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Trade Openness and Manufacturing Sector Performance in Nigeria

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How important is trade openness as a vehicle for driving productivity in developing countries? We offer a sector-specific analysis with focus on the manufacturing sector for meaningful policy insights. Using a modern econometric technique—the autoregressive distributed lag approach to cointegration—this article attempts to establish the relationship between openness to trade and manufacturing performance in Nigeria for the period 1970–2008. The results suggest that trade openness has a significant positive impact on manufacturing productivity in Nigeria both in the short and long run. These coefficient estimates are robust and stable over the time. Therefore, the policy direction for the manufacturing sector in Nigeria should focus more on open policies through trade liberalisation as a long-term plan. Reduction in trade restrictions and implementation of appropriate incentives are vital for resuscitating the performance of the sector. In this aspect, policy-makers should leverage the benefits of openness to the comparative advantages in the liberalised sector.

Keywords: *Trade Openness, Manufacturing Growth, Cointegration, Autoregressive Distributed Lag, Nigeria*
JEL Classification: *F41, C22, O55*

1. Introduction

Industrial development remains a driver of structural change and long-run growth for two reasons (Dijkstra, 2000; Zattler, 1996). First, industries (especially manufacturing) have higher productivity growth and technological development than other sectors of the economy, and also technological spillovers. Second, countries that neglect industry depend on primary exports which are subject to long-run deterioration of the terms of trade. However, the extent of

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industrialisation depends on the prevailing macroeconomic environment, the dynamic and complementary nature of economic policies targeted at shifting resources from low productivity to high-productivity sectors. One such policy is trade liberalisation.

Openness to trade in an economy has the potential of engendering productivity growth. Theoretically, various channels through which an open trade regime can lead to improvements in industrial productivity exist in the literature. The channels include access to better and cheaper technology, economies of scale and X-efficiency as a result of exposure to foreign competition. For instance, firms that operate in an open economy have access to foreign technology, adopt the best production techniques and produce on a more efficient scale. With access to foreign technology, economies of scale and spillover effects, openness to trade fosters competition among firms and provides markets for their exports. Enhancing competitiveness among firms for greater productivity is central to an open trade policy (Ekpo and Umoh, 2008).

While much controversy on the trade–productivity link remains, with some studies upholding a positive relationship (Dollar, 1992; Edwards, 1998; Jonsson and Subramanian, 2001; Sachs and Warner, 1995), others express doubts about the existence of such a relationship (Harrison and Hanson, 1999; Rodriguez and Rodrik, 1999), an examination of the nexus at a country-specific level using disaggregated industrial sector data becomes apt and an important alternative to cross-country panel data analysis which has shown mixed results. A sector-specific analysis accounts for the complexity of economic environment and histories of the sector. For example, Dutta and Ahmed (2001) and Chandran and Munusamy (2009) conducted a sector-level analysis and reported that trade openness is important to the industrial sector.

If trade openness matters, what then is its impact on the manufacturing sector in Nigeria? The objective of this article is to investigate the impact of trade openness at a sectoral level within the framework of Nigeria's manufacturing sector. The motivation for this article is twofold. First, scant empirical studies exist to analyse the effects of trade openness on the performance of the Nigerian manufacturing sector for better understanding and guidance for policy formulation. Second, we make a methodological contribution to the literature by adopting a recent cointegration test called the autoregressive distributed lag (ARDL) bounds test developed by Pesaran et al. (2001) which is robust in dealing with small sample observations, to establish the existence of a long-run relationship between variables.

The remainder of the article is organised as follows. Section 2 presents a theoretical and empirical review of the literature. Section 3 provides stylised facts on Nigeria's trade policy and manufacturing sector performance. Section 4 describes the model and data, while the methodology is discussed in Section 5. Section 6 presents the empirical results and Section 7 concludes with policy implications.

2. Literature Review

Two opposing views exist on the impact of trade liberalisation on industrial productivity. The first view is that opening of an economy through trade liberalisation will stifle industrial productivity by forcing infant industries to fold up due to foreign competition. The infant industry and export pessimism arguments, strengthened by Prebisch (1950), support the adoption of protectionist trade policies to protect infant industries and conclude that trade openness will promote unequal distribution of trade gains and deindustrialisation in developing countries. The other view favours an outward-oriented trade policy capable of improving productivity through efficiency in factor allocation with exposure to competition, and adoption of foreign technology in the production process.

In recent times, the latter view has become more persuasive and influential with robust theoretical arguments about the channels through which trade openness could increase industrial productivity. Basically, three arguments exist in the literature based on 'X-efficiency', 'technological catch-up' and 'economies of scale' (see, for example, Edwards, 1998; Haddad, 1993; Tybout, 2000). The crux of the X-efficiency (technical efficiency) argument is that trade liberalisation will induce competition and precipitate a 'challenge-response' mechanism forcing the adoption of new technologies by domestic industries and therefore, a reduction in 'X-inefficiency' and costs generally. X-inefficiency is interpreted as a form of managerial slackness on the part of firms due to insufficient competition in a closed trade regime. Under the neoclassical model with assumptions of perfect competition, the analysis is straightforward. Firms in the previously protected industry will now face lower prices, and therefore move down the short-run supply curve. In the long-run, the supply curve will shift downwards as firms adjust under pressure to lower costs through investment in new technology. Alternatively, firms that are unable to lower costs in line with the new lower long-run price will be forced to exit the industry.

