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RESEARCH ARTICLE

Analysis of Ghana—Nigeria Export Trade: Linkages, Impacts and Policy Implications

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ABSTRACT

This study hypothesised that the Ghana-Nigeria export trade significantly impacts Ghana's economy. Time series on variables of interest were obtained from the World Development Indicators (WDI) of the World Bank and the Ghana Statistical Service (GSS). The 2018 input-output table for Ghana was obtained from the social accounting matrix of the Organisation for Economic Co-operation and Development (OECD). The data were analysed using descriptive statistics, input-output analysis, and the autoregressive distributed lag (ARDL) bound testing approach. Through input-output analysis, this study found significant total impacts (151.585 to 190.139 million Ghana cedis) in 2017 and 2018, centred around export commodities such as food and live animals, beverages, and tobacco. The expanding field of influence (214.373 to 268.898) and the ratio of impacts to Ghana's GDP (0.058% to 0.062%, then 0.044%) substantiate their pronounced role in the economy. The ARDL model showed that a percent increase in Ghana-Nigeria exports led to a 0.1017% increase in Ghana's real GDP on the log-run. The speed of adjustment was 42.18% in each period. Both countries can leverage their comparative advantages, strengthen economic ties, and foster sustained growth through increased export trade by supporting exporters.

Keywords: Agribusiness; Export Trade; Real GDP; Input-Output Analysis; Linkages; OECD

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1. Introduction

Ghana, situated in Sub-Saharan Africa (SSA), is an emerging economy with a modest open market structure reliant on external trade. The nation's economic landscape is a blend of public and private enterprises, with the services, industry, and agriculture sectors contributing to around three-fifths of the gross domestic product (GDP) at respective proportions of 45.92%, 28.26%, and 19.71% in 2021[1]. According to the World Bank[2], exports constituted approximately 37.4%, 20.7%, 29.9%, and 27.5% of the GDP for the years 2019, 2020, 2021, and 2022, respectively.

Ghana's primary exports include cocoa, gold, and petroleum, with key export destinations comprising China, Switzerland, India, South Africa, the Netherlands, and the United Arab Emirates. In 2019, Ghana's exports to Nigeria amounted to US$164.06 million, as per data from the United Nations COMTRADE international trade database. The Ghana National Chamber of Commerce and Industry[3] reported that Ghana contributes less than one percent (0.131%) to Nigeria's import market with beverages, spirits, vinegar, plastics, tanning or dyeing extracts, essential oils, paper and paperboard, soap, and organic surface-active agents, as major export products. The role of exports within neighbouring countries and regions in attracting economic growth in developing countries cannot be overemphasized. This is more serious as countries in this category face long-lasting structural problems, weak policy frameworks and associated institutions, and protection at home and abroad[4]. Other issues include infrastructural shortcomings, high transaction costs, weak integration into globalization, and the government's commitment[5].

Existing empirical studies strongly support export and economic growth in developed and developing countries with mixed directions. The exports in developed economies have a beneficial influence on economic growth, however in less developed economies, they have both positive and negative impacts[5–9]. Lee and Huang[7] adopted a multivariate threshold autoregressive approach and reported consistent output growth in selected Asian countries due to exports. In an earlier study on the relationship between exports and imports on real GDP using time series data in developing countries; Modi[5], Mensah and Okyere[8] found that, although exports' past values could not predict their future values, the coefficient of export positively influenced GDP. In contrast, some studies have observed that exports negatively affect economic growth, particularly when a significant portion of a country's exports consists of primary goods[6–9]. Studies (see for example, Modi[5]; Mensah and Okere[8]; Okyere and Jilu[10]; Tetteh[11]; and Enu, Havi and Hagan[12]) with a focus on Ghana's economy were on overall export and GDP at the macroeconomic level. This present study focused on Ghana's exports to Nigeria, which is a neighbouring country and makes a case for a strong trade relationship between the two countries. Also, this study explores the use of input-output tables for meso-level analysis and the relatively new Autoregressive Distributed Lag (ARDL) bound testing approach to estimate the impact of exports on Ghana's economic growth. Thus, this study considered the impact of Ghana's exports to Nigeria on Ghana's economy.

