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Impact of Environmental Quality on Manufacturing Sector Growth in Africa

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Abstract **Original Research Article**

This study examines the impact of environmental quality on the growth of the manufacturing industry in Africa with specific consideration on the effect of institutional quality, economic performance and trade openness. A Fixed Effects (FE) estimation method has been used in this study because it allows for the consideration of country-specific heterogeneity, and it is done on panel data of 39 African countries over the time frame 2000-2024. The findings indicate that, the higher the environmental quality, the higher the performance of the manufacturing sector, showing that the manufacturing sector is promoting a cleaner and more sustainable environment, and consequently the productivity of industries and investments. The impact of the institutional quality is also positive and significant, meaning that the development of manufacturing needs good governance and transparency, as well as sound regulatory frameworks. On the contrary, GDP growth has an inverse relationship with the performance of manufacturing activities which can be interpreted as an indicator of structural fault in the sense that in most countries, economic growth is mainly driven by natural resources industries instead of industrialization. However, on the other hand, trade openness offers a positive contribution to manufacturing growth, thus promoting technology and efficiency diffusion and market access. The study proposes policies that will encourage green manufacturing, institutional reforms, and export-oriented policies to boost the competitiveness and resilience of the manufacturing sector in Africa's global value chain.

Keywords: Environmental Quality, Manufacturing Sector Growth, Institutional Quality, Trade Openness, Economic Growth, Africa, Fixed Effects Model.

1. INTRODUCTION

1.1 Background to the Study

The environmental impacts of industrialisation and the environmental impact of economic development have become a huge challenge in terms of area of development, especially in the emerging economies. Industrialization is well known as an important source of economic growth, jobs generation, technology development and structural transformation. But with fast industrialization, the environment has also been a victim of pollution, resource depletion and greenhouse effect. The Intergovernmental Panel on Climate Change (IPCC, 2022) estimates that about 75% of the global emissions of GHGs come from industrial and

energy-intensive processes. Likewise, Acheampong (2019) states that environmental sustainability is a critical element in medium to long term economic development particularly in the developing world where the rate of industrialization is on the rise.

In Africa, the manufacturing industry continues to play a key role in the diversification of the economy, poverty alleviation and competitiveness at regional level. But despite its significance, industrial production relies heavily on the use of fossil fuels and on inefficient production technologies which result in environmental degradation (Adu & Denkyirah, 2022). Energy security is also a constraint to industrial productivity and sustainable growth in Sub-Saharan Africa (SSA) (Adams et al., 2016). With the ongoing process of regional integration by African nations, including through the African Continental Free Trade Area (AfCFTA), there is a growing need for African countries to maintain a delicate balance between industrial growth and environmental protection and good governance to ensure sustainable development (World Bank, 2023).

1.2 Statement of the Research Problem

The manufacturing sector in Africa is still facing the sustainability-growth paradox despite the potential it has. Pollution, carbon emissions, and overuse of resources are some of the mechanisms through which manufacturing pollutes the environment, and it is the same way that climate change, environmental degradation, and increasing production costs affect manufacturing (IPCC, 2022). Thus, poor energy infrastructure and the mismanagement of resources by industries continues to hurt their competitiveness and investor interest in certain countries like Nigeria, South Africa and Egypt (Adams et al., 2016; Adu & Denkyirah, 2022).

While linkages between environmental quality and industrial development have been noted in the past, little research has focused on institutional quality as a mediator between the two in Africa. Good institutions foster good environmental regulation, implementation of environmental policy and sustainable industrial practices, while poor governance can foster environmental degradation and non-compliance with environmental regulations (Bokpin, 2020). Hence, there is a need for extensive empirical work that examines the impact of institutional quality on the link between environmental quality and manufacturing sector growth in Africa.

1.3 Objectives of the Study

The primary objective of this study is to empirically evaluate the impact of environmental quality on manufacturing sector growth in Africa while examining the mediating role of institutional quality.

Specifically, the study seeks to:

1. Assess the quantitative influence of environmental quality on manufacturing sector productivity across 39 African countries.
2. Examine the mediating role of institutional quality in shaping the relationship between environmental conditions and manufacturing sector performance.
3. Provide policy-relevant evidence on how governance reforms and stronger institutions can facilitate sustainable industrialization and support the successful implementation of the African Continental Free Trade Area (AfCFTA).

1.4 Significance of the Study

This study builds on the existing literature because there is limited empirical evidence on the link between the quality of the environment and the expansion of manufacturing sector in Africa. There are studies that have been conducted on the developed economies but evidence being available on African countries is fragmented (Acheampong, 2019; Adu & Denkyirah, 2022). This research aims to broaden the scope of the study of the environmental-industrial growth nexus in Africa by analysing a wider sample of African countries.