The technological catch-up thesis posits that exposure to foreign competition following trade liberalisation will facilitate technological diffusion and influence the pace and direction of technical change through firm-level technological development. With easier access to cheaper and high-quality foreign technologies, and intermediate and capital goods, trade liberalisation offers an avenue for increasing industrial productivity. For example, lowering of trade restrictions allows the importation of superior technology and intermediate and capital goods which help reduce costs and increases productivity growth in the sector. However, a firm's ability to make such investments depends on access to knowledge and financing which may not improve with liberalisation (Paus et al., 2003).

Lastly, trade liberalisation may improve productivity through economies of scale (or scale efficiency). The rationale is simple. Trade liberalisation changes the relative price ratio between exportables and import substitutes in favour of the exportable sector, making exports relatively more attractive. For example, lowering of export restrictions eliminates anti-export bias of the previous protection era allowing for the flow of resources and capacity utilisation in the sector while offering greater incentives for producers to sell on the international market. Aside from the scale effects, increased exports can enhance productivity through increased awareness of best-practice technology and production techniques abroad (Paus et al., 2003).

These arguments provide justification for freer trade policies in the mould of outward-looking trade reforms. Continued protection of industries from foreign competition will severely hinder X-efficiency, and also limit the adoption of new technologies and the exploitation of economies of scale. In effect, technical change will be hindered and productivity will decline or stagnate.

The debate on the relationship between trade openness and productivity has been bolstered by significant improvement in the new growth theories as discussed by Grossman and Helpman (1991), Lucas (1988) and Romer (1986). With the assumption of endogenous technological change, the trade–productivity link can be analysed within the framework of the new growth theories. Empirically, the relationship between trade openness and productivity has been investigated at two broad levels: aggregate and disaggregate.

Aggregate studies (mostly cross-country) have examined the impact of trade openness on productivity without exploring the underlying casual mechanisms. However, evidence from the literature remains mixed. One strand of the literature has found that openness fosters growth (Dollar, 1992; Edwards, 1998; Greenaway et al., 1998; Sachs and Warner, 1995, among others), while the other is sceptical about such positive relationship (Harrison, 1996; Levine and Renelt, 1992; O'Rourke, 2000; Rodriguez and Rodrik, 1999, among others) due to varying methodologies such as variable measurement, model specification and estimation technique. For example, Rodriguez and Rodrik (1999) provide a critique of these studies on the grounds of not controlling adequately for other economic policies. They opined that measures of 'trade policy' as used by these studies capture more than just trade policy, or possible omission of relevant control variables. Since economic policies are highly correlated, disentangling their specific effects will be difficult in an econometric analysis.

At disaggregated levels of plants, firms and industries (sectors), the trade openness–productivity link has been studied with varying methodologies. Here, the scale and technical efficiency dimension of industrial performance are examined along with productivity levels and growth. Jayanthakumaran (2002) provides a survey of the literature on the impact of trade liberalisation on manufacturing sector performance in developing countries. Using the multiple regression framework, the effect of changes in trade policy variables on manufacturing performance has been examined for the following countries: Thailand (Urata and Yokota, 1994); Cote d'Ivoire (Harrison, 1994); Mexico (Iscan, 1998; Tybout and Westbrook, 1995); South Korea (Kim, 2000); Peru (Alam and Morrison, 2000); and Ecuador (Wong, 2009), among others. All confirm a strong positive relationship between trade policy measures and productivity.

Kim (2000), for example, explored the link between trade openness and total factor productivity growth in Korean manufacturing at a disaggregated level. Employing a number of policy measures of openness (legal rates of tariff, coverage ratios of quotas and nominal rates of production) within the underlying assumption of imperfect competition and non-constant returns to scale, he found that trade liberalisation impacted positively on productivity performance, though the productivity increase was not significant since trade liberalisation was not substantial enough in Korea. Studies such as Dodzin and Vamvakidis (2004) and Paus et al. (2003) also corroborate the evidence of a positive correlation between trade and productivity measures.

Others have incorporated recent advances in time series analysis to examine the relationship. For example, Dutta and Ahmed (2001) examined the relationship between trade liberalisation and industrial growth in Pakistan using cointegration analysis within the endogenous growth model framework. Using two measures of trade liberalisation, namely, an outcome-based measure (real export) and incidence-based measure (average import tariff collection), the study found a significant relationship between the measures of trade liberalisation and growth of the industrial sector value added. Chandran and Munusamy (2009) used time series data from 1970 to 2003 to investigate the long-run relationship between trade openness and manufacturing growth in Malaysia. They adopted a recent cointegration test called the bounds testing to establish if the variables are co-moving. They found that openness to trade had a positive significant effect on manufacturing value added, particularly in the long run, thus emphasising the benefits of openness as a long-term affair.

For Nigeria, evidence on this link is scant. Chete and Adenikinju (2002) undertook a firm-level study of the impact of trade liberalisation on productivity growth in the manufacturing sector between 1988 and 1990. They found trade liberalisation to be growth-enhancing. Adebiyi and Dauda (2004) investigated the relationship between trade liberalisation and industrial sector performance using an error correction mechanism (ECM) technique on annual data from 1970 to 2002 and found trade liberalisation, measured as degree of openness, to be a significant determinant of industrial production in Nigeria. Adewuyi (2006) examined the impact of trade policy reform on technical efficiency in the manufacturing sector utilising panel data for 10 manufacturing sub-sectors over selected trade liberalisation episodes covering the period before, during and after the implementation of the structural adjustment programme (SAP). Technical efficiency measures were obtained using the non-parametric technique—Data Envelopment Analysis (DEA). He found trade policy measures to have fostered technical efficiency in the sector.