This study is premised on the fact that Ghana-Nigeria trade is expected to have a significant impact on the economy of Ghana. It can create jobs, generate revenue, and boost economic growth. The outcome of this study can help to quantify these impacts and identify the sectors that are benefiting the most from trade. Export trade, especially regional integration and economic blocs can generate revenue for both the exporting and importing countries[13]. In the exporting country, revenue is generated from the sale of goods to the importing country. In the importing country, revenue is generated from the import duties and taxes that are levied on imported goods. Export trade can boost economic growth in both the exporting and importing countries. In the exporting country, economic growth is driven by the increased production and sales of goods for export. In the importing country, economic growth is driven by the increased consumption of imported goods.

2. Theoretical Consideration

This study is guided by two theories: the export-led growth theory and the Hecksher-Ohlin theory.

2.1. Export-Led Growth Theory

The export-led growth (ELG) theory posits that the proliferation of exports is a pivotal factor in propelling economic growth. According to this idea, a country's overall economic expansion can be attained not only through the augmentation of its labour and capital resources but also by actively fostering and enlarging its exports [14]. The ELG hypothesis has been extensively examined by scholars using different econometric methods and datasets. There is also a substantial body of literature that focuses on developing countries, employing various pragmatic techniques and datasets such as panel data, cross-section data, and time series data. The findings of these studies vary due to differences in econometric approaches, periods analyzed, the inclusion of real or nominal variables, perspectives on causality (unidirectional or bidirectional), control variables in the models, interactive terms, and other factors [15, 16]. Consequently, the association between exports and growth remains a topic of ongoing debate in the literature. According to Feenstra [17], trade openness (exports) remains critical to industrial specialization, as it allows for efficiency in resource allocation and serves as a stimulus to technological development. We believe that Ghana's exports to Nigeria could lead to better resource allocation, and technological improvements in agriculture, manufacturing, tourism, and other areas of comparative advantage. This will have a multiplier effect on Ghana's productivity and economic growth. Rodrik [18] emphasizes the role of policies in ensuring the associated benefits are shared across the economy through infrastructural development, investment in education, and other industry-related policies.

2.2. Hecksher-Ohlin Trade Theory

The Heckscher-Ohlin model, alternatively referred to as the H-O model or 2 × 2 × 2 model, is an economic theory proposing that countries are inclined to export goods that align with their highest efficiency and abundant production capabilities. The Heckscher-Ohlin (H-O) theory, also known as the factor proportions theory, is based on several key assumptions. These assumptions provide the foundation for the Heckscher-Ohlin theory, which explains patterns of trade based on differences in factor endowments and factor intensities between countries [17]. The assumptions are:

(1) Two countries: The theory assumes the existence of two countries engaged in international trade.
(2) Two goods: It considers the production and trade of two goods in the economies of these countries.
(3) Differences in factor endowments: The theory assumes that countries differ in their factor endowments, specifically labour and capital. Factors of production can be classified as either abundant or scarce in a particular country.
(4) Factor intensity: Goods can be categorized as labour-intensive or capital-intensive, based on the factor of production that is most intensively used in their production.
(5) Factor mobility: The H-O theory assumes that factors of production, particularly labour and capital, are not perfectly mobile between countries.
(6) Constant returns to scale: The theory assumes constant returns to scale, meaning that increasing inputs proportionally increases output.
(7) Identical production technologies: It assumes that the production technologies used in both countries are identical.
(8) Perfect competition: The H-O theory presupposes the presence of perfect competition in both the markets for commodities and the markets for means of production.

In this study's context, Feenstra provides the theoretical foundation for understanding how Ghana's factor endowments in manufacturing, agriculture, and tourism, among others, drive its trade with a neighbouring country like Nigeria with ready markets (population). Following Rodrik [18]; while Ghana may benefit from exporting to Nigeria based on its factor endowments, the full economic impact depends on how effectively the country manages trade policies and addresses potential disputes such as income inequality or dependency on a limited range of export goods.

2.3. Related Empirical Studies

In Bangladesh, Islam and Azad [19] analysed the relationship between economic growth (EG) and the export revenues from ready-made garments (RMG) as well as foreign direct investment (FDI). The study used a neoclassical growth function to analyse the impact of these factors on the country's economy. The study utilised annual data from 1986 to 2019. The authors applied the nonlinear autoregressive distributed lag (NARDL) model and the Toda-Yamamoto (T-Y) causality test. The NARDL analysis showed that the export profits of the RMG industry had an unequal impact on economic growth (EG). Panta, Devkota and Banjade [20] examined the export-led growth hypothesis in Nepal by employing a vector error correction model. Their findings indicated a lack of empirical support for the concept, both in the short-term and long-term. Kalaitzi and Chamberlain [6] found evidence of a causal relationship between merchandise export and short-term economic growth in the UAE. Nevertheless, there is insufficient empirical support for the existence of long-term causality, most likely attributable to the nation's heavy dependence on oil, which is susceptible to fluctuations in oil prices.