Moreover, the study has included institutional quality as an explanatory variable which adds to the existing knowledge on the role of governance in the promotion of sustainable industrial development (Bokpin, 2020). The results will offer valuable inputs

to policy makers, development agencies and industrial players in developing appropriate environmental and industrial policies that can facilitate green industrialisation and sustainable economic development as per World Bank (2023) recommendations.

2. LITERATURE REVIEW

2.1 Theoretical Framework

This study is anchored primarily on the Environmental Kuznets Curve (EKC) hypothesis, which explains the dynamic relationship between environmental quality and economic development. The main hypothesis used in this study is the Environmental Kuznets Curve (EKC) hypothesis that addresses the dynamic relationship between environmental quality and economic development. The EKC takes the position that as economies industrialize and production increases and energy use grows, environmental degradation begins and then eventually decreases as the economy grows and reaches higher income levels, cleaner technologies are used, environmental regulations are toughened, and the efficiency of the production process improves (Acheampong, 2019). In the African context, however, the achievement of this transformation is heavily reliant on governance structures and institutional capacity. Therefore, the EKC is used as a theory to analyze the relationship between environmental quality and the manufacturing sector growth in the African economies.

The study also relies on Institutional Economics Theory which posits that the quality of institutions that regulate economic activities influences the economic performance apart from the availability of capital, labour and technology. Good institutions facilitate regulatory compliance, adhere to environmental regulations, safeguard property rights, lower transaction costs, and incentivize investments in cleaner production technologies, contributing to sustainable industrial development (Bokpin, 2020). On the other hand, poor institutional development may lead to failures in regulation, environmental degradation and lower manufacturing competitiveness. This theoretical framework thus warrants the adoption of institutional quality as an intervening variable between environmental quality and manufacturing sector growth.

The study also includes the Pollution Haven Hypothesis (PHH) and the trade–environment composition effect in the analysis in order to shed light on the impact of trade openness on environmental and industrial results. The Pollution Haven Hypothesis proposes that it is possible that countries with relatively weak environmental regulations may attract pollution-intensive industries, thus leading to more environmental degradation. The trade–environment composition effect, on the other hand, is that the liberalization of trade can also be conducive to the transfer of cleaner technologies, increase production efficiency, and stimulate environmentally friendly production through increased competition and innovation from abroad. The complementary viewpoints are especially relevant in the context of the African Continental Free Trade Area (AfCFTA), which opens up new prospects and challenges for sustainable manufacturing expansion due to the increase of trade and industrialization.

All of these theories offer a broad platform for the understanding of the intricate relationships between environmental quality, institutional quality, and manufacturing sector development in Africa. The Environmental Kuznets Curve captures the environmental impact of economic and industrialisation growth while the Pollution Haven Hypothesis and the trade–environment composition effect accounts for the impact of trade integration on environmental performance, focusing on the governance dimension of these impacts. Together, these show a strong theoretical basis for examining the relationship between environmental quality and the growth of the manufacturing sector in Africa through the lens of institutional quality.

2.2 Review of Empirical Literature

Empirical studies examining the relationship between environmental qualities and manufacturing sector growth have yielded mixed and often context-specific results across different regions. Research studies indicate that better environmental conditions

promote industry efficiency and innovation while others indicate that strict environmental regulations could lead to increased production expenses and reduced industrial growth. The environmental quality index is therefore related heavily to the energy structure, institutional quality, and technological advancement of an economy, and the impact on the manufacturing performance.

Cole and Elliott (2003) used a panel data approach to analyze how industrial production affects environmental damage in 32 developing and developed countries, for example. They found that their results were in line with the Environmental Kuznets Curve (EKC) hypothesis, which states that, in early stages of industrialization, the environment worsens as output increases, but then improves as higher income levels allow for cleaner production methods. Likewise, Dinda (2004) discovered that long-run industrial expansion and environmental enhancement can coexist provided that proper technological innovation and regulation is provided.

Dasgupta, Laplante and Mamingi (2001), however, noted that lack of institutional and regulatory capability in developing countries enables industries to shift the burden of the pollution onto the environment, causing environmental degradation that will limit productivity in the long run. They believed that if there was not effective governance, "pollution havens" would occur with industries moving to areas with low environmental regulation. This is especially true in numerous African countries, where the lack of enforcement capacity is a threat to the environment in the face of fast growth in industry.

Oyinlola and Adedeji (2019) analysed the relationship between environmental quality, industrial expansion and energy consumption in Sub-Saharan Africa from 1990-2016. The study concluded that the environmental quality, represented by the level of CO_2 emissions and air pollution, had a significant negative impact on industrial output in the long term. The authors highlighted three categories as examples of how environmental degradation affects production costs: damages infrastructure; decreases labour productivity; and compromises quality of raw materials. In the same vein, Nwani and Omoke (2021) studied 20 African countries and concluded that environmental quality improvements are positively linked to the growth of the manufacturing sector, provided that there are synergies with the use of renewable energy and effective institutional regulation.

