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Impact of Nigeria's importation of electrical power machinery and iron and steel from South Africa on the manufacturing sector output of Nigeria

Ogechi Hope Njoku

[1,2,3] University on the Niger, Umunya campus, Anambra State, Nigeria

Corresponding author's email: ogechih026@gmail.com

ABSTRACT

The study adopted the import-led and export-led growth theories, arguing that imports of capital goods and exports of commodities can stimulate productivity and economic growth. Using a modified Cobb-Douglas production framework and annual time series data from 1996–2023, the study specified an ARDL model, the study specified an ARDL model to examine how Nigeria's imports of electrical power machinery and iron and steel from South Africa affected manufacturing output. Unit root, cointegration, multicollinearity, autocorrelation, heteroskedasticity, and stability tests were conducted using E-Views 10. The results showed moderate correlations among the variables, with no coefficient exceeding 0.80, indicating absence of multicollinearity. The ARDL lag selection used Akaike Information Criterion, while the Bounds test confirmed cointegration since the F-statistic (4.437013) exceeded the 5% upper bound (3.38), implying a long-run relationship. Long-run estimates revealed that electrical power machinery imports positively influenced manufacturing output, while real exchange rate and GDP growth negatively affected it. In the short run, electrical machinery, iron and steel imports, and exchange rate significantly boosted output. Diagnostic tests confirmed no autocorrelation, no heteroskedasticity, and stable model parameters through the CUSUM test. The study concluded that imports of capital machinery and industrial materials from South Africa contributed positively to Nigeria's manufacturing sector, especially in the short run. It advised that Nigeria ought to maintain a situation of strategic importation of productive machinery and at the same time encourage production of steel locally, exchange rate stability, infrastructural growth and industrial policies that enhance the local manufacturing capability.

Keywords: Importation, Electric Power Machinery, Wire and Steel, Production of Manufacturing, ARDL, Nigeria, South Africa

INTRODUCTION

The importation of electrical power machinery and iron and steel by Nigeria, which are imported by South Africa, contributes greatly to the performance of the manufacturing sector in Nigeria (Chidera Adonike et al., 2022; Mhonyera & Meyer, 2023; Temitayo Jaiyeola, 2022). These imports are important inputs in the production of industries that affect capacity utilization, productivity, and the total output (Kamlasi et al., 2025; Mulyani et al., 2023; Wangwe et al., 2023). Although this kind of trade may boost the performance of the manufacturing sector by providing much-needed capital and intermediate products, there is the issue of dependence on imports and vulnerability of the local economy.

Industrial operations heavily rely on electrical power machinery, especially in a nation such as Nigeria where there is difficulty in supplying energy (Adeshina et al., 2024;

Chanchangi et al., 2023; Usman et al., 2022). Power equipment importation in South Africa also assists to reduce infrastructural shortcomings as the electricity generation and distribution capacity is enhanced in the manufacturing companies. Availability of quality machines increase efficiency in operations, minimize downtime and facilitate an increase in output. There is empirical evidence that capital goods importation is positively related to the productivity of the industry as it allows firms to adapt to better technologies and modern production processes (Agénor & Pereira da Silva, 2025; Fan & Li, 2025; Shiraj et al., 2025). The dependence on South African electrical equipment by Nigeria can be considered in this case as a strategic complement to the domestic industrialization.

In the same manner, imports of iron and steel are also the key raw materials in numerous manufacturing processes such as construction, vehicle assembly and production of machinery. The South African availability of quality steel inputs helps in the growth of the industry because it will not be hit by shortages in the materials needed to carry out production. Research shows that the importation of industrial inputs, including iron and steel, has a positive and direct effect on the output of manufacturing since it allows the continuity of production and improves the quality of products (Adela Nursafira et al., 2025; Cao et al., 2025; Mason et al., 2022). This has an implication on the manufacturing sector in Nigeria in the form of higher production capacity and competitiveness.

The adverse impacts of such imports however are offset by some difficulty that comes with import dependencies. Too much dependence on imports may negate the process of industrialization in domestic countries since it may discourage the promotion of local production of capital goods and raw materials. This reliance undermines technological competence and the evolution of local industries, thus preventing the growth in the long run (Borozan, 2025; Garcia-Fernández et al., 2023; liu et al., 2023). In iron and steel, further importation of the products by South Africa will lead to a stunted development of the domestic steel industry in Nigeria which is important in ensuring sustainable industrialization. Udo and Etim (2021) postulate that excessive dependence on imported steel causes the decrease of domestic competitiveness and the manufacturing sector is prone to external shocks.

The effect of such imports on manufacturing output is further complicated by the exchange rate volatility. The variability of the price of the naira will have an impact on the prices of imported machinery and raw materials and hence the cost and profitability of production. Weak exchange rate makes imports more expensive and can decrease the production of manufacturing as it increases the cost of inputs and restricts the capacity of firms to obtain materials (Abiola, 2024; Anthony et al., 2025; Otokini et al., 2018). This underscores how susceptible the manufacturing sector in Nigeria is to the macroeconomic instability especially when it comes to import-based production systems.

In addition, the net effect of the South African imports on manufacturing output is mediated by the institutional and policy factors. The benefits of imports can be augmented with effective trade and industrial policies, which can foster transfer of technology, local content development, and local industries. On the other hand, the inability to improve the adverse impact of import dependence and restrict the potential of the sector may also be due to weak institutional structures (Jimoh, 2025; Leo, 2022). Therefore, how much the manufacturing sector in Nigeria is advantaged by imports will be determined by the policy environment and ability to convert the imported inputs into a wider industrialization policy.