Md. Alam and Md. Murad [21] reported that economic growth, trade openness, and technological progress had a substantial and lasting effect on the adoption of renewable energy in OECD nations. Hagemejer and Muck [22] reported that exports have exerted a predominant influence on economic growth in central and eastern European countries during the transitional phase and integration with the European Union. Ahmad, Draz and Yang [23] found evidence of a bidirectional causal association between foreign direct investment (FDI) and economic growth in the long run. However, in the short run, they discovered a unidirectional causal relationship between FDI to exports. Moreover, the findings substantiate the credibility of the export-led growth (ELG) and FDI-led growth hypotheses in both the immediate and extended periods. Lee and Huang [7] studied the causal relationship between exports and output in five Asian countries: Hong Kong, Taiwan, the Philippines, Korea, and Japan. The authors employed the multivariate Granger causality methodology and reported evidence of export-led growth, except for Hong Kong, under specific regimes.

Modi [5] examined the influence of both exports and imports on Ghana's economic growth, as measured by real GDP. The study utilised both univariate analyses and VAR-VECM approaches to examine the data and reported a negative correlation between GDP and its previous values when considered together. Furthermore, it was revealed that imports negatively impacted GDP over an extended period, whereas exports had a beneficial effect. The study also found that the rate of adjustment of real GDP was -28%, indicating the speed at which it responds to shocks caused by the model.

Mensah and Okyere [8] examined the causal connection between exports and economic growth in Ghana from 2010 to 2019. Their research reported a reciprocal relationship between exports and economic growth, accompanied by a swift adjustment to balance between exports and real gross domestic product (GDP). Farahane and Heshmati [24] evaluated the relationship between trade and economic growth in South African countries. They found that trade activities have a beneficial impact on economic growth. The report proposed promoting regional development by fostering international trade through the expansion of exports.

Dwi [25] analysed the effects of exports, imports, and investment on economic growth in Indonesia, which is an emerging nation. The findings revealed a statistically negligible and inverse correlation between exports and economic growth, a statistically significant negative effect of imports, and a statistically significant positive effect of investment. Similarly, Kholis [26] found a varied correlation between export and economic growth by the utilisation of pooled least square methods. The results indicate that export growth positively impacts economic growth, but import growth has a negative impact. Dwi [25] and Kholis [26] also verified this complex link in Indonesia through the application of distinct econometric models.

Mohsen [27] reported that in Syria, an increase in exports had a positive impact on GDP in the following years, whereas an increase in imports had a negative impact on GDP in the subsequent years. Dewi and Strisna [28] also noted this correlation between exports and economic growth. Njikam [9] studied the impact of agricul-

tural and manufactured exports on economic growth in Sub-Saharan African nations by employing the stepwise Granger-causality technique. The study found that agricultural exports had a one-way impact on economic growth in 9 out of 21 nations during the export promotion era, whereas manufactured exports had a positive effect on GDP in only 3 out of 21 countries.

3. Methodology

3.1. Study Areas

Ghana is known for its rich cultural heritage. The country gained independence from British colonial rule in 1957, becoming the first sub-Saharan African nation to achieve independence. Ghana has a population of over 30 million people and is home to various ethnic groups, each with their traditions and languages. Nigeria is also located in West Africa and is a diverse and populous country known for its cultural richness, natural resources, and economic potential. Nigeria has a population of over 200 million people, and it is currently the most populous country in Africa and the seventh most populous in the world. **Figure 1** shows the map of Ghana and Nigeria.

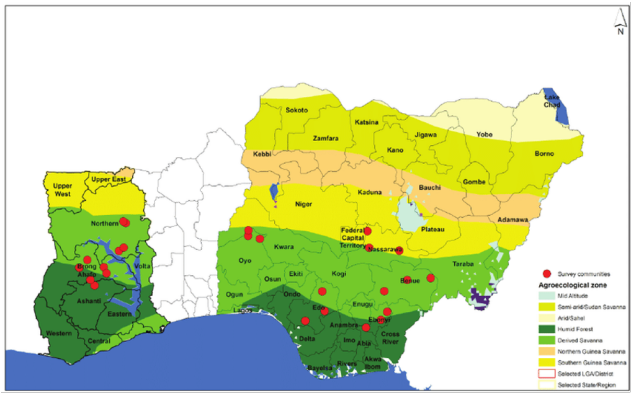

Figure 1. Map of Ghana and Nigeria.

