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Openness, Stock Market Development, and Industrial Growth in Nigeria

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In recent years the Nigerian economy has been moving towards increased liberalisation, greater openness, and greater financial development. This paper examines the implications of these developments for industrial growth in Nigeria. A simple model, which relates industrial output growth to openness, stock market development, and a battery of control variables, is specified and estimated, using annual data covering the period 1970–1997. The empirical evidence strongly suggests that openness to world trade and stock market development are among the key determinants of industrial output growth in Nigeria. The other important factors are human capital input, non-military expenditure, gross domestic product (GDP), which reflects the size of physical capital, and inflation.

I. INTRODUCTION

The Nigerian economy in recent years has been characterised by trends towards increased liberalisation, greater openness to world trade, higher degree of financial integration, and greater financial development. The increased liberalisation and openness have motivated high rate of increases in cross-border capital and direct investment flows. Both inflows and outflows of private capital have been sharply increasing since the early 1980s. Also direct investment flows to the country have significantly increased during this period [CBN (1997)]. But, these flows declined steeply in the early 1990s, due largely to political instability, which was heightened by the annulment of the 1993 presidential election by the military.

Also, against the background of increased liberalisation of particularly the financial sector, there have been remarkable financial integration and financial development. This is evident in the rapidly increasing size of the stock market capitalisation and the value traded. The recent surge in equity transactions is clearly the result of the recent internal and external liberalisation of the Nigerian economy. Internal liberalisation has generated large increases in new issues, and in the volume of trade in existing issues. The recent phenomenal increases in cross-border equity flows are largely due to increased external liberalisation (openness).

The purpose of this paper is to examine the implications of these developments for industrial production in Nigeria. Specifically, the question that this

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paper tries to address is: Do openness to trade and stock market development have any significant impact on industrial output growth in Nigeria? This question involves an examination of the empirical relationship between these exogenous variables (openness and stock market development) and industrial output growth.

At the theoretical level, there is yet little or no consensus among development economists regarding the macroeconomic impact of financial liberalisation, openness, and financial development. Goldsmith (1969); Mckinnon (1973) and Shaw (1973) were the first to hypothesise that financial liberalisation and the associated openness and financial development would promote economic growth through their impacts on the growth rate of capital and the efficiency of capital allocation. However, while Goldsmith focuses on the relationship between financial development and the efficiency of investment, what is now called the Mckinnon-Shaw model emphasises the strong positive effect of financial liberalisation on savings, investment, and therefore economic growth.

Since the appearance of the Mckinnon-Shaw model in the economic development literature, the relationship between financial development and economic growth has been a source of intense debate. The opponents of the Mckinnon-Shaw proposition (often referred to as neostructuralists) argue that financial liberalisation may not lead to increased growth rates of output [Burkett (1987); Buffie (1983); Taylor (1980)]. They contend that a fully liberalised financial sector may not be possible or desirable in a developing economy [Espinnosa and Hunter (1994)]. Some of these neostructuralists question the ascribed role of financial development in economic growth, and argue that in developing countries financial liberalisation may not necessarily spur greater increases in GDP than "financial repression".

However, a more hotly debated issue is the role of external liberalisation (liberalisation of trade and international capital flows) in economic development. The opponents of external liberalisation, or full openness to trade, agree that such policies remove barriers to trade and international capital flows, but argue that free cross-border capital flows may not enhance economic growth and welfare. This is because removal of capital controls (openness) may result in "capital flight", as capital is free to flow out in search of a high rate of return. In the process of opening up, many developing countries have found themselves in serious internal and external imbalances [Bruno (1988); Edward (1985)]. These arguments suggest that liberalisation and its associated openness may in fact slow down economic growth. Thus, the theoretical literature is divided on the issue of the growth effects of financial liberalisation, openness, and financial development.

The empirical evidence on these issues is also largely mixed, or rather less conclusive. Some studies have found evidence that indicates strong positive correlation between financial liberalisation and economic growth [Gregorio and Guidotti (1995); King and Levine (1993)]. In particular, Dornbusch and Reynoso

(1989) find that the liberalisation and opening up of South Korean economy in the late 1970s and the early 1980s were largely responsible for the recorded high rate of real growth during the 1980s. But, surprisingly, a cross-country study by Dornbusch and Reynoso could not establish that financial liberalisation has any significant positive impact on economic growth. This later evidence is supported by a recent study by Park (1993) which suggests that financial liberalisation in South Korea and Taiwan in the 1980s could not have any significant positive effect on economic growth.

To resolve these issues requires further empirical investigations. As already indicated, the purpose of this paper is to provide further empirical evidence on the issue, using Nigerian data and focusing on the effects of opening of the economy and stock market development on industrial production. The rest of the paper is organised as follows: Section II provides a brief survey of the analytical literature. Section III presents the empirical methodology and describes the data used for the analysis. Empirical results are presented and discussed in Section IV. Section V concludes the paper.

II. OPENNESS, FINANCIAL DEVELOPMENT, AND ECONOMIC GROWTH: AN ANALYTICAL FOUNDATION

The relationship between openness to world trade and economic growth has remained a source of intense debate among development economists. Numerous studies have proposed that outward orientation and openness improve growth performance through its positive effects on capital flows, foreign direct and portfolio investments, and development of domestic financial markets. It is argued that foreign investments (direct and indirect) promote competitiveness, efficiency in resource allocation, economies of scale, and technological knowledge or transfers.

Coe, *et al.* (1995) observe that greater openness and more trade flows have enabled the developing countries to benefit from research and development (R & D) in advanced economies. They link the increasing spillover from research and development to more trade flows between industrial and developing countries.

Openness and the associated free flow of capital promote industrial growth and development. Openness fosters open competition that drives innovation, greater resource allocation, efficiency, and technological advancement. Recent studies by Moreno (1993); Roubini and Sala-I-Martin (1991) and Gould, *et al.* (1993) have attributed the rapid growth of some developing countries, such as South Korea and Taiwan, to increased openness. Also recent models in wage inequality suggest that greater openness to trade has enabled some developing countries to narrow the wage differentials within these countries and between them as a group and the more advanced countries. Wood (1997) argues that openness boosts the relative demand for unskilled workers and reduces the gap in wages between unskilled and skilled workers.