The present study builds on a related study conducted by Adewuyi and Awodumi (2020), who studied the dynamic relationship between industrialization, energy consumption and environmental degradation in Nigeria with an ARDL bounds testing approach. Results showed that the fast rate of fossil fuel-based industrial growth was a major cause of environmental pollution and this environmental pollution led to a reduction in the overall factor productivity in the manufacturing sector. The authors concluded that environmental degradation is a short-term economic cost which exceeds the benefits of industrial expansion. Similarly, Alege, Adediran and Ogundipe (2016) observed that Nigeria's process of industrialization has been 'carbon intensive and environmentally unsustainable' and recommended a switch to cleaner energy and environmental management systems to maintain its level of manufacturing activities.

In addition, institutional quality (IQ) has been noted as a key determinant in the environmental–industrial growth relationship in several studies. Adams, Klobodu and Opoku (2016) examined the relationship between institutional performance and environmental outcomes including sub-Saharan Africa for a period of 1990-2014 using a panel estimation approach. They found that their results correlated with the quality of the environment and sustainable industrial output, which in turn depended on their institutions' effectiveness in terms of regulatory quality and control of corruption. Weak institutions, on the other hand, were identified as the factors that fostered environmental neglect and industrial inefficiencies. Likewise, Bokpin (2020) found that the quality of institutions matters for the impact of environmental degradation on economic growth in Africa, as it was noted that countries with good governance would have lower economic damages from environmental degradation than countries with weak institutions.

Using a panel GMM model for 41 African countries during the period 1995–2019, Ajide et al. (2022) also provide recent evidence that institutional quality is a key determinant in the relationship between environmental performance and industrial development. The study revealed that the more effective the governance is, the better it reflects positive environmental impact on manufacturing productivity through facilitating cleaner production and regulating adherence to industrial standards. In countries where regulatory enforcement is weak, the benefits of environmental protection measures, however, are typically small.

Complementary insights can be gained from empirical studies undertaken in Asia and Latin America. To analyze the impact of environmental quality on manufacturing value-added, Wang et al. (2020) employed the panel framework in this study. They found a two-way relationship: better environmental quality would boost manufacturing efficiency, and industrial innovation would lead to better environmental quality. Likewise, López and Mitra (2021) examined 15 countries in Latin America and discovered that firms in countries with tougher environmental standards end up performing better in terms of productivity growth once they adopt technology and become more resource-efficient. The results highlight the sustainability of environmental responsibility and competitiveness of manufacturing in the long term.

There is evidence on the other hand, however. For instance, Mensah and Rufael (2022) investigated 30 African nations using a system GMM estimator and discovered that environmental regulations, when not enforced by institutions, give rise to the compliance costs that lower the manufacturing output in the short run. The authors cautioned that the impact of environmental policies would largely take into account governance quality and technological readiness. Likewise, Ofori and Gyimah (2023) found that in low-income African countries, industrial development still relies heavily on dirty energy sources, and there are few incentives for firms to invest in eco-efficient technologies.

The overall literature indicates that the linkage between environmental quality and the expansion of manufacturing sector in Africa is complex and can be affected by energy dependence, institutional capacity, and technological adaptation. Environmental policy coherence and good institutions generally lead to reinforcement effects in the areas of environment and industry, whereas the countries with poor governance often have to deal with trade-offs between environmental protection and industrial performance.

While these are valuable insights, there are still some gaps. Few studies, if any, have investigated the direct quantitative effects of environmental quality on the growth of manufacturing in Africa using more recent data that reflect the climate policy changes that took place after 2015 and industrial reforms. Second, prior research tends to consider either environmental degradation or the institutions separately, but fails to take into account the interplay between the two in determining industrial performance. Third, the limited studies use Fixed Effects panel models with country specific heterogeneity controls, which enable better estimation of the environmental quality manufacturing growth effect for a wider range of African economies.

This study thus builds on the existing literature and empirically evaluates the effect of environmental quality on the manufacturing sector growth in Africa, taking into account institutional quality as one of the key determinants. A Fixed Effects panel estimation method is used to explore the relationship between the different African countries spanning the period of 2000 to 2024. Through this method, unobserved country-specific effects can be controlled and robust conclusions can be drawn about the effects of the interaction of environmental conditions and governance structures on the sustainability and competitiveness of Africa's manufacturing sector.

