy	0.2588	0.0783	3.30	0.001
LogLIB*Energy	-0.0909	0.0352	-2.59	0.011
LogLIB	-5.9941	0.2154	-27.82	0.000
Constant	5.4479	0.2767	19.69	0.000
R^2		0.8602		
F-statistic (probability)		286.45 (0.0000)		
Durbin-Watson statistic (10, 172)		0.5727		
Breusch-Godfrey LM Chi-square Statistic		76.518 (0.000)		
Ramsey RESET F-stat (3, 159)		0.86 (0.1563)		
Variable Deletion F-stat (5, 162)		286.88 (0.0000)		

Source: Authors Computation

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Table 5: **Results for the Power Sector with Robust Standard Errors**

LogELEC	**Coefficient**	**Robust Std Error**	**t-stat**	**p-value**
LogDOP	-0.0252	0.0276	-0.91	0.363
LogLIB*DOP	0.0224	0.0131	1.71	0.089
LogFIND	0.0529	0.1699	0.31	0.756
LogLIB*FIND	0.0353	0.0852	0.41	0.679
LogPOP	-0.0275	0.0418	-0.66	0.511
LogLIB*POP	0.3532	0.0481	7.31	0.000
LogEnergy	0.7049	0.1204	5.86	0.000
LogLIB*Energy	-0.2553	0.0722	-3.54	0.001
LogLIB	-2.7471	0.4736	-5.80	0.000
Constant	1.0442	0.4090	2.55	0.012
R^2		0.9466		
F-statistic (probability)		593.96 (0.0000)		
Durbin-Watson statistic (10, 172)		0.5722		
Breusch-Godfrey LM Chi-square Statistic		84.336 (0.0000)		
Ramsey RESET F-stat (3, 159)		0.59 (0.6554)		
Variable Deletion F-stat (5, 162)		75.66 (0.0000)		

Source: Author's Computation

Table 6: **Results for the Aggregate Industrial Sector with Robust Standard Errors**

LogINQ	**Coefficient**	**Robust Std Error**	**t-stat**	**p-value**
LogDOP	0.1059	0.0197	5.37	0.000
LogLIB*DOP	-0.0682	0.0089	-7.69	0.000
LogFIND	-0.3016	0.0814	-3.71	0.000
LogLIB*FIND	0.0900	0.0364	2.47	0.014
LogPOP	-0.1014	0.0277	-3.66	0.000
LogLIB*POP	0.5037	0.0220	22.88	0.000
LogEnergy	0.6509	0.0617	10.55	0.000
LogLIB*Energy	-0.2850	0.0283	-10.07	0.000
LogLIB	-4.7831	0.2238	21.37	0.000
Constant	3.7023	0.2779	13.32	0.000
R^2		0.9544		
F-statistic (probability)		445.54 (0.0000)		
Durbin-Watson statistic (10, 172)		0.8644		
Breusch-Godfrey LM Chi-square Statistic		50.642 (0.0000)		
Ramsey RESET F-stat (3, 159)		0.41 (0.1156)		
Variable Deletion F-stat (5, 162)		126.42 (0.0000)		

Source: Authors Computation

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