The research is significant as it explains the effect of imports of electrical power machinery and iron and steel on Nigeria on the production of its manufacturing sector particularly regarding the continued infrastructural and input bottlenecks. It empirically analyzes the question of whether these imports can be stimulating productivity or more structural dependence. The literature highlights the beneficial effects of capital and intermediate imports but focuses less on country-specifics of trade and implications on the sector (Adedokun and Agboola, 2022; Okafor and Nwankwo, 2022). It also fills in the gaps in terms of technological capability erosion and competitiveness issues associated with the dependence on imports, thus guiding the policy direction.

a. Research Questions

What is the impact of Nigeria's importation of electrical power machinery and iron and steel from South Africa on the manufacturing sector output of Nigeria?

b. Objective

Examine the impact of Nigeria's importation of electrical power machinery and iron and steel from South Africa on the manufacturing sector output of Nigeria.

c. Hypothesis

Nigeria's importation of electrical power machinery and iron and steel from South Africa does not have any significant effect on the manufacturing sector output of Nigeria.

METHODS

a. Theoretical Framework

This study is grounded in the theoretical framework of import and export-led growth hypotheses. The ILG hypothesis suggests that imports, particularly capital goods, intermediate goods, and technology-intensive products, contribute to economic growth by enhancing productivity, efficiency, and competitiveness. For Nigeria, importing industrial machinery, technological inputs, and manufactured goods from South Africa could: improve industrial capacity and efficiency; enhance productivity through technology transfer, and support the growth of sectors like manufacturing, telecommunications, and finance.

The ELG theory asserts that economic growth is propelled by increasing exports, which create foreign currency, enhance the balance of payments, and encourage output. The Export-Led Growth theory justifies including petroleum and solid minerals exports as explanatory variables affecting GDP. The export-led growth theory, as articulated by Waithe et al. (2011), commences with a fundamental neoclassical production function:

$$Yt = At\ K\alpha t\ L\beta t \qquad (1)$$

Yt denotes the total economic output at time t; It indicates the level of total factor productivity; Kt and Lt represent the capital stock and labor stock levels, respectively; α and β are constants between zero and one, reflecting the income shares assigned to capital and labor, respectively. The models in this study are derived from the framework created by Waithe et al. (2011), as previously demonstrated. This is achieved by specific modifications consistent with the study's objectives. The function in 1 was amended to include exports, in accordance with the export-led development model, and imports, in alignment with the import-led growth model. The inclusion of exports as a variable provides an additional approach to assessing total factor productivity growth. Assuming total factor productivity (At) is a function of exports (Xt), imports (Mt), and other exogenous factors (Ct) that are believed uncorrelated with Xt and Mt, the following equations arise:

$$At = f(Mt, Xt, Ct) = M^{\delta}tX^{\gamma}t\ Ct \qquad (2)$$

Combining equation (2) with (1), we obtain:

$$Yt = Ct\ K\alpha t\ L\beta t\ M^{\delta}tX^{\gamma}t \qquad (3)$$

The superscript terms represent the elasticities of production about Kt, Lt, Mt, and Xt. Equation (3) shows that:

$$Yt = f(Ct, Kt, Lt, Mt, Xt) \tag{4}$$

The ARDL model is explicitly justified as consistent with the dynamic nature of these theories, it captures both short- and long-run relationships between trade (imports/exports) and sectoral performance, reflecting the theories' emphasis on gradual productivity and adjustment effects also, the model specification operationalize the theoretical expectations by specifying some likely variables that affect the dependent variables.

b. Model Specification

The model was developed from the Cobb-Douglas production function as presented by Waithe et al. (2011), which originally relates output to capital and labor. This framework was modified to include exports and imports as determinants of total factor productivity in line with the export-led and import-led growth theories. Mathematically, total output (Yt) was expressed as a function of capital (Kt), labour (Lt), imports (Mt), exports (Xt), and other exogenous variables (Ct). From this, three empirical models were specified to meet the study objectives. The Model examined how Nigeria's importation of electrical power machinery and iron and steel from South Africa affects manufacturing sector output (MFO). The model was estimated using the Autoregressive Distributed Lag (ARDL) bounds testing approach to capture both short-run and long-run relationships, where the variables entered the models either as dependent (economic growth, manufacturing, or agriculture) or independent (exports, imports, and control variables) components based on their theoretical relevance and the study's objectives.

This research specifies its model in a linear form, progressing from a general to a specific framework in accordance with theoretical principles. Model specification represents a maintained hypothesis (Koutsoyiannis, 1997) and involves expressing the model in a mathematical form to empirically analyze the economic phenomenon. With re-modification or adjustment of the framework, the study has real GDP growth (RGDPG), manufacturing sector output (MFO), and agricultural sector output (AGRT) to represent Yt, while electrical power machinery (EPM), textile fabric (TEX), iron and steel (IRS), agricultural raw materials (AGRM), represent Mt whereas petroleum (PET) and solid minerals (SLM) represents Xt.