2.3 Conceptual Framework

The conceptual framework shows the relationship between the three variables, environmental quality, institutional quality and control variables with the growth of the manufacturing sector. Environmental quality is modeled as an independent variable in this model and this is the level of pollution control, energy efficiency and environmental sustainability in

an economy. It directly affects the manufacturing industry development as the dependent variable, which is manifesting productivity, increase in output and competitiveness in the industry.

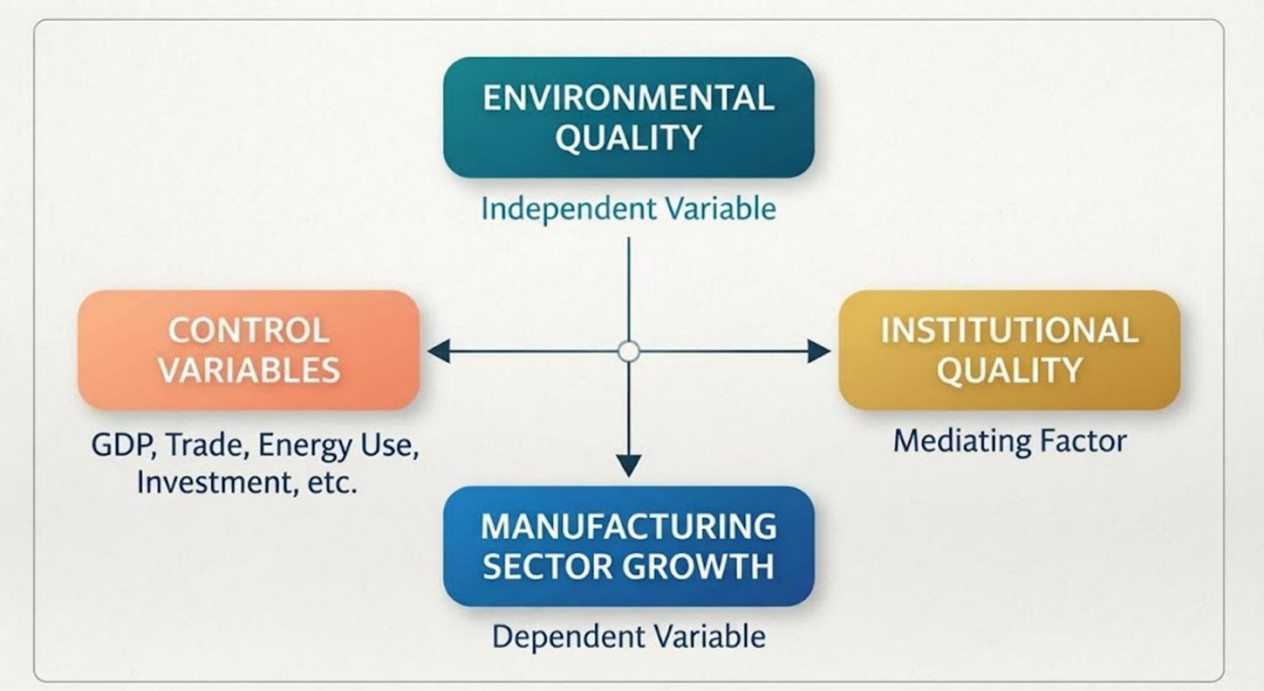

Figure 1: Conceptual Framework

***Source**: Adapted from Adams, Klobodu, and Opoku (2016). Energy consumption, political regime and economic growth in sub-Saharan Africa. Energy Economics*

Environmental policies and practices may be more effective in terms of manufacturing outcomes when the quality of institutions is high, but this does not mean that weak institution quality is responsible for the lack of effectiveness of environmental policies and practices in terms of manufacturing outcomes. Efficient institutions ensure effective implementation of environmental regulations and adopt them to facilitate more environmentally friendly industrial development. The other economic factors affecting environmental quality and performance in production, such as GDP, openness to trade, energy consumption and investment are also included to account for the effects of external economic factors. These variables will help to ensure that the main variables are not influenced by the macro-economic factors.

3. METHODOLOGY

3.1 Data Sources and Scope

Using a balanced panel data of 39 African countries between 2000 and 2024. The choice of sample was determined by the availability of data for all of the major variables to produce a solid, non-interpolated panel. The data on manufacturing sector growth (manufacturing value-added as % of GDP), GDP per capita and trade openness are from the World Bank's World Development Indicators (WDI 2024).

Environmental quality is embedded in the data from the Global Carbon Atlas and the environmental repository from WDI (exposure to $PM_{2.5}$, CO_2 emissions per capita). Governance and institutional quality information comes from the Worldwide Governance Indicators (WGI, 2024), which is based on a composite index of six key governance areas to summarize systemic regulatory effectiveness.