3.2. Data Description and Analysis

Time series data (GDP, export, GDP deflator, population, and wage) for this study were obtained from the World Development Indicatorsindicator of the World Bank and the Ghana Statistical Services (GSS). The input-output table for Ghana was obtained from the social accounting matrix of the Organization for Economic Co-operation and Development (OECD). For this study, Ghana's 22-industry national IO table was reduced to a 17-industry national IO table as illustrated in **Table 1**.

Data analysis was done using descriptive and inferential statistics. The input-output analysis, and the autoregressive distributed lag (ARDL) bound testing model were used to achieve the study's goal.

3.2.1. Input-Output (I-O) Analysis

The I-O analysis modelling technique as introduced by Wassily Leontief in 1930, is suitable for economy-wide analysis since it represents the inter-dependencies between different industries[29]. **Table 1** illustrates the fundamental pattern of an I-O table. It shows that the output produced by industry *i* serves as input for industry *j* (Intermediate demand) and for final demand, which includes consumption by households and government, capital expenditure, and exports. The I-O analysis was used to determine the impact of Ghana-Nigeria exports on Ghana's economy. The model offers insights into the immediate and indirect effects of exports on the economy. The Leontief inverse matrix, shown as P, measures the total output (direct and indirect) of industry *i* required to meet one unit of final demand from industry *j.* This calculation is determined by applying Equations (1) and (2).

$$P = I + A + A^2 + A^3 + A^4 \tag{1}$$

$$P = (I - A)^{-1} \tag{2}$$

The calculation of the vector of change in output (ΔX) resulting from the change in final demand (ΔF), using Equation (3), involves the multiplication of the Leontief inverse matrix (P).

$$\Delta X = P.\Delta F \tag{3}$$

The technical coefficient for a certain macroeconomic indicator, such as employment, is defined according to Equation (4):

$$\gamma_i = q_i / x_i \tag{4}$$

Where q_i and x_i denote the aggregate value of the macroeconomic indicator for industry i and the total production for industry i, respectively.

The multiplier matrix Ý for a certain macroeconomic indicator is derived by multiplying the diagonal

Table 1. Illustration of the 17-industry 2018 Ghana National Input-Output Table Linked to the 2021 Census Industry Employment Classification Format.

Industry	(Outputs) Industries in the Domestic Economy	Household Consumption Expenditures	Other Final Demand	Total Inputs
	1 2 3 17			
1. Agriculture (production) 2. Mining and quarrying 3. Manufacturing 4. Electricity, gas, and steam 5. Water supply and sewage 6. Construction 7. Wholesale and retail trade 8. Transport and storage 9. Hotels, restaurants, and food services 10. Information and communication 11. Finance and insurance 12. Real estate activities 13. Business services 14. Public administration 15. Education services 16. Health and social work 17. All other services	Producing quadrant Or the domestic industries quadrant	Final demand quadrant		
P1. Wages and salaries of workers P2. Incomes of land and capital owners P3. Indirect taxes (government) P4. Non-competing imports P5. Competing imports	Payments quadrant	Payments-to-final demand quadrant		
Total outputs				

Source: Kwabena (2023).

matrix of technical coefficients Y with the Leontief inverse matrix (P) as stated in Equation (5). The multipliers quantify the influence of an industry sector on the other economic sectors [29].

$$\acute{Y} = Y.P \tag{5}$$

Where Y is a 3 by 3 matrix as shown in Equation (6):

$$Y = \begin{matrix} \gamma_i & 0 & 0 \\ 0 & \dots & 0 \\ 0 & 0 & \gamma_i \end{matrix} \tag{6}$$

In Equation (6), the change in the quantity of a specific macroeconomic indicator, Ý, is determined by multiplying it by the change in the final demand vector, ΔF, as demonstrated in Equation (7).

$$\Delta Q = \acute{Y}.\Delta F \tag{7}$$

3.2.2. Auto Regressive Distributed Lag (ARDL) Bound Testing Model

As with time series variables, the series was tested using the Augmented Dickey-Fuller Unit Root Test (URT) before estimation. Post-estimated tests were also conducted using CUSUM and CUSUM SQ. The null hypothesis of the autoregressive unit root was tested using the Augmented Dickey-Fuller (ADF) test as presented in Equation (8).

$$Y_t = \alpha_0 + \beta_1 Y_{t-1} + \sum_{i=1}^{k} \lambda_i \Delta Y_{t-1} + ei \tag{8}$$

Where: Δ = the first–difference operator; Y = the variable under consideration; $\alpha_{0,}\beta_{s \text{ and } \lambda 1}$ = parameters to be estimated; and ei = the error term.