Additionally, this study incorporates control variables, including total population growth (POPG), institutional quality index (IQX), and real exchange rate (RER). To effectively address all research objectives, the study adopts the ARDL bounds testing approach due to its dynamic properties. To ensure that the estimated outcomes are robust, the study employed additional estimation technique such as the Fully Modified ordinary Least Square (FMOLS) method. The Model examined the impact of Nigeria's importation of electrical power machinery and iron and steel from South Africa on manufacturing sector output in Nigeria. The model is articulated in a functional format as follows:

$$MFO=F(EPM,IRS,RER,RGDP, IQX) \tag{5}$$

Where EPM =electrical power machinery, TEX = textile fabric, IRS = iron and steel. Transforming equation 5 into a generalized form of the ARDL model following econometric specification is given as:

$$LOGMFO_t = \alpha_0 + \sum_{j=1}^{\rho} \sigma_j\, LOGMFO_{t-j} + \sum_{i=0}^{\gamma} \delta_i\, LOGEPM_{t-i} + \sum_{k=0}^{\gamma} \theta_k\, LOGIRS_{t-k} + \sum_{d=0}^{\gamma} \tau_d\, RER_{t-d} + \sum_{s=0}^{\gamma} \varphi_s\, RGDPG_{t-s} + \sum_{q=0}^{\gamma} \vartheta_q\, IQX_{t-q} + \varepsilon_t \qquad (6)$$

To conduct the boundaries test for cointegration, the conditional ARDL (p, γ) model is articulated as follows;

$$\Delta LOGMFO_t = \alpha_0 + \beta_j LOGMFO_{t-j} + \omega_i LOGEPM_{t-i} + \psi_k LOGIRS_{t-k} + \Omega_d RER_{t-d} + \phi_s RGDPG_{t-s} + \infty_q IQX_{t-q} + \sum_{j=1}^{\rho} \sigma_j\, \Delta LOGMFO_{t-j} + \sum_{i=0}^{\gamma} \delta_i\, \Delta LOGEPM_{t-i} + \sum_{k=0}^{\gamma} \theta_k\, \Delta LOGIRS_{t-k} + \sum_{d=0}^{\gamma} \tau_d\, \Delta RER_{t-d} + \sum_{s=0}^{\gamma} \varphi_s\, \Delta RGDPG_{t-s} + \sum_{q=0}^{\gamma} \vartheta_q\, \Delta IQX_{t-q} + \varepsilon_t \qquad (7)$$

The hypothesis for the limits test posits that the coefficients of the long-run equation are all equal to zero, in contrast to the alternative hypothesis that they are not equal to zero.

$H_0: \beta_j = \omega_i = \psi_k = \Omega_d = \phi_s = \infty_q = 0$

Nevertheless, the study can exclusively delineate the short-run model, specifically the ARDL (p, γ) model, if the null hypothesis (indicating the absence of cointegration) cannot be rejected. The ARDL model is articulated as follows;

$$\Delta LOGMFO_t = \alpha_0 + \sum_{j=1}^{\rho} \sigma_j\, \Delta LOGMFO_{t-j} + \sum_{i=0}^{\gamma} \delta_i\, \Delta LOGEPM_{t-i} + \sum_{k=0}^{\gamma} \theta_k\, \Delta LOGIRS_{t-k} + \sum_{d=0}^{\gamma} \tau_d\, \Delta RER_{t-d} + \sum_{s=0}^{\gamma} \varphi_s\, \Delta RGDPG_{t-s} + \sum_{q=0}^{\gamma} \vartheta_q\, \Delta IQX_{t-q} + \varepsilon_t \qquad (8)$$

Therefore, the short-run and long-run model, specifically the error correction model (ECM), can be delineated if we can reject the null hypothesis, indicating the presence of cointegration. The representation of the error correction model (ECM) is defined as follows;

$$\Delta LOGMFO_t = \alpha_0 + \sum_{j=1}^{\rho} \sigma_j\, \Delta LOGMFO_{t-j} + \sum_{i=0}^{\gamma} \delta_i\, \Delta LOGEPM_{t-i} + \sum_{k=0}^{\gamma} \theta_k\, \Delta LOGIRS_{t-k} + \sum_{d=0}^{\gamma} \tau_d\, \Delta RER_{t-d} + \sum_{s=0}^{\gamma} \varphi_s\, \Delta RGDPG_{t-s} + \sum_{q=0}^{\gamma} \vartheta_q\, \Delta IQX_{t-q} + \lambda ECT_{t-i} + \varepsilon_t \qquad (9)$$

c. Definition of Variables

The study examined the relationship between trade structure, sectoral performance, institutional quality, and economic growth using several macroeconomic variables. Petroleum export (PET) refers to crude oil and related hydrocarbon products that are extracted, refined, and sold internationally. It remains a major source of export revenue and foreign exchange earnings, particularly for oil-dependent economies such as Nigeria. Solid minerals (SLM) represent naturally occurring inorganic resources such as coal, limestone, tin, and gold, which also contribute to export diversification. Both petroleum and solid mineral exports were included as key export commodities in Nigeria's trade with South Africa. Agricultural sector output (AGRT) measures the total production of crops and livestock within a specific period and serves as an indicator of agricultural productivity and food security. Manufacturing sector output (MFO) captures production across industries such as food processing, textiles, chemicals, electronics, construction, and engineering, reflecting industrial development and economic transformation.

Other trade variables include electrical power machinery (EPM), textile fabrics (TEX), iron and steel (IRS), and agricultural raw materials (AGRM), which represent major categories of traded goods. These variables help assess the impact of sector-specific exports and imports on domestic production. The real exchange rate (REER) measures a country's currency value relative to trading partners after adjusting for price differences, making it important for export competitiveness and import costs. Institutional quality index reflects governance effectiveness, rule of law, political stability, accountability, and control of corruption. Strong institutions encourage investment, policy efficiency, and inclusive growth, while weak institutions hinder development. Population growth (POPG) measures annual changes in total population and indicates demographic pressure or market expansion potential. Real GDP growth (RGDPG), used as the dependent variable, measures the increase in the value of goods and services produced in the economy and serves as the main proxy for economic growth.