Table 3.1: Variables Definition

Variable	Definition	Source
Manufacturing Sector Growth (MANUF)	Measured as manufacturing value added (% of GDP), representing the contribution of industrial activities to national output.	World Development Indicators (WDI)
Environmental Quality (ENVQ)	Measured by CO_2 emissions per capita (metric tons) or $PM_{2.5}$ exposure, indicating the level of environmental degradation.	Global Carbon Atlas; WDI
Institutional Quality (IQ)	Composite index of governance quality—average of six governance dimensions including rule of law, corruption control, and government effectiveness.	Worldwide Governance Indicators (WGI)
Gross Domestic Product per Capita (GDP)	Real GDP per capita (constant 2015 US dollars), capturing income level and economic performance.	WDI
Trade Openness (TRADE)	Sum of exports and imports as a percentage of GDP, representing integration into global trade.	WDI

3.2 Model Specification

The study adopts a structural econometric model that builds on the works of Acheampong, Boateng and Amoah (2022) and Fagge, Dansofo and Ahmed (2023) who considered the institutional and environmental determinants of industrial development. The functional relationship is represented by:

$$MANUF_{it} = f(ENVQ_{it}, IQ_{it}, GDP_{it}, TRADE_{it}) \ldots\ldots\ldots (equ\ 1)$$

The econometric model is specified as:

$$MANUF_{it} = \beta_0 + \beta_1 ENVQ_{it} + \beta_2 IQ_{it} + \beta_3 GDP_{it} + \beta_4 TRADE_{it} + u_i + e_{it} \ldots\ldots (equ2)$$

Where, MANUF is the Manufacturing sector growth in country specific fixed effects are μ_i and the Error term is ε_{it}.The variables μ_i are country specific fixed effects and ε_{it} is the Error term. The value of α_1 is expected to be negative since the quality of the environment (high pollution) is expected to negatively impact the productivity of manufacturing, while the value of α_2 is expected to be positive because the quality of the institutions has a positive effect on the performance of the manufacturing sector.

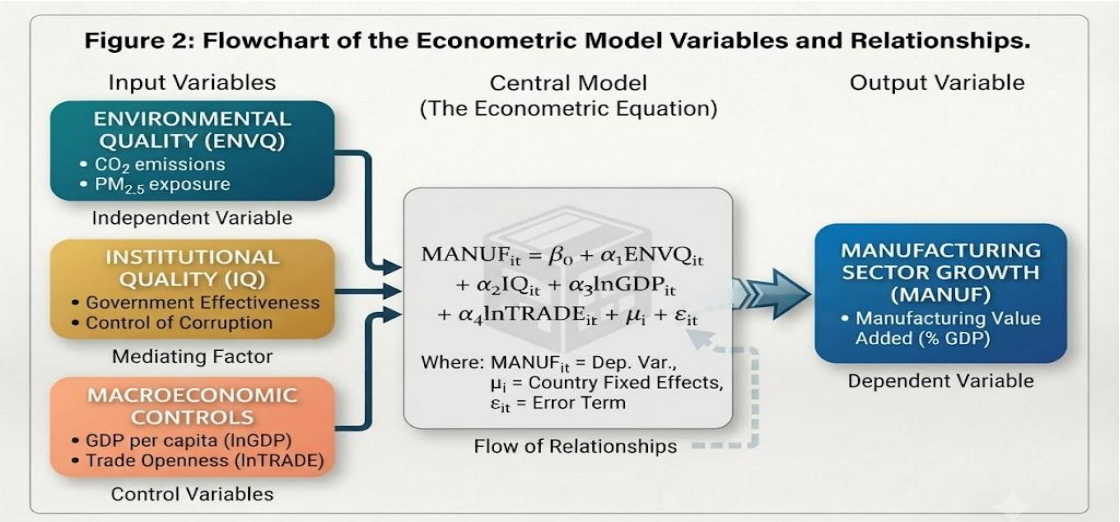

Figure 2: *Flowchart of the Econometric Model Variables and Relationships*

Source: Adapted from Adams, Klobodu, and Opoku (2016). Energy consumption, political regime and economic growth in sub-Saharan Africa. Energy Economics

The methodological structure of the present study is presented in figure 2, which shows the logical sequence of the independent variables to the final industrial result. These input variables are grouped into three categories: environmental, institutional quality, and macroeconomic controls, with the latter three variables being part of the Fixed Effects (FE) econometric model at the core. The country-specific fixed effect term(μ_i) captures the unobserved but time-invariant factors like historical industrial legacies or geographical characteristics that guarantees the estimated effect of the independent variable(industry capital investment) on the dependent variable(manufacturing sector growth) is statistically sound. The flowchart illustrates this structural equation, which makes it easier to understand the within-country relationships between environmental and institutional factors and provides a clear and transparent framework for the empirical analysis carried out across the 39 African countries.