However, intense import competition is said to have adverse effects on profitability of the firms and it is feared that this may also lead to unemployment in the liberalising country [Jacobson, Lalonde and Sullivan (1993)]. Also, the prospects of capital flight have been a major argument against liberalisation and openness. The Mexican experience was a case of serious outflow of funds that precipitated a number of problems. With the liberalisation of the Mexican economy, there was a precipitous depreciation of the peso, high level of inflation, and a significant drop in output growth [Fieleke (1996)]. However, it is argued that such unsuccessful trade liberalisation is the failure of the government to create a credible trade liberalisation policy [Gould (1992)]. Indeed, the Mexican case is clearly one of non-credible liberalisation attempt, which is often worse than no attempt at all.

The relationship between financial development and economic growth is an issue that has also generated intense controversy; most theoretical expositions suggest that a well-functioning stock market can significantly influence industrial growth rate. But there are disagreements as to the direction of the effect on growth. While some development economists argue that financial development has little or no effect on growth, others predict a strongly positive link between economic growth and financial development. However, there is little disagreement that a well-functioning stock market guarantees liquidity, risk diversification, acquisition of information about firms, corporate control, and savings mobilisation. Certainly, any changes in these factors will alter the rate of industrial growth.

For these reasons, the argument of those proposing a positive link between financial sector performance and economic growth appears more convincing. Financial development spurs higher economic growth by mobilising savings. Greenwood and Jovanovic (1990) and Khan (2000) show how a well-developed financial sector can enhance economic growth by pooling savings. In particular, a well-functioning stock market provides finance for long-term risky, but high-return, industrial projects rarely financed by other financial markets. This is because the stock market can pool together long-term funds needed for such projects; pooling of resources provide diversification, protects savers from idiosyncratic risk, and enables the stock market to fund lumpy and risky, though profitable, long-term industrial projects [Montiel (1995)].

Second, a well-developed stock market promotes efficient allocation of the accumulated savings. Becsi and Wang (1997) highlight the role of financial sector in channelling resources towards more profitable projects, or better investment opportunities. By allocating resources more efficiently to profitable long-term investments, the stock market increases productivity in the real sector.

The third role of a well-functioning stock market, or financial system as a whole, is its ability to guarantee adequate liquidity. That is, investment in long-term, high-return projects will be almost impossible without a liquid stock market or financial system. This is because savers may be unwilling to relinquish their funds if they are not assured of prompt and easy access to their savings when needed. Recent studies by Bencivenga, *et al.* (1996); Demirguc-Kunt and Levine (1996) and Levine (1991) show that a highly liquid stock market makes it possible for portfolio investors to acquire financial assets, and this enables industrial firms to have access to long-term funds. The investors are encouraged to invest in these assets because they have access to their savings throughout the investment period. Thus, a liquid stock market enhances investment in profitable projects with prospects for long-term growth.

The fourth role of a well-developed stock market is its ability to reduce investment risk by offering opportunities for portfolio diversification [Levine (1991)]. The availability of different investment opportunities with differing risk characteristics encourages savers to acquire diverse investment assets, as this ensures minimum risk exposure.

Fifth, a well-functioning stock market improves corporate control, monitors managers, and stimulates information acquisition about firms. Recent studies by Kyle (1984) and Holmstrom and Tirole (1993) show that the incentives for investors to obtain information about firms and improve corporate governance can be substantially increased by a developed highly liquid stock market. When a stock market is liquid, an investor can use information acquired to trade quickly and easily at posted prices. The profit from such information will further spur investors to embark on supervision and monitoring of firms.

Finally, internationally integrated stock market promotes industrial growth by enhancing capital inflows. With openness and stock market integration, capital flows freely across borders to equalise the price of risk. The net effects are more liquidity, greater risk diversification, and efficient allocation of resources. Recent studies by Saint-Paul (1992); Devereux and Smith (1994) and Obstfeld (1994) show that a faster rate of industrial growth could be achieved with financial market integration. By enhancing capital flows and risk diversification, openness and financial market integration make it possible for growth-stimulating industrial projects to be adequately funded.

These are some of the reasons why it is strongly argued that a well-functioning financial system in general, and stock market in particular, would promote savings and investments and, therefore, economic growth.

III. THE EMPIRICAL MODEL AND DATA

The primary objective of this study is to estimate the impact of openness to trade and stock market development on industrial output growth in Nigeria, and to ascertain whether openness and stock market development are important predictors of industrial growth in Nigeria. To achieve this objective, a modified and extended version of the stock market and economic growth model formulated independently by Levine and Zervos (1996); Demirguc-Kunt and Levine (1996) and Demirguc-

Kunt and Maksimovic (1996), is specified and estimated over the period 1970–1997. The functional form of the model is specified as;

$$INDP = f(CAPR, NMER, SEROL, INF, MXLR, OPNES, GDP), \quad \dots \quad (1)$$

where *INDP* is industrial output, *CAPR, NMER, SEROL, INF, MXLR, OPNES*, and *GDP*, are the ratio of stock market capitalisation to GDP, the ratio of non-military expenditure to GDP, school enrolment, inflation rate, maximum lending rate, openness to international trade, and gross domestic product, respectively.

The basic relationship to examine is a log linear version of Equation (1), and is of the following form:

$$\begin{aligned} lnINDP_t &= a_0 + a_1 lnCAPR_t + a_2 lnNMER_t + a_3 lnNMER_{t-1} + a_4 lnOPNES_t + \\ & a_5 lnMXLR_t + a_6 lnINF_t + a_7 lnINF_{t-1} + a_8 lnGDP_t + a_9 lnGDP_{t-1} \\ & + b_j \sum_{j=0}^{j} InSEROL_{t-j} + e_t \quad \dots \quad \dots \quad \dots \quad \dots \quad (2) \end{aligned}$$

Equation (2) shows that the variables *NMER, INF*, and *GDP* enter the model with one period lag respectively, and that the variable *SEROL* enters with lags.