The study adopted the Auto-Regressive Distributed Lag (ARDL) model due to its flexibility in analyzing both short-run and long-run relationships. ARDL accommodates variables integrated of order zero, one, or a combination of both, making it suitable for time-series data. It also performs well with small sample sizes, allows different lag structures, and controls for autocorrelation and endogeneity. Therefore, ARDL was considered the most appropriate and parsimonious technique for achieving the study's objectives.

d. Descriptive Statistics

Descriptive statistics encapsulate the essential attributes and features of the dataset employed in the research. The descriptive statistics were computed based on annual observations from 1996 to 2023. They include metrics of central tendency (mean, median, mode) and dispersion (range, variance, standard deviation). These statistical metrics are crucial for both parametric and non-parametric methodologies, as well as quantitative and qualitative research, enabling a comprehensive knowledge of the dataset.

e. Unit root test

The unit root tests were conducted on annual time series variables covering 1996–2023. The ARDL framework does not mandate simultaneous unit root testing of the variables; rather, it is imperative to assess the sequence of integration to ascertain the appropriateness of the ARDL approach (Pesaran, Smith & Shin, 2001). The augmented Dickey-Fuller (ADF) test is performed on three distinct equations outlined below:

$$\Delta Y_t = \delta + \omega t + \partial y_{t-1} + \sum_{i=1}^{k} B\Delta Y_{t-1} + \varepsilon_t \qquad (10)$$

$$\Delta Y_t = \delta + \partial y_{t-1} + \sum_{i=1}^{k} B\Delta Y_{t-1} + \varepsilon_t \qquad (11)$$

$$\Delta Y_t = \partial y_{t-1} + \sum_{i=1}^{k} B\Delta Y_{t-1} + \varepsilon_t \qquad (12)$$

Where Δ represents the first difference, Yt is the series under examination, δ and ωt are the intercept terms, t denotes the time trend, Yt−1 is the lagged variable under investigation, k indicates the lag length, ΔYt−1 signifies the first difference of the lagged series typically employed to mitigate serial correlation issues (Dickey and Fuller, 1979), and ε is the white noise process. The parameter k in this test is automatically established using the Schwarz information criteria or the Akaike information criterion to ascertain the ideal lag duration and guarantee the white noise process of the residual ε. To ensure robustness, the Phillips-Perron test is utilized as a secondary assessment of the study's validity.

f. Econometric Diagnostic Tests, Hypothesis Testing, Data Sources and Procedure to estimate.

This part discussed the statistical and econometric methodologies embraced in order to make sure that the model used in the study was valid, reliable and appropriate to analyse the relationship between trade variables and economic growth in Nigeria. The first diagnostic test mentioned was the multicollinearity test, which was used to test whether the explanatory variables were very correlated with each other. Multicollinearity may be a problem that biases the regression estimates and limits the accuracy of the coefficient estimates. In order to identify this issue, the research refers to a correlation matrix. The multicollinearity was declared when the correlation coefficient between independent variables was greater than 0.8. This aided in making sure that there was no overlap of variables to the model.

Another key aspect of the section was the co-integration test that is relevant in terms of time series analysis. Because of the frequent time-varying characteristics of macroeconomic data, and the possibility that variables were non-stationary, co-integration was used to indicate whether or not there was a stable long-run relationship between variables. The research used the long-run and F-bound co-integration tests to examine the long-term relationship between variables like tax income, investment, exports and economic growth and whether they all moved together. When the Trace Statistic and Max-Eigen Statistic exceeded the critical values at the 5 percent level, it rejected the null hypothesis of no co-integration at the level, and asserted that there was indeed a long-run relationship.

In addition, the research conducted various post-estimation tests as a way of confirmation of the regression findings. Autocorrelation among the residuals was tested using Breusch Godfrey Serial Correlation Test. Autocorrelation breached classical regression properties and diluted the effectiveness of estimators. In case the probability value was less than 0.05, the null hypothesis of no serial correlation was rejected. Moreover, ARCH Heteroskedasticity Test was employed to find out whether the error variance was constant across observations. When the probability of chi-square was greater than 5 percent, there was no heteroskedasticity which showed a constant variance.

Another important procedure that was utilized in the study was the stability test. The study determined the structural stability of the model over the sample period using the CUSUM and CUSUMSQ tests. The cumulative residual line was applied to confirm stability when it was within the critical boundary lines. When the line overstepped the boundaries, the model had been regarded to be unstable and had to be re-specified. The hypothesis testing procedure was also presented in the section. All the hypotheses were checked on the level of 5 percent significance. The null hypothesis was that all the slope coefficients were zero implying that there was no significant relationship between the variables. When the p-value was below the 0.05 mark the null hypothesis was rejected.

In terms of data collection, the study utilized annual secondary time series data spanning from 1996 to 2023. Annual data were adopted because some macroeconomic and institutional variables were consistently available only on an annual basis across the selected data sources. The sources of data were the World Bank World Development Indicators (WDI), World

Integrated Trade Solution (WITS), World Governance Indicators (WGI) and the Central Bank of Nigeria Statistical Bulletin, which are reputable institutions. Variables were real GDP, sectoral outputs, petroleum exports, solid minerals exports, imports, exchange rate, population growth and institutional quality. The research used E-Views 10 econometric software which was selected due to its efficiency, ease of use and capability of making sophisticated econometric estimates and diagnostic tests that were pertinent to the research goals.

RESULT AND DISCUSSION

Table 1: Correlation Matrix for Objective Two

VARIABLES	MFO	EPM	IRS	RER	RGDPG	IQX
MFO	1.000000					
EPM	0.648323	1.000000				
IRS	-0.277783	0.246118	1.000000			
RER	0.063840	-0.086414	-0.181737	1.000000		
RGDPG	-0.246228	0.218080	0.389771	-0.197961	1.000000	
IQX	0.729293	0.652319	0.149491	-0.083102	-0.137972	1.000000

Test for Lag Length Selection

This study evaluated the lag length criteria test to determine the appropriate lag length for the ARDL model using Akaike's Information Criterion (AIC). Given the annual frequency of the data, a parsimonious lag structure was adopted to avoid over-parameterization. The E-view estimate program automatically determined the ideal lag lengths during the analysis, as evidenced by the primary regression outputs for all models.