Consequently, this study follows Chandran and Munusamy (2009) in adopting a sector-specific analysis with the application of recent bounds testing approach to cointegration analysis in examining the link between trade openness and manufacturing sector performance for a possible long-run relationship.

3. Trade Policies and Manufacturing Performance in Nigeria: Stylised Facts

3.1 Overview of Nigeria's Trade Policies

Trade policies are used to influence the direction of a country's trade regime for the promotion of economic growth. Broadly, the objectives of trade policies, particularly in a developing economy, are: revenue generation; protection of domestic industries; protection of the trade balance position; maintenance of price stability; and overall enhancement of domestic economy linkages through the adoption of tariff and non-tariff measures. For Nigeria, the design of her trade policies has been influenced by two opposing development paradigms: import-substitution strategy and export-promotion strategy, which run between trade restrictions and liberalisation, respectively. Between

1960 and the mid-1980s, Nigeria adopted a restrictive trade regime, and later switched to a more liberalised regime (which it still maintains) after adopting the SAP.

The thrust of trade policy in the 1960s was on revenue generation and protection of domestic industries, consistent with the import-substitution strategy of the time, to stimulate industrial development. Both tariff and non-tariff measures such as quantitative restrictions and import duties were placed on several items, and in some cases outright prohibition. For instance, commodities like textiles, beverages and tobacco had tariffs as high as 120 per cent (Chete and Adenikinju, 2002; Kayode and Teriba, 1977). The demands for post-war reconstruction after the civil war in 1970 made trade policies less restrictive. Restrictions were relaxed on items such as raw materials, spare parts, agricultural equipment and machinery. Import surcharge was reduced from 7.5 per cent to 5 per cent, while import licensing was abolished for certain specific commodities.

Similarly, the oil boom of the early 1970s, which ushered in a favourable balance of payments position, shifted the source of government revenue from tariffs to crude oil. However, the less restrictive trade regime was maintained and import duties were substantially reduced on a wide range of commodities, industrial raw materials, food and other consumables. For example, duties on industrial raw materials were reduced to a uniform rate of 10 per cent in 1974 and that of building materials was slashed by 60 per cent. The licensing requirements as well as import and excise duties on food and other commodities associated with agriculture and food-processing activities were considerably cut (Chete and Adenikinju, 2002). However, nominal tariff rates were raised in 1977 on a wide variety of imported finished goods such as clothing, flash batteries and electric filament, as government sought to: encourage the growth of local industries; alter the consumption pattern towards locally made goods; prevent the depletion of foreign exchange reserves; and prevent dumping of stale products in the country. Duties on cars of capacity between 2,000 cc and 2,500 cc increased from 100 to 150 per cent and the import of cars above 2,500 cc was banned; the duty on adult shoes increased from 50 to 100 per cent and on primary flash batteries, from 40 to 75 per cent.

Between 1976 and 1978, further trade restrictions were placed on 82 items, including cigarettes, live poultry, textile fabrics of all types, ornaments, bottled beer and stout, jewellery, etc., trade of which was absolutely prohibited due to persistent balance of payments deficits occasioned by dwindling oil revenue. With persistent external disequilibrium, the government promulgated the Economic Stabilization (Temporary Provisions) Act in 1982 which imposed a blanket ban on 'non-essential' imports. Consequently, tariffs on 49 items were raised with prohibition on gaming machines and frozen poultry. Compulsory advance deposits (CAD) for imports were imposed on certain classes of imports and 152 additional commodities were brought under specific import licence (SIL). For instance, the open general licence (OGL) was abolished and the industrial materials (or intermediate goods) under it were moved under SIL. The objective was to intensify the use of local raw materials in industrial production. In addition, foreign exchange regulations became more stringent with the promulgation of the Foreign Exchange Anti-Sabotage Decree in 1984.

From 1986, there was a dramatic policy shift from erstwhile protectionist trade policies towards greater liberalisation. This was occasioned by the adoption of the SAP. Two important policy developments marked the SAP period: the institution of a flexible exchange rate mechanism; and adoption of a comprehensive tariff system (Adewuyi, 2006; Chete and Adenikinju, 2002). The rationale was, in part, to reduce the uncertainties which characterised the policy environment for long-term investor decisions. A new tariff system, Customs, Excise, Tariffs, etc. (consolidated) Decree, promulgated in 1988, provided for a seven-year (1988–94) tariff regime and was succeeded by another seven-year (1995–2001) tariff regime established by Decree No. 4 of 1995. The thrust of the tariff structure over the period 1988–2001 was to reduce duties on imported finished goods while lowering tariffs on intermediaries.

Currently, trade liberalisation is rigorously pursued with the aim of enhancing the competitiveness of domestic industries through the promotion of local value added and export diversification. Current reform packages are designed to allow a certain level of protection of domestic industries with relative application of high import duties on finished goods that compete with local production. As a result, tariff rates are widely dispersed, ranging from 2.5 per cent to a maximum of 150 per cent, with high effective rates in several sectors and lower import duties on raw materials and intermediate goods unavailable locally (Briggs, 2007).