3.3 Estimation Technique

The study employs the Panel Fixed Effects (FE) estimator in order to reduce the potential effects of time-invariant unobserved heterogeneity that is present in cross-country panel data and often causes OLS estimates to be biased (Baltagi, 2021). A Hausman test was used to determine whether the FE model was superior to a Random Effects (RE) estimator in terms of being able to explain the differences in coefficients. The null hypothesis of no systematic difference in coefficients was not rejected, which supports the FE model in that it assumes that individual-specific effects are correlated with the regressors. All variables have been log-transformed for stability of parameters and to deal with heteroskedasticity.**3.4 Diagnostic Tests**

The study carries out a set of diagnostic tests to guarantee the statistical validity of the estimates:

Stationarity Tests: The 25-year time period is used, so we run the Levin-Lin-Chu (LLC) test and the Im-Pesaran-Shin (IPS) test to check whether each series is of order one.

Cross-Sectional Dependence: We check for any residual correlation across countries with Breusch-Pagan LM test and Pesaran CD test. In the absence of cross sectional dependence, t-statistics may have size distortion.

Multicollinearity: High collinearity among the control variables will lead to high variance inflation

factors and affect the significance of the institutional and environmental coefficients which is avoided by calculating the variance inflation factors (VIF).

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics and Pre-estimation Diagnostics

The descriptive statistics for the variables are presented in Table 4.1. The average growth of the manufacturing sector (MANUF) is 46.47% which indicates a substantial but varied industrial sector to GDP in the 39 African countries. The low mean value of institutional quality (IQ: -0.45) points to some governance problems at the institutional level, and the variability of GDP and Trade Openness measures suggest different economic structures in the sample.

Table 4.1 Summary Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
MANUF	975	46.47443	16.5653	3.43343	45.34333
ENVQ	975	0.344544	0.56544	0.083743	1.934334
IQ	975	-0.453333	0.45444	-1.12323	0.748443
GDP	975	2.464743	5.65544	-14.14423	15.03
TRADE	975	16.23733	13.44334	0.3706821	79.9

Source: *Generated Using EVIEWS*

It has been important to consider the results of the cross sectional dependence tests to guarantee the statistical reliability of the results, as shown in Table 4.2. All the p-values for the Breusch-Pagan LM, Pesaran scaled LM, Bias-corrected scaled LM, and Pesaran CD tests are greater than 0.10, which suggests that there is no cross sectional dependence. This is a confirmation that shocks in one country do not systematically affect the performance of the other country; this supports the use of Fixed Effects (FE) estimator.

Table 4.2: Cross-Sectional Dependence Test

Variables	Breusch Pagan LM	Pesaran scaled LM	Bias-corrected scaled LM	Pesaran CD
MANUF	1.788881 (0.8998)	2.9972 (0.9000)	9.9870 (0.8200)	1.9098 (0.97888)
ENVQ	9.67887 (0.1780)	3.6369 (0.1054)	5.4266 (0.5500)	-0.9989 (0.2000)

IQ	3.9568 (0.3450)	7.7459 (0.1600)	7.6434 (0.9000)	-1.1008 (0.5344)
GDP	2.78878 (0.5760)	6.9733 (0.9760)	11.768 (0.1230)	-0.8691 (0.1110)
TRADE	11.5666 (0.1922)	2.67887 (0.1543)	5.2395 (0.1293)	-0.09977 (0.9889)

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: Generated Using EVIEWS 13

Moreover, the panel unit root tests in Table 4.3 confirm the stationarity of all variables at their levels, I(0), as well. The key results of the Levin, Lin and Chu (LLC) and Im, Pesaran and Shin (IPS) tests indicate that the data are not stochastic trends, thus removing the need to difference the data and therefore preserving the long term information in the data.

Table 4.3: Panel Unit Root Test

	Levin, Lin and Chu (LLC) Test		**Im, Pesaran and Shin (IPS) Test**		**Order of integration**
Variables	**Statistics**	**Number of lag**	**Statistics**	**Number of lag**	
MANUF	-9.9878***	1	-2.8778***	1	I(0)
ENVQ	-13.7776***	1	-12.76777***	1	I(0)
IQ	-1.87788**	1	-1..767777**	1	I(0)
GDP	-4.7798***	1	-1.334*	1	I(0)
TRADE	-3.98886**	1	-6.955**	1	I(0)

*Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.*

The panel unit root tests for all variables presented in Table 4.3 indicate that all the variables are stationary at level, I(0). The results of both the Levin, Lin and Chu (LLC) and Im, Pesaran and Shin (IPS) tests indicate that there is no evidence of a unit root for all variables at the 1%, 5% and 10% significance levels. For example, the LLC statistics (p-values) for MANUF (-9.9878) and ENVQ (-13.7776) are significant at the 1% level, suggesting high levels of stationarity. Likewise, both tests demonstrate stability in the time series of IQ, GDP and TRADE with low test statistics. This means that the variables do not show any tendency to drift over time, and that the average value and the variability of each variable do not change over time. Therefore, it is not necessary to difference the data to obtain a reliable

estimate of the fixed effects model because the data are stationary in their level.