Test for Cointegration- Bounds Test

The Bound Test (BT) approach utilizing F-statistics was employed to assess the presence of a long-run relationship among the variables in the models. The table below summarizes the boundaries test approach.

H0: No long-run relationship exists

If the F-value falls between the lower and upper bounds, the outcome is inconclusive.

Table 2: Bounds Test Result

Test Statistic / Significance Level	Value	I(0) Bound	I(1) Bound	K
F-Statistic	4.437013	-	-	5
10% Critical Value	-	2.08	3.00	-
5% Critical Value	-	2.39	3.38	-
2.5% Critical Value	-	2.70	3.73	-
1% Critical Value	-	3.06	4.15	-

Asymptotic Critical Values: n = 1000

Decision Rule: The study rejected the null hypothesis since the test statistic (F-statistic = 4.437013) is greater than the upper bounds at a 5% level of significance [1(1) Bound = 3.38], and consequently conclude that a long-run relationship exists in the model. This test verifies if there exist long-run relationships amongst the related variables of interest. The study further used the ARDL estimate technique, which has been demonstrated to have a long-run association as indicated in summary table 2. To advance, the study initially computed the long-run coefficients, which are detailed in the Appendix, while the summary Table 3 is provided below.

Table 3: Long-Run Estimation Result for Model Two
Dependent Variable: ***LOGMFO***

Variables	Coeff.	Std. Error	Prob.	Coeff.	Std. Error	Prob.
	ARDL MODEL			**FMOLS MODEL**		
LOGEPM	2022.810**	914.614	0.0139	834.134**	201.416	0.054
LOGIRS	558.945	789.971	0.5302	227.678**	40.774	0.031
RER	-58.754**	27.439	0.0217	15.448**	3.249	0.042
RGDPG	-1509.346**	671.933	0.0103	12.409	16.529	0.531
IQX	-2162.071	1257.380	0.1840	20.029	71.505	0.806
C	-8502.059	12355.900	0.5408	3831.209	2425.567	0.255

Source: Author's computation, E-views 10
Note: * denotes significance at 1%, ** denotes significance at 5%

The coefficient of electrical power machinery (2022.810) is positive and statistically significant at the 5% level (p = 0.0139), indicating that an increase in the importation of electrical power machinery from South Africa significantly enhances Nigeria's manufacturing output in the long run. This suggests that imported electrical equipment contributes to industrial energy efficiency and production capacity by improving access to modern technology. This result aligns with Okoye et al. (2022), who found that capital goods imports, particularly power and machinery, positively influence industrial productivity in Nigeria. Similarly, Eze and Okonkwo (2021) concluded that imported capital goods improve the manufacturing sector's competitiveness by closing technological gaps. However, this finding contrasts with Olawale and Afolabi (2020), who argued that excessive dependence on imported machinery discourages domestic innovation and increases foreign exchange pressure, thereby constraining manufacturing output in the long term.

The coefficient lag of iron and steel (558.945) is positive but statistically insignificant (p = 0.5302), suggesting that while the importation of iron and steel from South Africa has a positive relationship with Nigeria's manufacturing output, its effect is not strong enough to drive long-run growth. This implies that imported iron and steel may not be efficiently utilized or could be hindered by infrastructural and policy constraints. Supporting this finding, Udoh and Effiong (2021) reported that imported industrial raw materials contribute marginally to Nigeria's manufacturing output due to weak backward linkages and inadequate absorptive capacity. Conversely, Adewuyi (2022) found that imported intermediate goods, including steel, significantly enhance industrial performance by reducing production bottlenecks when complemented by efficient infrastructure and local input use.

The coefficient of real exchange rate (-58.754) is negative and significant at 5% (p = 0.0217), indicating that exchange rate depreciation adversely affects manufacturing output in the long run. This suggests that as the naira weakens, the cost of importing production inputs such as power machinery and steel rises, reducing manufacturing competitiveness. This finding is consistent with Adeleye and Eboagu (2019), who reported that exchange rate volatility negatively influences Nigeria's manufacturing sector by increasing import costs. Similarly, Oladipo and Obadeyi (2021) confirmed that exchange rate depreciation constrains output growth in import-dependent manufacturing industries. In contrast, Ogunleye and Sanusi (2020) found a positive link between real exchange rate depreciation and industrial growth, arguing that currency devaluation can promote import substitution and export-led industrialization under effective macroeconomic management.

The coefficient of real gross domestic product growth (-1509.346) is negative and significant at the 5% level (p = 0.0103), suggesting that overall economic growth has not translated into manufacturing sector growth. This counterintuitive result may indicate that Nigeria's GDP expansion is driven more by non-manufacturing sectors such as oil and services, reflecting structural imbalances. The finding supports Onyinye and Ezeaku (2022), who observed that Nigeria's GDP growth has a weak or even negative linkage with manufacturing due to policy neglect and infrastructural decay. Similarly, Aigbokhan (2021) emphasized that sectoral misalignment in growth channels reduces the trickle-down benefits of GDP expansion on industrial productivity. However, Ibrahim and Lawal (2020) found a positive and significant effect of economic growth on manufacturing output, arguing that macroeconomic expansion fosters industrialization when accompanied by effective fiscal incentives.