The fundamental proposition of this paper is that openness to trade and a well-developed stock market, respectively, have a strong positive influence on industrial output growth. That is, greater openness of the economy to international trade and a liquid stock market can strongly stimulate industrial production. We expect, therefore, that the estimated values of the coefficients on *CAPR* and *OPNES* will be positive (a_1, $a_4 > 0$), and statistically significant. We use market capitalisation as the measure of stock market development because it is assumed that stock market size reflects, to a considerable extent, the market liquidity and extent of integration. The greater the stock market liquidity and integration with international capital market, the more it will encourage savings, investment, and economic growth. The proposition that increased openness accelerates economic growth is based on the fact that most developing countries have abundant raw materials to export in exchange for machinery and equipment, including technical skill for industrial development. Trade restriction does not allow free flow of capital and equipment.

Undoubtedly, public infrastructure investment is the major component of non-military expenditures: it is productive and complements private capital stock. Thus, since non-military expenditure, especially on infrastructure, increases the productivity of the private capital [Tatom (1991, 1993); Aschauer (1990); Udegbunam (2000)], it is expected to generate industrial growth in Nigeria. The estimated coefficient on *NMER* and its lag is expected to be positive (a_2 , $a_3 > 0$) and statistically significant.

A large number of studies have shown that inflation and high interest rates exert individually a significant negative impact on investment and output growth [Barro (1991, 1996); Clark (1993)]. Thus, it is expected that the coefficients on these variables *INF*, INF_{-1}, and *MXLR*, will be negative (a_7 , a_5 , a_6 < 0).

A country grows faster if it begins each period with higher level of human capital. With a high level of educational attainment, labour is better equipped to adapt to new technologies and management skills developed elsewhere. The school enrolment rate, a crude proxy used for human capital, enters the model with lags. It takes fairly a long time to accumulate sufficient human capital for increases in output growth. Barro (1991) and Barro and Lee (1992) estimated that average educational attainment begins at two years in most Sub-Saharan African countries. Until this crucial threshold in educational attainment is reached, it is expected that increases in labour input, with a given level of capital stock will, according to neoclassical prediction, yield positive but diminishing marginal products. However, with educational attainment in about two years, marginal product of human capital input is expected to be positive and increasing (b_0, $b_1 < 0$, b_2, $b_3 > 0$).

A large body of empirical literature, including Barro (1991); Lucas (1988); Levine and Zervos (1996), provides evidence of strong negative link between initial income measured by initial GDP and long-run growth. This evidence is attributed to the convergence hypothesis, which posits that an economy grows faster the lower is its GDP. In other words, the rate of growth of an economy depends inversely on the gap between the economy's initial income and the economy's long-run or steady-state GDP. We represent initial income simply with one period-lagged GDP and expect that its coefficient would have a negative sign ($a_9 < 0$). We also include current income in the model. It plays a dual role in industrial growth. First, it is a source of supply of funds for industrial expansion; second, the level of income determines the demand for industrial output. Current income is therefore expected to have a positive impact on industrial growth ($a_8 > 0$).

The general use of differencing has been found to reduce the possibility of spurious regression results [Granger and Newbold (1974); Plosser and Schwart (1978); Philip (1986)]. Recent studies by Layson and Seaks (1984); Adams (1992); Anyanwu and Udegbunam (1996) conclude that first-differencing achieves stationarity of variables and thus reduces the possibility of spurious results. Based on the suggestions of the above studies, and to roughly gauge the robustness and consistency of our estimation results, the regression Equation (2) is also estimated in first difference form. Differencing Equation (2) yields:

$$\begin{aligned}\Delta lnINDP_t = & \beta_0 + \beta_1 \Delta lnCAPR_t + \beta_2 \Delta lnNMER_t + \beta_3 \Delta lnNMER_{t-1} \\ & + \beta_4 \Delta lnOPNES_t + \beta_5 \Delta lnMXLR_t + \beta_6 \Delta lnlNF_t + \beta_7 \Delta lnIN_{t-1} \\ & + \beta_8 \Delta lnGDP_t + \beta_9 \Delta lnGDP_{t-1} \\ & + \phi_j \sum_{j=0}^{j} \Delta lnSEROL_{t-j} + \in_t \ \dots \quad \dots \quad \dots \quad \dots \qquad (3)\end{aligned}$$

Where Δ is the first-difference operator. As in Equation (2), the *a prior* signs of the coefficients are:

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_8, \phi_2, \phi_3 > 0$
$\beta_5, \beta_6, \beta_7, \beta_9, \phi_0, \phi_1, < 0$

The Data

The data for this study have been obtained from the Central Bank of Nigeria's (CBN) *Statistical Bulletin* and *Annual Report and Statement of Accounts* (various issues), and the Federal Office of Statistics (FOS), *Annual Abstracts of Statistics*. The time series of the variables of the model are used to examine the impact of particularly openness and stock market development on industrial development.

There are time series data on various measures of industrial production in the CBN *Statistical Bulletin*. These include real, nominal values, and index of industrial production. We use annual values of gross real industrial output, as it is expected that the real values would reflect better the roles of openness and stock market development in industrial development.

Recent studies by Levine and Zervos (1996); Demirguc-Kunt and Levine (1996) and Bonser-Neal and Dewenter (1996) used three different indicators of stock market development as explanatory variables in their estimations. The indicators are market capitalisation, value traded, and the ratio of value traded to market capitalisation. For our purpose in the present study, the stock market development indicator, market capitalisation, is more appropriate. We use the ratio of market capitalisation to GDP (Market Capitalisation/GDP). The data on market capitalisation are obtained from the Nigerian stock exchange Fact Book; for GDP, the data are from the CBN *Statistical Bulletin* (various issues).