3.2 Structure and Performance of Nigeria's Manufacturing Sector

Nigeria's manufacturing sector encapsulates a wide range of industrial activities, from informal sector enterprises with simple technology application to heavy capital goods industries within the automotive and electrical equipment sector. However, the production of consumer goods—textiles, beverages, soaps and detergents, woods and woods products—dominates the manufacturing profile.

These have been reinforced by a perverse structure of incentives that favoured the growth of import-intensive consumer goods against the capital goods sector, and localisation of assembly and final processing of relatively simple products (Chete and Adenikinju, 2002). As a result, the manufacturing sector has remained heavily import-dependent.

The structure of manufacturing production has been a derivative of the various development plans (Chete and Adenikinju, 2002). The First National Development Plan (1962–68) emphasised the establishment of light industries and assembly plants. The outcome was the production of machine tools, kitchen utensils, electric fans and vehicle assembly. The Second National Development Plan (1968–75) had a similar thrust with revenue generation as its objective through the promotion of exports industries as its central focus. The Third National Development Plan (1975–80) shifted emphasis to heavy industries with projects in the steel and petroleum refining sub-sectors becoming dominant. The Fourth National Development Plan (1980–85) was in consonance with the third, but was later jettisoned (for example, the iron and steel sub-sector) due to the profound economic crisis of the 1980s.

To offer insights into the performance of the manufacturing sector, Table 1 shows the contribution of various sectors in Nigeria's gross domestic product (GDP) profile between 1960 and 2008. Starting with a modest 4.5 per cent in 1960, the contribution of manufacturing rose to 7.5 per cent in 1970 before nosediving to 4.3 per cent in 1975. In 1980, it surged to a record high of 11.1 per cent, and later declined to 8.6 per cent in 1985. This performance was maintained up to 1990 which coincided with the SAP period, and thus it can be inferred, tentatively, that trade liberalisation led to an improved output contribution of the sector during the period 1985–90. However, the contribution of the manufacturing sector since 2000 has not exceeded 4 per cent which indicates the sector's dwindling performance.

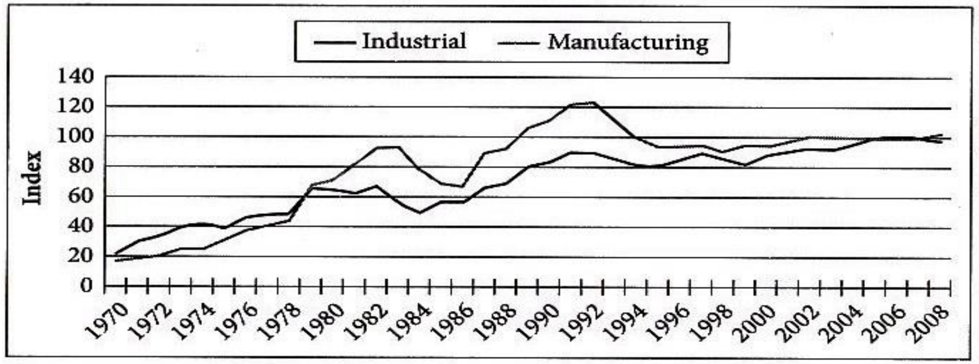
For more insights on manufacturing output performance, Figure 1 shows trends in Nigeria's index of industrial and manufacturing production between 1970 and 2008. The latter index increased from 17.13 per cent in 1970 to 94.44 per cent in 1983. However, a decline was recorded from 78.17 per cent in 1984 to 67.18 per cent in 1986 due to the collapse of the international oil market and the economic crisis that ensued afterwards. The adoption of a basket of SAP policies such as trade liberalisation and reductions in tariffs led to an upswing from 89.78 per cent in 1987 to 124.18 per cent in 1992 exceeding the production index for 1983. Since 1993, the index of manufacturing production has shown slight volatility with a marginal increase particularly from 2001.

Table 1 Sectoral Composition of GDP in Nigeria, 1960–2008

Sector	*1960*	*1970*	*1975*	*1980*	*1985*	*1990*	*1995*	*2000*	*2005*	*2008*
Agriculture	64.3	44.7	28.1	20.6	32.7	31.9	34.2	35.8	41.2	42.1
Industry (including Mining)	5.8	19.4	27.4	34.6	42.3	43.2	38.4	36.9	28.3	21.7
Crude Petroleum & Natural Gas	0.4	11.1	21.2	21.4	35.8	37.4	33.2	32.4	24.2	17.3
Manufacturing	4.5	7.5	4.3	11.1	8.6	8.1	6.6	4.2	3.7	4.1
Building and Construction	4.4	5.2	7.1	9.6	1.6	1.6	1.8	1.9	1.5	1.8
Wholesale and Retail Trade	12.4	12.1	21.1	20.1	13.8	13.3	13.9	13.1	13.7	17.4
Services	12.9	18.4	16.2	15.1	9.4	10.2	11.5	12.1	15.2	16.8

Source: Computed from Central Bank of Nigeria (CBN, 2010).