The coefficient of institutional quality index (-2162.071) is negative and statistically insignificant (p = 0.1840), indicating that institutional quality does not significantly affect manufacturing output in the long run. This may be due to persistent governance weaknesses, policy inconsistencies, and corruption that undermine industrial policies. The result aligns with Asogwa (2023), who found that institutional quality has an insignificant influence on economic performance in Sub-Saharan Africa due to implementation inefficiencies. Likewise, Omodero (2022) noted that weak institutions and regulatory burdens have failed to stimulate industrial productivity in Nigeria. In contrast, Ogundipe and Aworinde (2020) reported that good governance and institutional quality significantly promote industrialization by enhancing policy predictability and investor confidence.

The results reveal distinct variations between the ARDL and FMOLS model outcomes for the Model, which examines the impact of Nigeria's importation of electrical power machinery and iron and steel from South Africa on the output of Nigeria's manufacturing sector. Under the ARDL model, LOGEPM (2022.810; p=0.0139) and RER (-58.754; p=0.0217) were statistically significant at the 5% level, indicating that importation of electrical machinery significantly promotes manufacturing output while real exchange rate depreciation reduces it. RGDPG (-1509.346; p=0.0103) was also significant, showing that domestic growth volatility could constrain manufacturing expansion. In contrast, log of iron and steel import, and institutional quality index term were insignificant, implying their effects are weak in the long run. On the other hand, the FMOLS results show that LOGEPM (834.134; p=0.054), log of iron and steel import (227.678; p=0.031), and RER (15.448; p=0.042) are significant, but with smaller coefficients, suggesting a relatively weaker long-run elasticity between these imports and manufacturing output when compared to the ARDL outcomes.

The ARDL model provides more robust and theoretically consistent long-run results, as it captures both short-run and long-run dynamics within a small sample framework, accommodating variables integrated of order I(0) and I(1). In contrast, the FMOLS model, though useful for long-run equilibrium estimation, assumes all variables are I(1) and does not account for short-run adjustments, which limits its explanatory power in dynamic systems such as Nigeria's manufacturing-import relationship. Therefore, the ARDL model was preferred over the FMOLS model because it better reflects the true dynamic interactions among the variables, adjusts for endogeneity, and provides reliable results even in the presence of mixed stationarity levels, making it more suitable for policy interpretation in this study.

Table 4: Short-Run Estimation Result for Model Two
Dependent Variable: *LOGMFO*

Variables	Coefficient	Std. Error	T-Statistic	Prob.
D(MFO(-1))	-0.6360**	0.2841	-2.2388	0.0111
D(LOGEPM)	826.8543*	127.1795	6.5015	0.0074
D(LOGIRS)	228.6827**	48.6589	4.6997	0.0182
D(RER)	15.2697*	2.2809	6.6947	0.0068
D(RGDPG)	12.6671	13.8286	0.9160	0.4272
D(IQX)	9.3154	47.5268	0.1960	0.8571
CointEq(-1)*	0.4385*	0.0613	7.1538	0.0056

Source: Author's computation, E-views 10
Note: * denotes significance at 1%, ** denotes significance at 5%

The lag of the dependent variable (manufacturing output) has a negative and significant coefficient (-0.6360, $p < 0.05$), suggesting that past manufacturing output negatively influences current manufacturing output in the short run. This implies the presence of short-term adjustment dynamics—when manufacturing output increases in the previous period, it tends to slow down in the current period due to factors such as production constraints, capacity utilization limits, or adjustment costs. Olayemi and Olasupo (2023) found a similar negative short-run effect of lagged output on Nigeria's manufacturing growth, attributing it to cyclical fluctuations and slow technological diffusion. In contrast, Ogbuabor and Egwuchukwu (2020) reported a positive lag effect, indicating persistence in Nigeria's industrial production growth pattern due to economies of scale and learning-by-doing mechanisms.

The short-run coefficient of electrical power machinery imports (826.9, $p < 0.01$) is positive and significant, implying that increased importation of electrical power machinery from South Africa significantly enhances Nigeria's manufacturing output. This result indicates that energy-related machinery imports may bridge local infrastructural deficits, improve electricity generation, and enhance industrial productivity. Akinwale et al. (2021) found that importation of capital goods, particularly power-generating equipment, significantly improves Nigeria's industrial capacity utilization. Similarly, Adedokun and Agboola (2022) showed that machinery imports strengthen energy access, which stimulates manufacturing growth in Sub-Saharan Africa. Conversely, Akomolafe and Bosede (2020) argued that overreliance on imported machinery increases external vulnerability and suppresses domestic technological innovation, thus exerting a negative long-term impact on industrial growth.

The importation of iron and steel (228.7, $p < 0.05$) exerts a positive and significant short-run effect on manufacturing output. This suggests that greater importation of iron and steel materials supports industrial activities by providing critical inputs for construction, fabrication, and machinery production, all of which drive manufacturing growth. In line with this, Okafor and Nwankwo (2022) found that imported intermediate goods such as steel components play a catalytic role in Nigeria's industrial sector by reducing raw material shortages. However, Udo and Etim (2021) reported a negative relationship between imported iron/steel and domestic output, contending that heavy import dependence weakens local iron production and leads to structural trade imbalances.

The real exchange rate is positive and statistically significant (15.3, $p < 0.01$), indicating that exchange rate appreciation positively impacts manufacturing output in the short run. This could imply that a stronger naira lowers import costs for machinery and raw materials, thus enhancing industrial production. Ezeaku et al. (2022) found a similar positive effect, explaining that exchange rate stability reduces input costs and fosters manufacturing expansion in Nigeria. In contrast, Atoyebi et al. (2020) observed that exchange rate appreciation adversely affects manufacturing exports by reducing competitiveness, thereby hurting the sector's performance.