In the case of openness to trade, we adopt the measure often suggested in the literature [Iyoha (1976); Wood (1997)]. This is the ratio of imports plus exports to GDP [(Imports + exports)/GDP]. The appropriateness of this measure is certainly a subject for further investigation. However, it seems to have performed creditably in the present study. The data on exports and imports have been obtained from the federal office of statistics' *Abstracts of Statistics*.

Following Schultz (1961), and more recent studies by Lucas (1988); Romer (1990); Stokey (1991); Barro (1991), school enrolment is used as a proxy for human capital input.

IV. EMPIRICAL RESULTS

The results of estimating Equations (2) and (3) by the ordinary least squares (OLS) method, on annual data covering the period 1970–1997, are reported in Equations (A-1) and (A-2) in Appendix A. Below each parameter estimate, *t*-ratios are reported in parenthesis. The Durbin-Watson statistics of 2.7771 for Equation (A-1) and 2.8521 for Equation (A-2) indicate that for these two results the negative first-order serial correlation cannot be ruled out. Thus the two results are corrected for serial correlation using the Newton-Raphson method for the Log-level specification [Equation (A-1)], and the Cochrane-Orcult procedure for the first difference version [Equation (A-2)]. The corrected version of Equation (A-1) is reported in Equation (4), while the corrected version of Equation (A-2) is reported in Equation (5).

$$\begin{aligned} lnINDP = & \underset{(16.9289)^{***}}{4.4664} + \underset{(3.3675)^{***}}{0.2171 lnCAPR} + \underset{(6.1035)^{***}}{0.2363 lnOPNES} + \underset{(3.6043)^{***}}{0.1885 lnMXLR} \\ & + \underset{(1.9471)^{**}}{0.0964 lnNMER} - \underset{(-0.0491)}{0.0162 lnNMER_{(-1)}} - \underset{(-3.3980)^{***}}{0.0584 lnINF} \\ & + \underset{(0.0345)}{0.0006 lnINF_{(-1)}} + \underset{(7.6946)^{***}}{0.2279 lnGDP} - \underset{(-3.5823)^{***}}{0.1479 lnGDP_{(-1)}} \\ & + \underset{(1.7269)^{*}}{0.0641 lnSEROL} - \underset{(-1.1132)}{0.0487 lnSEROL_{(-1)}} + \underset{(0.8455)}{0.0400 lnSEROL_{(-2)}} \\ & - \underset{(-2.5783)}{0\ 0.0868 lnSEROL_{(-3)}}. \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (4) \end{aligned}$$

$\bar{R}^2 = 0.9658$; $DW = 2.5563$; $F(13,11) = 44.334$; $SEE = 0.0385$
*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

$$\begin{aligned} \Delta lnINDP = & \underset{(1.1065)}{0.1472} + \underset{(10.5149)^{***}}{0.3325 \Delta lnCAPR} + \underset{(7.8241)^{***}}{0.2604 \Delta lnOPNES} + \underset{(4.0024)^{***}}{0.1280 \Delta lnMXLR} \\ & + \underset{(4.8436)^{***}}{0.0971 \Delta lnNMER} - \underset{(-5.9880)^{***}}{0.1089 \Delta lnNMER_{(-1)}} - \underset{(-5.5773)^{***}}{0.0495 \Delta lnINF} \\ & + \underset{(2.7602)^{**}}{0.0240 \Delta lnINF_{(-1)}} + \underset{(6.8473)^{***}}{0.3422 \Delta lnGDP} - \underset{(-8.9301)^{***}}{0.3416 \Delta lnGDP_{(-1)}} \\ & - \underset{(-1.1328)}{0.0537 \Delta lnSEROL} - \underset{(-5.5970)^{***}}{0.3565 \Delta lnSEROL_{(-1)}} + \underset{(11.3556)^{***}}{0.6584 \Delta lnSEROL_{(-2)}} \\ & - \underset{(-12.6898)^{***}}{0.5112 \Delta lnSEROL_{(-3)}} \quad \dots \quad \dots \quad \dots \quad \dots \quad \dots \quad (5) \end{aligned}$$

$\bar{R}^2 = 0.9681$; $DW = 2.5509$; $F(16,3) = 38.987$; $SEE = 0.0186$
*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

The above two regression results are the version of the two OLS results in Appendix A corrected respectively for serial correlation. Also note that the results in Equation (5) are the differenced version of the results in Equation (4). Again *t*-ratios are reported in parentheses below each parameter estimate.

A close examination reveals that even with the presence of serial correlation, each of the regression results reported in Appendix A is largely in conformity with our predictions. In particular, the estimated coefficients on the key variables, *CAPR* and *OPNES*, are statistically significant with the predicted signs in both equations. But clearly, in terms of overall fit measured by adjusted–R^2 and F-value, coefficient estimates and their t-values, Equations (4) and (5), are very much better than their respective OLS counterparts. Our analysis is therefore based on Equations (4) and (5), as clearly their respective Durbin-Watson statistics are better; they show that the problem of serial correlation has been substantially reduced, if not completely eliminated.

The adjusted–R^2 of approximately 0.97 for each of the Equations (4) and (5) indicate that about 97 percent of the systematic variations in the growth rate of industrial production during the period of study are explained by the corrected versions of the model. The F-values of 44.334 for Equation (4) and 38.987 for Equation (5) are significant at the less than 1 percent level, indicating a significant linear relationship between the dependent variable (INDP) and the thirteen independent variables taken together.

It is interesting to note that, of the thirteen explanatory variables, the coefficient estimates on nine, viz., *CAPR, OPNES, MXLR, NMER, INF, GDP*, $GDP_{(-1)}$, *SEROL*, and $SEROL_{(-3)}$, are statistically significant in Equation (4). Of the nine independent variables that are statistically significant, the coefficients on seven have the expected sign. That is, coefficients on two variables, *MXLR* and *SEROL*, have the wrong sign. The performance of Equation (5) is more remarkable. Of the thirteen explanatory variables, only one (*SEROL*) failed to pass the t-test at any acceptable level of significance. However, of the twelve variables that passed the significance test, nine have the predicted sign, while three have the counter-intuitive sign: these are *MXLR*, $NMER_{(-1)}$, $INF_{(-1)}$. Except for the fact that the results presented in Equation (5) are undoubtedly more robust, the two regression results are virtually the same. The most remarkable is the excellent performance of the two variables, which are of particular interest to this study. The two variables are openness to trade (*OPNES*) and stock market development (*CAPR*). In both equations, the coefficients on these two variables passed the t-test at the 1 percent level.