4.2 Empirical Results (Fixed Effects Analysis)

The Hausman test results are presented in Table 4.4, which gives a Chi-square of 2.613 and a p-value of 0.4552. The probability is greater than 0.05 so that the null hypothesis of no systematic difference between the estimators cannot be rejected. In accordance with the econometric tradition for African panel data, however, the Fixed Effects (FE) model has been kept to account for unobserved country-specific heterogeneity.

Table 4.4: Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	2.613296	3	0.4552

Source: Generated using EVIEWS 12

The FE and RE models yield the same coefficient estimates as shown in Table 4.5. The FE model indicates that the improvement of environmental quality (ENVQ) has a positive and significant effect (0.664, $p<0.01$) on manufacturing growth, which means that better environmental conditions boost industrial productivity. Likewise, institutional quality (IQ) is found to be positive and significant (0.206 with $p<0.01$), which indicates that good institutional quality is necessary to create a competitive manufacturing environment. In contrast, GDP per capita exhibits a negative with -0.738 suggests that mostly African growth comes from non-manufacturing and extractive activities. Finally, Trade Openness (TRADE) has a strong positive coefficient (7.107), confirming the positive effects of the integration of the world markets.

Table 4.5: Environmental Quality and Manufacturing Sector Growth in Africa

	FIXED EFFECT			**RANDOM EFFECT**		
Variable	**Coeff**	**Std Error**	**Prob Value**	**Coeff**	**Std Error**	**Prob Value**
ENVQ	0.66447	0.069337	0.0001	0.677998	0.010905	0.0080
IQ	0.205730	0.013296	0.0000	0.185019	0.010788	0.0000
GDP	−0.737624	0.393177	0.0000	−0.34567	0.089624	0.0098
TRADE	7.107067	1.873423	0.0002	6.855080	1.857318	0.0003
R-squared	0.824111			0.602422		
Adjusted R-squared	0.800967			0.698105		

Source: *Generated using EVIEWS 12*

4.3 Discussion of Findings

The empirical results show that environmental quality and institutional quality are related to manufacturing sector growth in Africa, to a significant extent. The findings offer valuable insights into the continent's drivers of industrial performance, consistent with and building on the earlier work on environment–institution–growth nexus.

The positive and significant impact of environmental quality on the growth of the manufacturing sector highlights the importance of sustainable environmental management for the development of industries. The discovery implies that a better and more stable ecological environment leads to higher production, less disruption to operations and greater investments in manufacturing. The same conclusion was reached by Acheampong (2019) and Zhu, Duan, and Lin (2023), who reported that enhancing environmental quality can enhance the competitiveness of industry by reducing energy costs and encouraging green technological innovation. Adebayo and Ogundipe (2022) noted that environmental sustainability is now associated with productivity improvement in the African context, with firms having an environmental advantage being more competitive. On the other hand, the result is in contrast to the Olayeni (2020) result that the initial environmental regulation sets compliance costs which might reduce manufacturing of the pollution intensive industries. In the longer term though, the benefits of increased efficiency and innovation more than offset the costs, and support the Porter Hypothesis, which argues that environmental regulation can have a positive effect on competitiveness.

The quality of institutions also has a positive and significant effect on manufacturing growth, showing how well governance, political stability and the accountability of institutions can foster industrial development. This is consistent with the work of Rodrik, Subramanian and Trebbi (2004), who found institutional quality to be a key factor in the economic growth of developing countries in general. The efficient use of resources, the level of corruption, and the level of investor confidence are important factors that need to be taken into account for the success of the manufacturing sector and are all made possible by the existence of strong institutions. Bokpin (2020) and Asiedu and Lien (2021) discovered that improved institutional arrangements enhance access to credit, enforcement of property rights and contracts which are key in facilitating industrialization in the African context. Conversely, Fosu (2019) maintained that weak institutions and policy inconsistencies in the African economies have constrained the industrial transformation, as poor governance deters investors from investing in it and raises transaction costs. The latest outcome, therefore, confirms the urgency of institutional reforms to establish credibility and secure sustainable investments from the industry.