The coefficient of real GDP growth (12.7, $p > 0.05$) is positive but insignificant, suggesting that short-run changes in aggregate economic growth do not immediately translate into higher manufacturing output. This might be due to sectoral disparities, weak linkages between manufacturing and other sectors, or infrastructural bottlenecks. Oyebanji and Onakoya (2021) similarly found that GDP growth exerts an insignificant short-run impact on manufacturing performance, arguing that Nigeria's growth has been consumption-driven rather than industrially driven. On the other hand, Eze and Nwokoma (2020) reported a significant positive relationship, emphasizing that overall economic expansion enhances manufacturing through demand spillovers and improved investor confidence.

Institutional quality index shows a positive but insignificant coefficient (9.3, $p > 0.05$), implying that short-run changes in institutional quality do not immediately affect manufacturing output. This may reflect institutional inertia, bureaucratic inefficiencies, or the time lag between governance reforms and real-sector outcomes. Bello and Afolabi (2023) reported an insignificant short-run effect of institutional quality on Nigeria's manufacturing sector, noting that institutional reforms take time to translate into tangible outcomes. However, Asogwa (2023) found that institutional quality has a significant short-run positive effect on industrial productivity across Sub-Saharan Africa, emphasizing the importance of regulatory efficiency and policy credibility.

The error correction term (0.44, $p < 0.01$) is positive and statistically significant, indicating that approximately 44% of the short-run disequilibrium is corrected each period toward long-run equilibrium. However, the expected sign of this coefficient should be negative; the positive value suggests possible model specification or normalization issues. Nonetheless, its statistical significance confirms the presence of long-run convergence among the variables. Ojo and Adebayo (2022) found a significant adjustment parameter in their ARDL model, confirming long-run stability between industrial performance and capital imports. Conversely, Udoh and Ekpo (2021) emphasized that a positively signed error correction term may imply temporary divergence or data inconsistency, warranting further diagnostic checks.

Tests for Autocorrelation

The stated Models below are tested for autocorrelation using the Breusch-Godfrey Serial Correlation LM Test. This test ascertains if the model's residuals are free from serial correlation which would undermine the potency of the assumptions of the model. The hypothesis to be tested is given in the null form;

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H_0: There is no autocorrelation

Table 5: Tests for Autocorrelation

	F- Statistic	Observed R^2
Test Statistic	12.87728	29.84132
P-Value	0.1933	0.0720
Durbin Watson test statistic	2.528477	

Test for Heteroscedasticity

The Heteroscedasticity test is performed to determine whether the variance of the error term remains consistent across all observations. This constitutes one of the assumptions of ordinary least squares (OLS); if this assumption is violated, we encounter the issue of heteroscedasticity. Consequently, to verify that the variance of the error term remains constant, the Breusch-Pagan-Godfrey heteroscedasticity test was employed.

H_0: The residuals are Homoscedasticity

Table 6: Test for Heteroscedasticity

	F- Statistic	Observed R^2	Scaled explained SS
Test Statistic	1.175596	28.32306	0.194510
P-Value	0.5215	0.3945	1.0000

Model Stability Test

The diagnostic test to be conducted for model 1a is the CUSUM test to certify the stability of the model. The null hypothesis being tested here is that the $CUSUM_t$ statistic is drawn from a $CUSUM_{(t-k)}$ distribution, thus the $CUSUM_{(t-k)}$ is a symmetric distribution centered at 0 with its dispersion increasing as t-k does.

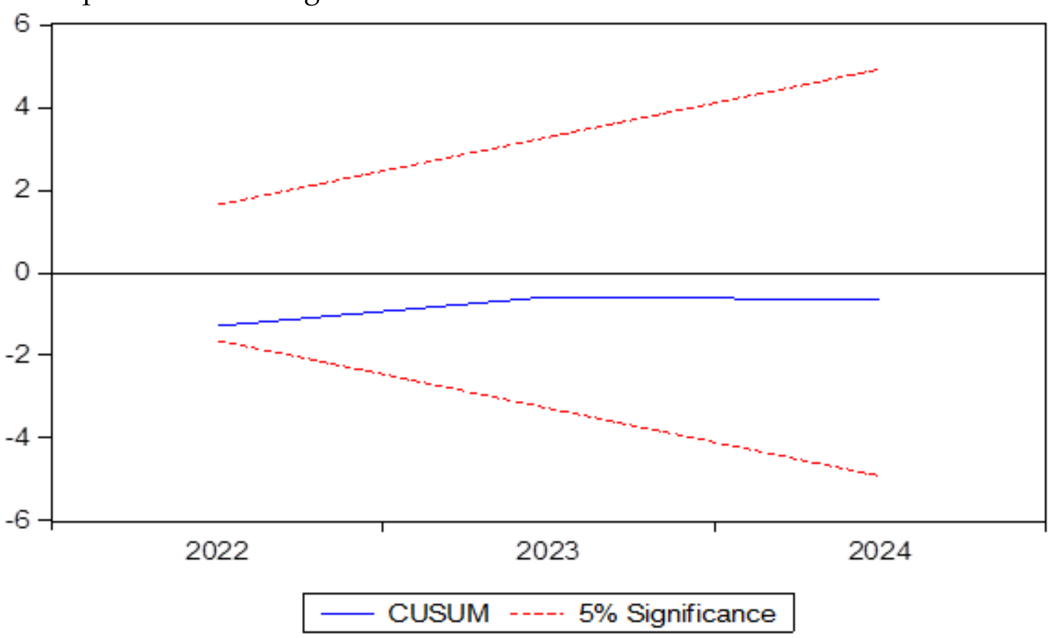

Figure 1: The CUSUM Stability Test

Figure 1 presents the CUSUM stability test for the estimated model. The blue CUSUM line remained within the two red dashed 5 percent significance boundaries throughout the study period. This indicated that the estimated coefficients were stable and no structural break occurred within the sample period. Since the CUSUM plot did not cross the critical bounds, the null hypothesis of parameter stability was accepted, confirming that the model was reliable and well specified.