Thus, the empirical evidence provides strong support for the openness and financial development hypotheses. The openness hypothesis posits that industrial growth is strongly motivated by trade liberalisation. This is because openness allows the developing economies in particular easy access to foreign savings or pool of funds. It boosts international capital flows, enhances liquidity of domestic capital market, and reduces the cost of capital for industrial projects. The financial development hypothesis contends that greater financial development would have a positive impact on industrial production.

The results suggest that recent financial deregulation in Nigeria and the associated increases in trade liberalisation since 1987 have had a strong positive effect on industrial growth. Since the model is specified in log-linear form, the coefficient estimates are direct measures of impact elasticity. Thus, the estimated coefficient of openness to trade (*OPNES*) in Equation (4) suggests that a 1 percent increase in openness would increase industrial growth by 0.24 percent. For the first difference version (Equation 5), an increase of 1 percent in annual change in openness to trade will result in an increase in the change in industrial growth of 0.26 percent. It may be surprising to note that the impact on industrial growth of a 1 percent increase in openness is virtually the same as the impact of an increase of 1 percent in annual change in openness. This indicates the consistency and robustness of these results.

Clearly, the performance of this variable (*OPNES*) is remarkable. It is in accord with the neoclassical argument that free trade is beneficial; it allocates resources to their most efficient use, fosters competition and therefore innovation, spreads technical knowledge, and increases efficiency in production. The result is also largely in conformity with the empirical evidence provided by Iyoha (1976); Kim, *et al* (1989) and Wood (1997). In line with the Hecksher-Ohlin theory that trade increases the demand for abundant factors because of comparative advantage, Kim, *et al.* (1989); Wood (1995, 1997) and Robbins (1995, 1995a) find that increased openness in developing countries raises the demand for abundant unskilled labour relative to skilled labour.

The evidence of a strong positive relationship between stock market development and industrial production is consistent with recent empirical findings by King and Levine (1992, 1993); Levine (1997); Levine and Zervos (1996) and Fernandez and Galetovic (1994). The estimated coefficient of the variable measuring stock market development (*CAPR*) is robust and highly significant. The robustness of this result is further confirmed by the first-difference version of the results presented in Equation (5). From Equation (4), an increase in stock market development by 1 percent would result in about 0.22 percent increase in industrial growth per year. It is interesting to note that that impact of the stock market on industrial growth is virtually the same as the impact of openness, and the current GDP. That is, industrial growth has virtually the same degree of sensitivity to changes in any of these three variables, as the elasticity estimates are 0.24 for openness, 0.22 for stock market development, and 0.23 for current GDP. This evidence is almost replicated by the first-difference version, as the elasticities are 0.26 for openness, 0.33 for stock market development, and 0.34 for current GDP. Thus, a well-developed stock market accelerates the rate of growth of industrial firms.

As already observed, the coefficient estimates of 0.23 in Equation (4) and 0.34 in Equation (5), both of which are significant at the less than 1 percent level, reveal a strong positive link between industrial growth and the aggregate demand proxied by current GDP. This finding corroborates our proposition that industrial growth depends on income, first as a source of supply of funds for industrial expansion, and second, as a determinant of demand for industrial output.

Interestingly, the coefficient of initial income proxied with one period-lagged GDP is also highly significant, and with the expected negative sign in the two equations. This evidence, which is consistent with the findings of other similar studies [Lucas (1988); Barro (1991); Levine (1997); Levine and Zervos (1996)], lends further support to the convergence hypothesis. With the estimated coefficient of –0.1479 on initial income, which is significant at the 1 percent level, Equation (4) implies a rate of convergence to the target growth (steady-state) of 1.5 percent per year. Similarly, the estimated coefficient of –0.3416 on initial income in Equation (5) indicates an annual change of 3.4 percent in the rate of convergence.

It is surprising to find a strong positive link between maximum lending rate (*MXLR*) and industrial production in Nigeria. Although the two versions of the results are consistent in this evidence, it contradicts our prediction and the findings of recent studies cited above. A plausible explanation for this apparent perverse behaviour of interest rate is that, because of scarcity of loanable funds in Nigeria, industrialists are guided not so much by the cost of funds as by their availability. That is, with interest rates often regulated, what matters to the industrialist is not the cost but the availability of funds; high interest rate encourages availability, as it motivates savings and inflow of capital from abroad.

The empirical evidence is in conformity with our expectation that public non-military expenditure would exert significant positive effect on the industrial production in Nigeria. The estimated coefficient on current *NMER* is highly statistically significant, especially in the more robust first-difference version of the results, with the predicted sign. This suggests that an increase of 10 percent in change in non-military expenditure will result in an increase of 1 percent in the change in the industrial production. Or that an increase of 10 percent in public infrastructure investment will increase industrial growth by 1 percent (Equation 4). The two versions of the results are again consistent in indicating that public infrastructure investment, which is a major component of non-military expenditure, boosts industrial growth. This finding lends further support to Tatom (1991, 1993); Aschauer (1988, 1989, 1989a, 1990); Munnel (1990) and Udegbunam (2000). Surprisingly, the coefficient on lagged non-military expenditure has the counter-intuitive sign, and is statistically significant only in the first-difference version of the models. This evidence appears to suggest that what matters is the maintenance and improvement in the infrastructure facilities and not the existing stock of infrastructure *per se*. This is because the existing stock of infrastructure may not be yielding the desired level of services if it is in a state of disrepair, and this may have a negative effect on output growth.