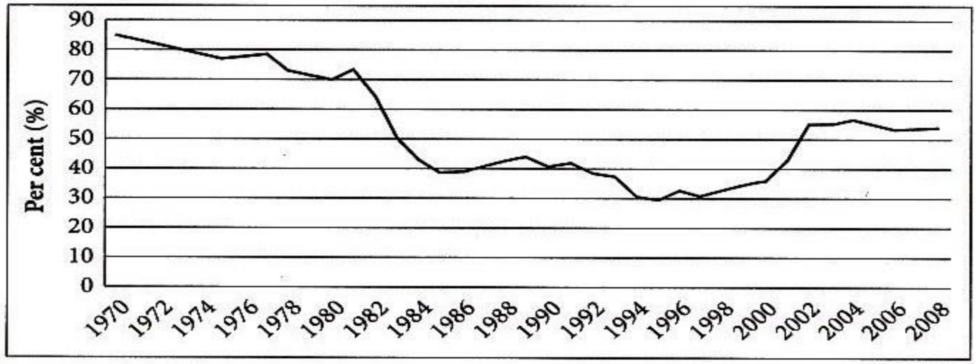
Figure 1 Nigeria's Index of Industrial Production, 1970–2008



Source: International Monetary Fund (IMF, 2010).

The performance of the manufacturing sector between 1970 and the early 1980s can be attributed largely to the effect of the oil boom, and the government's restrictive trade policy and its active participation in the industrialisation process (Adewuyi, 2006; Soludo and Adenikinju, 1996). In addition, the capacity utilisation level was high throughout this period due to domestic market expansion and currency overvaluation. Figure 2 shows the trend in Nigeria's average capacity utilisation which continually declined from above 80 per cent in 1970 to 30 per cent in 1994, resulting in low value added and high production costs in the sector. From 2002, the average capacity utilisation has been slightly

Figure 2 Nigeria's Average Manufacturing Capacity Utilisation, 1970–2008



Source: CBN (2010).

above 50 per cent. This improvement is linked to supportive policy measures such as a temporary ban on imported goods that can be produced locally and lowering of the cash reserve requirement for banks to fund activities in the real sector.

Although manufacturing has had its own misfortunes, Edo (2002) opines that the unstable investment environment (which has stifled foreign investment), neglect of the sector following the resource sector boom, exchange rate fluctuations and changes in the lending rate have seriously affected the sector's performance over time. The latter two factors have resulted in low capacity utilisation following the high cost of importing raw materials and inaccessibility to finance for expansion activities, respectively. This corroborates the idea that initial macroeconomic conditions prevailing in a country and complementarity in macroeconomic policies can affect industrial productivity.

4. Model Specification and Data

Following the objective of this article, we examine along with trade openness, the impact of some complementary policies on Nigeria's manufacturing performance by specifying a multivariate model as follows:

$$imp_t = f(irs_t, exr_t, open_t, dsap_t) \quad (1)$$

where imp_t is the index of manufacturing production; irs_t is the interest rate spread; exr_t is the nominal exchange rate; $open_t$ is trade openness; and $dsap_t$ is a dummy variable for the SAP. The dummy variable, $dsap_t$, is assigned one for the period of structural adjustment and zero for other periods. With the exception of $dsap_t$, all other variables are expressed in their logarithm form.

Annual data from 1970–2008 are used for the estimation. The series on the index of manufacturing production and exchange rate were obtained from the IMF's *International Financial Statistics* CD-ROM (2010). Trade openness measured as the ratio of exports plus imports to GDP was obtained from the Penn World Table Version 7.0 (PWT 7.0) of Heston et al. (2011) at the Center for International Comparisons, University of Pennsylvania. The interest rate spread, which is the difference between the lending and deposit rates, was retrieved from World Bank's *World Development Indicators* (2011).

A priori, the interest rate spread is expected to have a negative effect on manufacturing performance. The logic is simple. Monetary policy which engenders high interest rates (lending rates) discourages investment, which in turn affects capacity utilisation and hinders technological change and productivity. The wide spread between lending and deposit rates indicates that the interest rate is high, and also reflects accessibility and affordability of the interest rate.

The exchange rate effect is ambiguous due to its effect on exports and imports. A depreciation of the exchange rate induces export growth, as it corresponds to a fall in the relative prices of the tradable sector. Export growth, in turn, propels a shift of productive factors into the export sector which is now considered more efficient than others, thus enhancing productivity. On the import side, the cost of imported capital goods is increased, along with production costs. The reverse holds for an appreciation of the exchange rate. In actual fact, the prior sign should be negative such that a depreciation will increase industrial productivity through export growth while appreciation will reduce it via import growth.

The trade openness effect is expected to be a positive impact based on the identified theoretical channels of X-efficiency, cheaper technology and economies of scales highlighted earlier.

5. Methodology

In the last two decades, several econometric procedures have been employed for the testing of cointegration in a model. Cointegration describes the existence of an equilibrium (stationary) relationship between two or more time series. It also allows the integration of both long and short-run relationships between variables in a unified framework. The univariate cointegration approaches of Engle and Granger (1987) and Phillips and Hansen (1990), and the multivariate cointegration procedures of Johansen (1988) and Johansen and Juselius (1990), have been used extensively in the literature. Recently, the cointegration approach by Pesaran et al. (2001), known as the ARDL bounds testing, has become popular among researchers.