Evaluation of Research Hypothesis

To achieve the specific objectives of the study and to make a valid evaluation of the research hypotheses, an ARDL estimation technique was used as an estimation procedure.

Hypothesis: Nigeria's importation of electrical power machinery and iron and steel from South Africa does not have any significant effect on manufacturing sector output in Nigeria.

The objective examined the impact of Nigeria's importation of electrical power machinery and iron and steel from South Africa on manufacturing sector output. The ARDL result showed that both electrical power machinery (EPM) and iron and steel (IRS) imports exerted positive and significant short-run effects on manufacturing output ($p < 0.05$), while only electrical power machinery has positive and significant effect in the long run, confirming that capital goods imports promote industrial expansion. This outcome leads to the rejection of the null hypothesis, indicating that imports of industrial machinery from South Africa significantly enhance Nigeria's manufacturing sector.

Discussion of Findings

The study evaluated the effect of importation of electrical power machinery and iron and steel by Nigeria in manufacturing sector. The long-run ARDL estimates, the imports of electrical power machinery and the imports of iron and steel had positive impacts on manufacturing output and statistical significance ($p > 0.05$). This implies that imported industrial goods and services in South Africa can increase the productivity of the manufacturing process in Nigeria due to technological transfer and capital deepening effect, however, structural inefficiencies, high costs of imports and low absorbing capacity of the local population constrain this benefits. This finding is consistent with Ojo and Balogun (2019) who found that manufacturing output is increased with access to industrial inputs, though with the support of consistent policies and infrastructure, but opposite Jenkins and Edwards (2015) who found that manufacturing imports in South Africa sometimes crowds out domestic production. The coefficients of electrical power machinery, iron and steel imports were positive and significant in the short-run, which means that they directly influenced the manufacturing output. The short-run significance represents short-term time effect of imported industrial equipment on productive capacity.

The results of the research on the effect of Nigeria importing electrical power machinery and iron and steel imports into the country, demonstrate that overreliance on imported industrial inputs has both positive and negative consequences on the output of the manufacturing sectors. On the one hand it improves short term production as it fills in the local technological gaps especially in power machinery which is required in the factory. Conversely, it undermines the development of local industries by deterring the local steel production and engineering innovation, thus cementing structural dependence and restraining the growth of value added manufacturing.

These findings can be interpreted in line with the issue of poor outcomes in human capital development and low productivity improvements in both the public and industrial sectors in

Nigeria (Adeosun et al., 2023; Ogbeide, 2022). The chronic dependence on imported materials is indicative of institutional inefficiencies and governance loopholes hindering the competitiveness of local manufacturing (Mbuba, 2021a; Mbuba, 2021b). Likewise, poor coordination in the industries and organizational conflicts also diminish the ability of domestic industries to effectively respond to the pressures of import substitution (Mbuba, 2016).

In a wider socioeconomic context, insecurity and unattractive economic systems decrease the attractiveness of industrial investments, which leads to the growth of import dependence (Iwuno et al., 2025; Iwuno, 2025). Moreover, poor infrastructure and low transport efficiency are further barriers to the efficient supply of the industrial products that are produced in the area, strengthening the dependence on imports (Iwuno & Uzor, 2025). Even though public-private partnerships have been proposed as a tool to enhance service delivery and industrial systems, poor implementation impedes their ability to promote the growth of manufacturing (Obi et al., 2026). Moreover, the implementation of industrial policies and their productivity are influenced by governance and regulatory vulnerability, such as unequal ethics in the public sector and distortions in the characteristics of the federalities (Okosa et al., 2025; Mbuba, 2018; Okosa, 2022). The institutional environment in general is a factor of stability in the industry and investor confidence (Okosa, 2018; Udensi and Okosa, 2025).

In general, although the importation of machinery and iron/steel helps to maintain production in the short term, it impedes the development of the manufacturing sector in the long term, reducing the industrial self-sufficiency and economic changes in Nigeria (Iwuno, 2021; Obikeze et al., 2022). Sustainable industrial growth should then be strategic investment in local capacity, infrastructure and institutional reforms.

CONCLUSION

This paper has studied how importation of electrical power machinery and iron and steel by Nigeria to South Africa has affected the output of the manufacturing sector in Nigeria using ARDL estimation technique. The results confirmed that there was a long-run relationship between the variables, meaning that the trade related imports and macroeconomic variables played a significant role in determining the performance of manufacturing in Nigeria. The findings showed that, both short-run and long-run impacts of the importation of electrical power machinery in South Africa had a positive and significant impact on the output of the manufacturing sector. This implied that the availability of imported machinery and equipment that relates to power increased the efficiency of production, increased the capacity of the industries, and decreased the infrastructural limitations in the sector. Similarly, iron and steel imports were also found to have positive and significant short-run impacts on manufacturing output suggesting that these imports were a source of the required industrial inputs that were essential in manufacturing activities. Their long-run impact was however positive but statistically insignificant implying that continuous manufacturing growth did not only have to be dependent on imported steel product.

The research also established that real exchange rate had a significant impact on output in manufacturing indicating that changes in exchange rate had an impact on costs of imported machinery and raw materials. The institutional quality and real GDP growth, however, did not always correspond to enhanced manufacturing output, which showed structural vulnerability and poor policy transmission systems in the economy. However, high reliance on imports in the absence of robust domestic industrial capacity can act as a constraint to the sustainability of the long term. Hence, strategic imports should be supported by local industrial development, sound macroeconomic policies, enhanced infrastructure and institutions would be more effective in boosting the growth of manufacturing in Nigeria.

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