As postulated, the coefficient on current inflation rate (*INF*) passed the *t*-test at the 1 percent level with the expected negative sign in both versions of the model. This evidence suggests that the current high level of inflation in Nigeria impedes industrial sector performance. Interestingly, the results from the two versions of the model continue to be virtually the same, as they both indicate that a 10 percent rise in inflation would reduce industrial production by about 0.55 percent. This evidence is consistent with the findings provided by a large body of empirical research on inflation and growth [Barro (1996); Motley (1998)]. It may not be surprising that the coefficient estimate on one period-lagged inflation rate consistently has unexpected positive sign. When inflation rate is persistently rising, as in Nigeria recently, industrial firms may adjust by increasing production based on their past inflation experience, so as to take advantage of future expected price increases.

Clearly, equipment and machinery can be assembled quickly but it is not possible to rapidly produce educated people; to attempt that would be at the cost of a sharp fall in productivity. It is estimated that average educational attainment in Sub-Saharan Africa begins at two years [Barro (1991); Barro and Lee (1992)]. Our results, especially the first-difference version, are in conformity with this estimate. The estimated coefficient on two period-lagged school enrolment rate is positive and highly significant in Equation (5). This suggests that after reaching the critical threshold on educational attainment, industrial output grows faster with additional amounts of educational attainment. This evidence supports the recent empirical reports by Barro (1991, 1996); Easterly and Levine (1994) and Udegbunam (2000), but contradicts Clark (1993); Schmidt-Hebbel (1994) and Anyanwu (1998). However, the highly significant negative coefficient on three-period-lag school enrolment rate appears to conform with the neoclassical prediction of diminishing returns.

Robustness

An important issue in the interpretation of growth regressions is the endogeneity of the regressors. Usually single-equation models are constructed on the assumption that causation is unidirectional, but as economic variables are often interdependent, causation can run in both directions. This issue has been of intense debate among economists [Rajan and Zingales (1998); Fortune (1998); Khan (2000)]. For example, Fortune (1998) observes that "The notion of causation is inherently slippery, and economists often use a particular definition called 'Granger Causation', in which the direction of causation is synonymous with the existence of a lead or lag relationship". Goldsmith (1969) doubted if researchers would be able to resolve the issue of causality. Indeed, despite all the attempts to resolve it, causality is still an important issue.

An attempt is made here to probe the robustness and validity of our results by:

(i) applying the test proposed by Granger (1969), as suggested by Fortune;
(ii) specifying and estimating a first-difference version of the model;
(iii) carrying out the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests as proposed by Brown, *et al.* (1975).

Despite its limitations [Jacobi, *et al.* (1979); Zellner (1988)], the test procedure proposed by Granger has become a widely used test for causality. The test is based on the notion that if the forecasts of *Y* obtained by using both past values of *Y* and past values of *X* are better than the forecasts obtained using past values of *Y* only, then *X* is said to cause *Y*. But *Y* should not help to predict *X*, or it will mean that some other variables (omitted) are in fact 'causing' both *X* and *Y*. Based on this premise, we test the null hypothesis that change in any of the five regressors, *OPNES*, *MCAPR*, *INF*, *NMER*, and *GDP*, does not cause changes in industrial growth (*INDP*), and, similarly, that industrial growth does not cause changes in any of these regressors.

The results of these tests are reported in Table (B 1) of Appendix B. The upper half of the table reports the results of the null hypothesis that changes in any of the five regressors do not cause changes in industrial growth, while the lower half reports test results for the hypothesis that industrial growth does not cause changes in any of the five regressors. As indicated, *Y* is the left-hand variable and *X* the right-hand variable in the unrestricted regression. The *a*s are the coefficients on the lagged values of *Y*, and *b*s are the coefficients on the lagged values of *X*.

For all the regressions, lag length is arbitrarily set at 4, and *t*-ratios are reported in the parentheses below each parameter estimate. The Durbin-Watson statistics indicate no evidence of serial correlation in any of the regressions. Also, for all the regression results in the upper half of Table (B 1), *F*-statistics passed the significance test at the 1 percent level. Thus, the null hypothesis—that changes in any of the five regressors (*OPNES, MCAPR, INF, NMER,* and *GDP*) do not cause changes in industrial growth—is rejected. On the other hand, of all the regression results in the lower half of the table, only GDP passed the *F*-test at the 5 percent level. None of the other four regressions passed the test at any acceptable level of significance. We, therefore, accept the null hypothesis that changes in industrial growth do not cause changes in any of the four regressors.

As indicated in the main body of this paper, another way we have tried to probe the robustness of the results is to estimate a first-difference version of the model. The results obtained from this version of the model [Equation (5)] are not only consistent with our previous results but are more robust, thus upholding more strongly the openness and stock market development hypotheses.

But even so, there is still the fear of other problems associated with causality, especially those resulting from omitted third variables. To lessen this aspect of the problem, and following Barro (1996), a battery of control variables are included, each with one-period lag.

Finally, the *CUSUM* and *CUSUMSQ* tests are used to test the hypothesis that the regression model is correctly specified and that it is stable. The *CUSUMSQ* is a slightly stricter test used for further check on the stability of the behavioural parameters. The *CUSUM* of recursive residuals is plotted together with a pair of straight lines drawn at 5 percent confidence interval. If the plotted *CUSUM* of recursive residuals crosses any of the two 5 percent critical lines, then the hypothesis that the model is correctly specified and has stable parameters must be rejected at the 5 percent level. The same is true with *CUSUMSQ* of recursive residuals, which is the stricter test of the hypothesis. The *CUSUM* and *CUSUMSQ* tests for the log-level version of the model are provided in Appendix C Figures A and B, while the tests for the first-difference version are in Figures C and D. It is interesting to note that none of the plotted *CUSUM* and *CUSUMSQ* of recursive residuals crosses any of the two 5 percent critical (dotted) lines. They are all within the two critical lines, and with this evidence we accept the null hypothesis that the model is correctly specified and has stable behavioural parameters during the period of study.