We use the ARDL bounds testing procedure to test for a long-run equilibrium relationship between the manufacturing index of production and the explanatory variables of trade openness and other determinants. The ARDL has several advantages over other cointegration techniques (Pesaran et al., 2001). First, it is applicable irrespective of whether the underlying regressors are purely *I(0)*, purely *I(1)* or fractionally integrated. Second, the model uses a sufficient number of lags to capture the data-generating process in general to the specific modelling framework. Third, the error correction model is derivable from the ARDL through a simple linear combination, which integrates both short-run adjustments with long-run information without losing the latter's information. Fourth, the small samples properties of the ARDL procedure are far superior to those of the multivariate cointegration techniques. Fifth, endogeneity and serial correlation problems are corrected through appropriate lag selection.

The ARDL procedure involves the estimation of equation (1) as follows:

$$imp_t = \beta_0 + \sum_{i=1}^{p} \delta_i \Delta imp_{t-i} + \sum_{i=1}^{p} \vartheta_i \Delta irs_{t-i} + \sum_{i=1}^{p} \phi_i \Delta exr_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta open_{t-i} + \lambda_1 imp_{t-1} + \lambda_2 irs_{t-1} + \lambda_3 exr_{t-1} + \lambda_4 open_{t-1} + \Psi dsap_t + \mu_t \quad (2)$$

where β_0 and μ_t are the drift component and error term, respectively, while Δ is the first difference operator. The terms with summation signs represent the error correction dynamics, while the second part of the equation with λ_i corresponds to the long-run relationship. The first step in the ARDL bounds test involves examining the existence of a long-run relationship between the variables through the Wald-type (F-test) coefficient restriction test. This entails testing the null hypothesis in equation (2) as $H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$. This indicates the absence of a long-run relationship. The alternative hypothesis is $H_1: \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq 0$.

The computed F-statistics is compared with two sets of critical values suggested by Pesaran et al. (2001). The critical values provide the critical bounds for all classification of the regressors into purely *I(0)*, purely *I(1)* or fractionally integrated. If the computed F-statistics exceed the upper critical value, the null hypothesis of no cointegration is rejected irrespective of the order of integration of the variables. If it is below the lower critical value, the null hypothesis of no cointegration cannot be rejected. If it lies within the critical value bounds, the test is inconclusive. The choice of the optimal lag length is made using an appropriate lag selection criterion—either the Schwartz Bayesian information criterion (SBIC) or the Akaike information criterion (AIC). The SBIC is known as a parsimonious model selecting the minimum possible lag length, while the AIC selects the maximum relevant lag length.

As a second step, the long-run relationship using the selected ARDL model is estimated through AIC or SBIC. Once a long-run relationship exists among the variables, there is an error correction representation.

The third step involves the estimation of the following error correction model:

$$\Delta imp_t = \beta_0 + \sum_{i=1}^{p} \delta_i \Delta imp_{t-i} + \sum_{i=1}^{p} \vartheta_i \Delta irs_{t-i} + \sum_{i=1}^{p} \phi_i \Delta exr_{t-i} + \sum_{i=1}^{p} \varphi_i \Delta open_{t-i} + \lambda_1 imp_{t-1} + \lambda_2 irs_{t-1} + \lambda_3 exr_{t-1} + \lambda_4 open_{t-1} + \Psi dsap_{t-1} + \mu_t \quad (3)$$

where the error correction term, ecm_{t-1}, captures the speed of adjustment back to long run after a short-run shock.

The goodness-of-fit of the model is evaluated by conducting diagnostic and stability tests. The diagnostic tests examine the model for serial correlation, functional form specification, normality and heteroscedasticity. The stability of the model is evaluated using Brown et al. (1975) cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) statistics. These statistics are updated recursively and plotted against the break points. The null hypothesis of all coefficients in the regression is considered stable and cannot be rejected if the plots of the CUSUM and CUSUMSQ lie within the critical bounds of a 5 per cent significance level.

6. Empirical Results

6.1 Unit Roots Testing

We examined the order of integration of the selected variables. Although the ARDL bounds test is applicable irrespective of whether the variables are purely *I(0)*, purely *I(1)* or fractionally integrated, the presence of the *I(2)* variables renders the computed F-statistics by Pesaran et al. (2001) invalid. This is because the bounds test assumes that the variables are either *I(0)* or *I(1)*. Therefore, unit root testing becomes mandatory to ensure that no variable is integrated at an order *I(2)* or beyond. The conventional Augmented Dickey–Fuller (ADF) test of Dickey and Fuller (1981) is used along with the Phillips and Perron (PP) (1988) unit roots test which allows a mild assumption on the distribution errors and controls for higher serial correlation and heteroscedasticity.

Table 2 presents both the ADF and PP tests for all variables at levels and first differences.

Table 2 Unit Root Test

	ADF		*PP*	
Variables	*Level*	*First Difference*	*Level*	*First Difference*
imp	–3.4223**	–4.5134*	–3.4223**	–4.528*
irs	–1.9903	–6.071*	–2.026	–6.0991*
exr	0.0147	–5.4367*	–0.0412	–5.4311*
open	–2.3262	–7.9151*	–2.2262	–7.8021*

Source: Computed by the authors.

Notes: Critical values are from MacKinnon (1996) one-sided p-values; * and ** denote significance at the 1 per cent and 5 per cent levels, respectively.