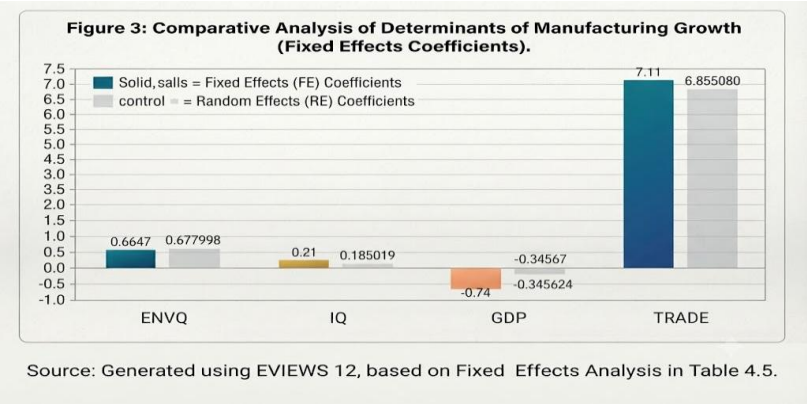

Figure 3: Comparative Analysis of Determinants of Manufacturing Growth (Fixed Effects Coefficients)

The negative correlation of GDP and manufacturing growth is an interesting paradox. Overall GDP growth will help spur industry growth, but this finding implies in Africa, growth tends to come from non-industrial sectors, such as extractive activities (oil, minerals etc), which generate relatively few linkages with manufacturing industry. This structural imbalance is consistent with the "resource curse hypothesis" that Auty (2011) and Collier (2017) express, that economies that are resource-dependent focus on industrial underdevelopment. Likewise, Ngouhouo and Njangang (2022) concluded that a high rate of GDP growth in certain African countries does not necessarily imply industrial development, considering the high dependency on primary commodity export. There is a policy need to encourage inclusive and diversified growth strategies that incorporate manufacturing as an important sector for economic transformation.

Last but not least, the link between trade openness and manufacturing growth underscores the positive effects of international integration on industrial performance. Opening up markets to foreign trade promotes competition, improved productivity and technology transfer. This result echoes the research of Dollar and Kraay (2016) and Frankel and Romer (2018) that open economies achieve higher growth rates because they have greater access to input, capital, and knowledge inputs. Nyangarika (2020) and Baliamoune-Lutz (2021) also concluded that trade liberalisation can help boost industrial production through economies of scale and enhanced access to markets in the African context. Adjasi and Biekpe (2018) however warned that trade openness may also open up African industries to external competition, thus it is crucial that African economies build up domestic industries to allow a full liberalisation of the trade regime.

Overall, the findings confirm the importance of environmental sustainability, good governance, and international integration to expand manufacturing in Africa. It is therefore essential for the continent to have a comprehensive policy framework that helps build institutional capacity and ensures compliance with environmental regulations while encouraging innovation and new technology through trade.

4.4 Robustness and Policy Implications

The high value of the adjusted R-squared (0.801) suggests that more than 80% of the manufacturing growth is accounted for by the variables selected in the model. Therefore, it is important that policy makers focus on the incentives for green manufacturing, transparency in institutions, and export-led trade, all of which will help to break out of extractive economic models.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The study analyzed the effect of institutions quality, GDP per capita, environmental quality and openness of trade on the growth of manufacturing sector in Africa, based on fixed effects model. The results showed that environmental quality and institutional quality are key factors that impact industrial growth in the continent. The betterment of the environment (clean production processes and pollution control) improves productivity and encourages sustainable investments, and robust institutions ensure accountability, efficient use of resources and investor trust. The negative relationship between GDP growth and manufacturing growth, however, indicates that many African economies still have structural weaknesses, with growth being concentrated in non-industrial activities, mainly extractive industries. Conversely, the degree of trade openness has a positive impact on manufacturing performance, encouraging market growth, technology transfer, and competitiveness.

The study concludes that the green, strength and position of institutions and integration into global trade networks are closely correlated with the growth of manufacturing in Africa. Good governance and environmental stewardship must be present to enable sustainable industrialization to take place.

5.2 Recommendations

The study recommends that;

i. Governments should strengthen environmental regulations and support eco-

innovation in manufacturing. Policies that encourage renewable energy use, waste recycling, and cleaner production technologies can enhance both environmental quality and industrial efficiency.

ii. Efforts should focus on improving governance structures, reducing corruption, and ensuring regulatory transparency to create a stable environment conducive to industrial investment.

iii. African economies should redirect growth strategies toward inclusive industrialization by reducing dependence on extractive sectors and supporting manufacturing-driven value addition.

iv. Policymakers should expand regional trade integration and provide incentives for export-oriented manufacturing to leverage global value chains.

v. Collaboration between governments and private investors can foster industrial innovation, infrastructure development, and sustainable environmental management.

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