V. CONCLUSION

The question of whether openness and stock market development are important factors in industrial growth is empirically evaluated in this study, using Nigeria data. This effort is spurred by the raging debate on the relevance of free trade and financial development to economic growth in developing countries [Hetzel (1994); Gould, *et al*. (1993); Roubini and Sala-I-Martin (1991)], and the fact that the empirical evidence, so far, is somewhat mixed, and that there is none yet for Nigeria.

Using a simple model, similar to those used by Levine and Zervos, King and Levine, and Bonser-Neal and Dewenter, the empirical evidence suggests that openness to trade and stock market development have independently a strong positive correlation with industrial production. That is, the empirical findings provide strong support for the proposition that openness and stock market development are among the key determinants of industrial growth in Nigeria. The other key factors, as indicated by the results, are human capital input proxied by school enrolment rate, non-military expenditure that largely reflects the level of infrastructure facilities, GDP that reflects the size of physical capital and level of aggregate demand, and inflation rate.

Although our results suggest that openness and stock market development have a strong positive link with industrial growth, this evidence should be viewed with some caution.

(i) The measures of openness used in this study may not be very adequate. Although the ratio of imports-plus-exports to GDP, as a measure of openness, has been popular in the literature, it is clearly an *ex post* measure. An *ex ante* measure would have been better for our purpose, but the problem has been: How to construct an appropriate proxy to measure openness *ex ante*. A good *ex ante* measure must incorporate tariff and non-tariff barriers in their varying degrees; Nigeria places greater reliance on non-tariffs, but there is an acute data problem. Barro (1991) tried to deal with this problem by relating the imports-to-GDP ratio with the tariff rate. This yields what seems to me an uninterpretable result, as the coefficient on such variables can be positive, negative, or zero, depending on the weight of each component.

(ii) In the case of stock market development, the ratio of market capitalisation to nominal GDP (Market capitalisation/GDP) is used in this study; it provides an indication of the market size, and market size appears to be a better indicator of market development. However, according to the literature, two other measures have been tried: the ratio of value traded to GDP (value traded/GDP), and the ratio of value traded to market capitalisation (value traded/market capitalisation). These two measures provide indications of market liquidity, and this explains why the results obtained with market capitalisation to GDP ratio are more robust than the results obtained using these two alternative measures.

(iii) Following Barro (1991, 1992, 1996); Levine and Zervos (1996) and Barro and Sala-I-Martin (1992), we used school enrolment rate as a crude proxy for human capital input. This may not be a good measure of human capital, especially in Nigeria, where there is a high level of college and graduate unemployment. It is not surprising, therefore, that we find that three period-lag of this variable exhibits negative sign, thus indicating that the increasing number of surplus college graduates results in diminishing, if not negative, marginal productivity.

In view of these caveats and the ongoing debate over the exact role of openness and financial market development in economic growth, the results of the present study should not be viewed as conclusive empirical evidence, but rather as an additional motivation for further research in this area.

Appendices

APPENDIX A: OLS RESULTS

(A-1)
$$lnINDP = 4.5191 + 0.2242 lnCAPR + 0.2466 lnOPNES$$
(11.5192)*** (2.8898)** (3.7549)***

$$+ 0.1772 lnMXLR + 0.085 lnNMER - 0.0096 lnNMER_{(-1)}$$
(2.0397)** (1.2992) (–0.2532)

$$- 0.0608 lnINF + 0.0058 lnINF_{(-1)} + 0.2363 lnGDP$$
(–2.8602)** (0.2174) (3.9159)***

$$- 0.1572 lnGDP_{(-1)} + 0.0257 lnSEROL + 0.0065 lnSEROL_{(-1)}$$
(-2.1511)** (0.5259) (0.1266)

$$- 0.0130 lnSEROL_{(-2)} - 0.0589 lnSEROL_{(-3)}$$
(–0.3241) (–0.9895)

$\bar{R}^2 = 0.9245$; DW = 2.7771
F = 20.252; S.E of Regression = 0.054
*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

(A-2)
$$\Delta lnINDP = 0.0147 + 0.3187 \Delta lnCAPR + 0.3158 \Delta lnOPNES$$
(1.2974) (3.5140)*** (3.2108)***

$$+ 0.0139 \Delta lnMXLR + 0.0020 \Delta lnNMER + 0.0211 \Delta lnNMER_{(-1)}$$
(0.2322) (0.0330) (0.3568)

$$- 0.0193 \Delta lnINF + 0.0509 \Delta lnINF_{(-1)} + 0.09629 \Delta lnGDP$$
(–0.8815) (2.23.2)** (0.8220)

$$- 0.2108 \Delta lnGDP_{(-1)} - 0.0625 \Delta lnSEROL - 0.1162 \Delta lnSEROL_{(-1)}$$
(–2.1137)** (–0.4743) (–0.7195)

$$+ 0.2169 \Delta lnSEROL_{(-2)} - 0.3064 \Delta lnSEROL_{(-3)}$$
(1.6612) (–2.5891)**

$R^2 = 0.5741$; DW = 2.8521
F = 3.3845; S.E. of Regression = 0.0677
*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.

APPENDIX B

$$Y_t = \sum_{i=1}^{n} a_i Y_{t-i} + \sum_{i-1}^{n} b_i X_{t-1} + e_t$$

Table (B -1)