The unit root test shows that the variables (*irs, exr, open*) were non-stationary at levels and became stationary after first differencing. Therefore, the variables are integrated at *I(1)*. The index of manufacturing production variable, *imp*, is stationary at both levels and first differences, which implies that it is integrated at both *I(0)* and *I(1)*.

6.2 Cointegration Analysis

We tested for the presence of a long-run relationship between the variables using the bounds testing approach. The lag length selection was determined using the SBIC. Due to small sample size, a maximum lag length of four was allowed in which the optimal length was found to be two. Bounds testing was carried out by estimating Equation (2) through the ordinary least squares (OLS) procedure and computed the F-statistics for the joint significance of the lagged levels of variables to compare with the critical values provided in Pesaran et al. (2001). As presented in Table 3, the computed F-statistics of 6.248 exceeds both the lower and upper critical values, respectively, at various levels of significance. Therefore, a long-run relationship exists among the variables in Equation (1).

6.3 Long-run and Short-run Estimates

Having found a long-run relationship between the variables, we proceed to estimate the long-run coefficient estimates in Equation (2). The long-run elasticities were estimated based on the SBIC, with ARDL [1,0,0,0] found to be the optimal model and the results presented in Table 4. In the long-run, interest rate spread (*irs*) has a significant negative impact on manufacturing

Table 3 ARDL Cointegration Test

	Critical Bounds for the F-Statistic					
	90% level		*95% level*		*99% level*	
k	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
3	2.72	3.77	3.23	4.35	4.29	5.61
Calculated F-statistic: *F(imp|irs, exr, open)* = 6.2482*						

Source: Computed by the authors.
Notes: Critical values are obtained from Pesaran et al. (2001: Table C1.iii: Case III), with unrestricted intercept and no trend. K is the number of regressors; * indicates a 1 per cent (99 per cent) level of significance; the dummy variable is not included.

Table 4 ARDL Long-run Estimates

	Dependent Variable: imp	
Variables	*Coefficient*	*t-statistics*
irs	–0.2857**	–2.5014
exr	0.1285*	3.1176
open	0.7591*	2.7951
dsap	0.3285**	2.2432
constant	1.4456	1.5610

Source: Computed by the authors.
Note: * and ** indicate 1 per cent and 5 per cent significance levels, respectively.

production in Nigeria. Thus, an increase in the spread (due to an increase in the lending rate) is inimical to the performance of the manufacturing sector as it discourages accessibility to credit from financial institutions. Specifically, the magnitude of –0.285 implies that a 1 per cent increase in the interest rate spread decreases manufacturing production by –0.285 per cent. Trade openness (*open*) has a significant positive impact on Nigeria's manufacturing sector. This justifies the trade liberalisation policy undertaken during the structural adjustment era and its subsequent post-SAP consolidation. A 1 per cent increase in trade openness increases the manufacturing index of production by 0.759 per cent. The magnitude of the trade openness coefficient shows its influence in the sector during the period of analysis. This result is in line with Chandran and Munusamy (2009) for Malaysia, Dutta and Ahmed (2001) for Pakistan and Adebiyi and Dauda (2004) for Nigeria.

The exchange rate (*exr*) has a significant positive impact on manufacturing production. Specifically, a 1 per cent depreciation in the exchange rate reduces the index of manufacturing production by 0.128 per cent. This runs contrary to the a prior expectation. A simple explanation in this case is that a change in the exchange rate (for example, depreciation) does little to stimulate export growth due to the narrow export base of the sector which is highly import dependent on raw materials. Hence, the import growth effect tends to cancel out that of export growth, thus increasing production costs and reducing productivity. The size of the elasticity indicates that the relationship between manufacturing production and the exchange rate in the long run is relatively inelastic. The impact of the dummy variable for the SAP is positive and statistically significant. This implies that policies undertaken during the structural adjustment era impacted positively on the production performance of the sector, though its effect is marginal (that is, 0.328 per cent).

Table 5 ARDL Short-run Estimates

Dependent Variable: Δ imp		
Variables	*Coefficient*	*t-statistics*
Δ *irs*	–0.1975*	–2.8746
Δ *exr*	0.0905**	2.5706
Δ *open*	0.6159*	3.3143
dsap	0.2911**	2.2225
ecm_{t-1}	–0.5472*	3.5261
Constant	1.3689*	3.1876

Diagnostic tests:

$R^2 = 0.493$, $\sigma = 0.359$

$\chi^2_{norm} = 0.2516$, $\chi^2_{auto} = 0.1730$, $\chi^2_{reset} = 0.5349$, $\chi^2_{white} = 0.9116$

Source: Computed by the authors.