Granger Test—Regression Results

I = 1, 2, 3,- - n; n =4

Y	X	a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4	CONST.	R^2	D.W.	F(8.15)
INDP	INF	.6991	.1242	.1706	–260	.0977	–.0039	.2958	–.06111	23.1698	.796	1.78	7.302
		(2.299)	(.345)	(.479)	(–.907)	(.419)	(–.014)	(1.228)	(–2803)	(1.785)			
INDP	OPNES	.8022	0.742	.2130	–.2168	–17.971	19.771	–41.951	21.176	23.493	.778	1.75	6.582
		(2.769)	(.222)	(.671)	(–.769)	(–.548)	(.586)	(–1.211)	(.632)	(1.584)			
INDP	MCAPR	.6881	.2174	.0363	–.1054	39.863	–173.17	–50.139	194.384	20.779	.789	2.006	7.000
		(2.824)	(.716)	(.123)	(–.449)	(.306)	(–1.271)	(–.324)	(1.296)	(1.604)			
INDP	NMER	.8030	.1143	–.1399	.0648	3.853	44.982	–172.25	112.91	21.045	.818	1.47	8.428
		(3.291)	(.383)	(–.464)	(.286)	(.056)	(.536)	(–2.113)	(1.791)	(1.238)			
INDP	GSP	.6705	.1571	.0780	–.1354	–.00001	–000004	.00006	.00009	25.814	.760	1.866	5.92
		(2.607)	(.478)	(.252)	(–.547)	(–.0238)	(–.0013)	(.0324)	(.0342)	(1.334)			
INF	INDP	.8683	–.5739	0.423	–.0820	.3153	.3707	–.7652	.4012	–16.796	.582	1.890	1.695
		(2.784)	(–1.554)	(.131)	(–.281)	(.775)	(.770)	(–1.606)	(1.045)	(–.967)			
OPNES	INDP	.3055	–.0498	–.0988	.1092	.0043	.0033	–.0020	–.0019	.1862	.485	1.891	1.058
		(1.071)	(–.140)	(–.328)	(.375)	(1.697)	(.114)	(–.711)	(–.781)	(1.443)			
MCAPR	INDP	.2808	.3476	.2568	–.4155	.0018	–.0028	.0002	.0046	–.0042	.673	2.163	0.597
		(1.204)	(.0425)	(.928)	(–1.55)	(.415)	(–.510)	(.040)	(1.095)	(–.180)			
NMER	INDP	.6828	–.0774	.2508	–.1731	.0069	–.0082	.0021	–.0089	.1115	.823	2.329	1.992
		(2.886)	(–.267)	(.892)	(–.796)	(.812)	(–.796)	(.206)	(1.140)	(1.901)			
GDP	INDP	.8173	–1.2222	5.5784	–2.8169	–2318	1341	–1183	213.69	143748	.998	1.484	3.75
		(3.964)	(–9.790)	(13.60)	(–2.692)	(–2.252)	(1.018)	(–.953)	(.216)	(1.856)			

F (8,15): Critical value at 5% = 2.64.
Critical value at 1% = 4.00.

APPENDIX C

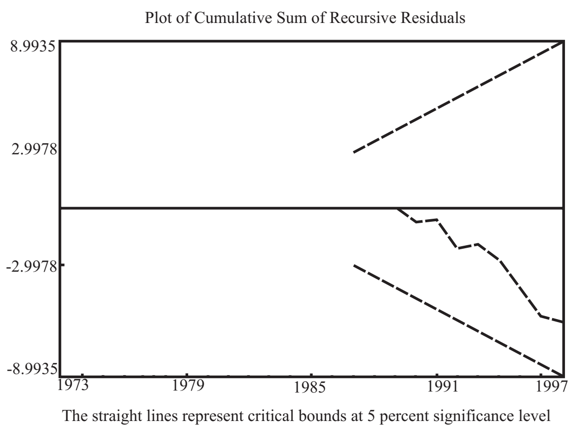

Fig. A.

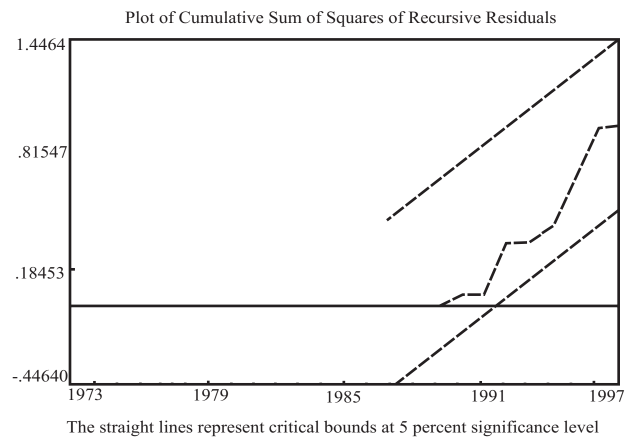

Fig. B.

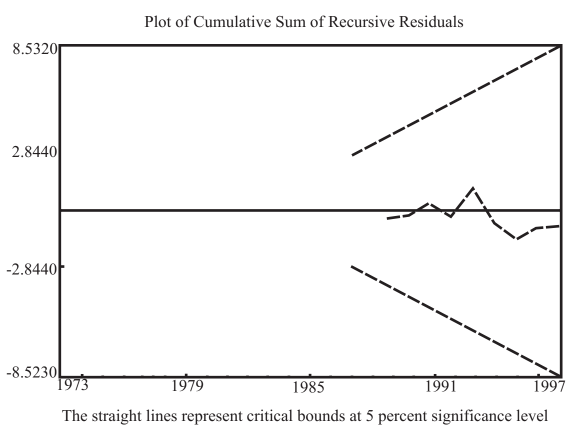

Fig. C.

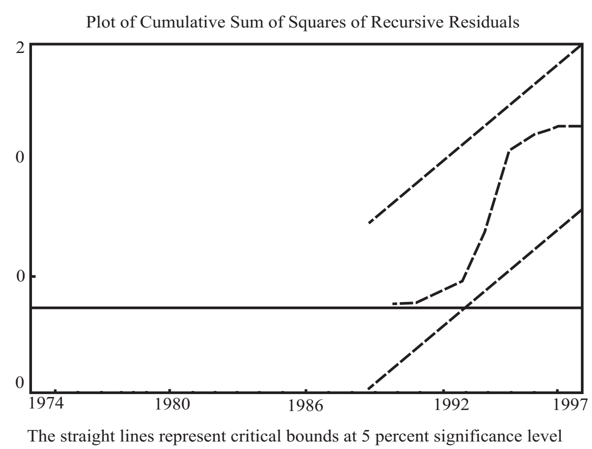

Fig. D.

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