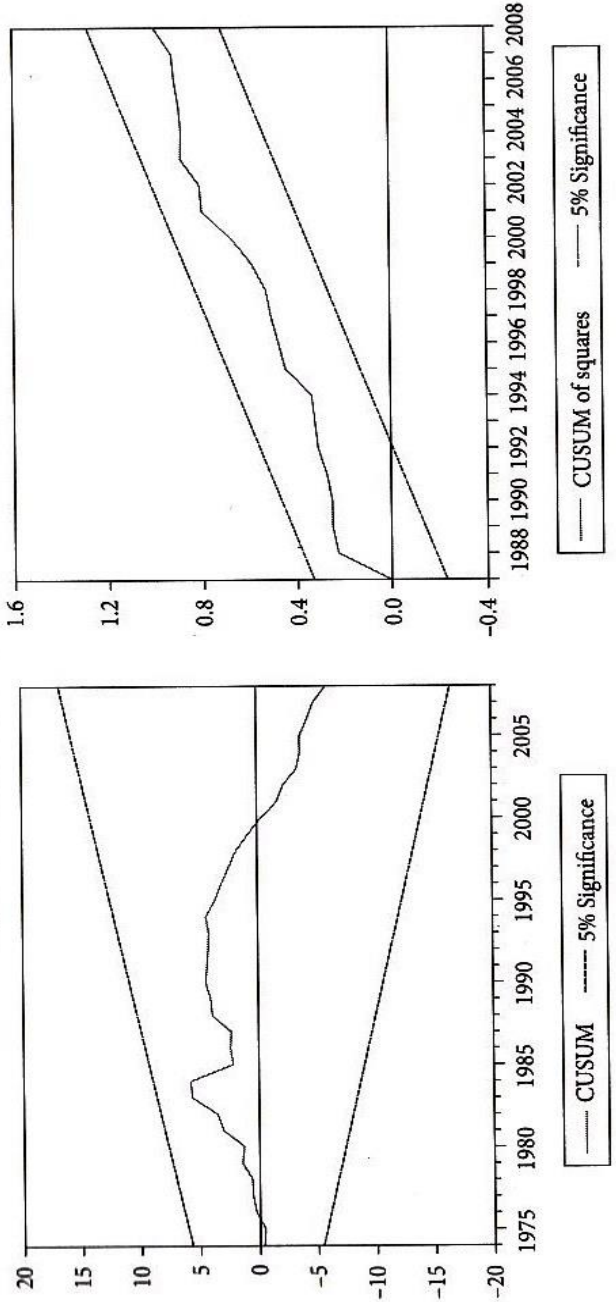
Notes: (*i*) * and ** indicate 1 per cent and 5 per cent significance levels, respectively.
(*ii*) *Norm*, *auto*, *reset*, *white* stand for normality, serial correlation, functional form and heteroscedasticity, respectively.
(*iii*) σ is the standard error of regression.

Next, we estimate Equation (3) for the short-run estimates of the model. We used the R^2 criterion, AIC and SBIC to determine the parsimonious short-run model. Table 5 presents the result for the short-run model. All explanatory variables exert a statistically significant impact on the manufacturing index of production. Unlike the long-run estimates, the magnitude of the short-run estimates is smaller. This implies that the variables have a stronger impact in the long run.

The parameter (η) for the lagged error correction coefficient, ecm_{t-1}, is negative and statistically significant, thus verifying the established cointegrating relationship between the variables. As a measure of the speed of adjustment back to long-run equilibrium following a shock, its coefficient of 0.547 implies that nearly 54.7 per cent disequilibrium in the manufacturing index of production of the previous year's shock adjusts back to long-run equilibrium in the current year.

The diagnostic tests for the short-run error correction model are presented in Table 5. The tests for normality of residuals, serial correlation, heteroscedasticity and functional form specification show no significant evidence of any deviation from the standard assumptions. The CUSUM and CUSUMSQ statistics for the stability of the short-run model parameters are all within the critical bounds as presented in Figure 3. Thus, all coefficients in the short-run error correction model are stable and can be used for forecasting.

Figure 3 CUSUM and CUSUMSQ Plots for Stability Tests



Source: Computed by the authors.

7. Conclusion and Policy Implications

This article attempts an investigation of the impact of trade openness, along with some control variables (interest rate spread and exchange rate), on the performance of the manufacturing sub-sector in Nigeria using time series data from 1970 to 2008. Using the recent cointegration technique of Pesaran et al. (2001), known as the ARDL bounds test, we determine whether a long-run relationship exists between the manufacturing index of production, interest rate spread, exchange rate and openness to trade. This methodology provides reliable and robust estimates in small sample sizes, such as for the present article. The long-run estimates and the short-run dynamics derived from the ECM are validated by the diagnostic tests and the parameter stability test.

The significance of the long-run coefficient of trade openness clears any ambiguity of whether trade openness promotes growth in manufacturing, especially in the case of Nigeria. With the available market in Nigeria, opening to trade will allow manufacturing firms in the sector to enjoy economies of scale with significant expansion in their scale of production to achieve growth. In addition, with the focus of the government's industrial policy on encouraging private sector involvement in the sector, openness to trade will encourage new entrants into the sector with significant technology transfer from abroad. The embedded technologies and technical know-how remain invaluable towards resuscitating and spurring the export performance of the manufacturing sector, and as viable options from tapping into the global market and learning from other countries via open trade policy.

The policy direction for the Nigerian situation should focus on more open policies as a long-term plan. The pursuit of outward-looking strategies should be strengthened depending on the comparative advantages in the liberalised sector and as a cushion against vulnerability impacts of the exports and imports market. In pursuance of the liberalisation policy, efforts must be made to reduce if not eliminate anti-trade bias in the form of export restrictions and import protection. While advocating for more open trade policies, we join Rodrik (2001) in stressing that '...no country has developed simply by opening itself up to foreign trade and investment'. What is required, therefore, is the provision of a conducive macroeconomic environment that combines the opportunities offered by trade openness to stimulate domestic productivity.

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