The ARDL bounds testing approach is a cointegration method developed by Pesaran and Shin [30] and Pesaran, Shin and Smith [31]. This model is suitable for analyzing both short-run and long-run relationships between variables, even when the underlying data series are integrated of different orders [i.e., I(0) or I(1)]. This becomes critical since the series considered in this study exhibited mixed levels of stationarity. Another justification for using the ARDL model is its ability to test for the existence of a long-run equilibrium relationship between Ghana-Nigeria exports and Ghana's GDP through

the bound testing procedure. Furthermore, the ARDL bounds testing can be used to create an unlimited error correction model (ECM) using a straightforward linear transformation; the model has both short-run and long-run dynamics [32].

The ARDL bounds testing approach was employed to analyse the long-term and short-term nexus of Ghana-Nigeria exports and Ghana's real GDP, as indicated in Equations (9) and (10).

$$\text{Rgdp}_t = f(\text{NGTRADE}, \text{EGROWTH}, \text{GHAINF}, \text{RMWAGE}, \text{GHAPOP})] \quad (9)$$

$$\begin{aligned}\Delta\ln\text{Rgdp}_t = {} & \beta_0 + \beta_1\ln\text{Rgdp}_{t-1} + \\ & \beta_2\ln\text{NGTRADE}_{1t-1} + \beta_3\ln\text{EGROWTHt}_{-1} \\ & + \beta_4\ln\text{GHAINF}_{t-1} + \beta_5\ln\text{RMWAGE}_{t-1} \\ & + \beta_6\ln\text{GHAPOP}_{t-1} + \sum_{i=1}^{k}\alpha_1 \\ & \Delta\ln\text{Rgdp}_{t-1} + \sum_{i=1}^{k}\alpha_2\Delta\ln\text{NGTRADE}_{1t-1} \\ & + \sum_{i=1}^{k}\alpha_3\Delta\ln\text{EGROWTH}_{t-1} + \\ & \sum_{i=1}^{k}\alpha_4\Delta\ln\text{GHAINF}_{t-1} + \\ & \sum_{i=1}^{k}\alpha_5\Delta\ln\text{RMWAGE}_{t-1} + \\ & \sum_{i=1}^{k}\alpha_6\Delta\ln\text{GHAPOP}_{t-1} + \mu_{it}\end{aligned} \quad (10)$$

Note: The first part of the right-hand side (RHS) of Equation (10) with parameters β_1 to β_6 signifies the long-run parameters of the model. On the other hand, the second part with parameters α_1 to α_6 shows the short-run dynamics of the model.

As seen in Equation (3), the variables were transformed. The log transformation model is used to reduce heteroscedasticity as well as skewness in a model [33], since most economic variables have the feature of being positively skewed and are heteroscedastic.

3.2.3. Bound Cointegration Test

On a general note, the bound co-integration test of the variables in Equation (10) was undertaken using the ARDL method as developed by Pesaran, Shin and Smith [31] and as depicted by Equation (11):

$$\Delta \ln y_{it} = \lambda_0 + \sum_{i=1}^{n}\lambda_i \Delta \ln y_{it-1} + \sum_{j-1}^{p}\beta_j \ln y_{it-1} + \varepsilon_{it} \quad (11)$$

Decision Rule: If F-statistic is more than the critical value of the upper bound, the null hypothesis is to be rejected. On the other hand, if the lower critical bound value is more than the F-statistics, then the null hypothesis is to be accepted and establish the presence of co-integration (long-run relationship) among the variables and vice versa.

The variables used in the model and the unit of measurement are presented in **Table 2**.

4. Results And Discussion

4.1. Ghana's Total Export as a Percentage of GDP

Figure 2 represents the export value as a proportion of Ghana's GDP, providing insights into the relative significance of exports in the country's economy over time.

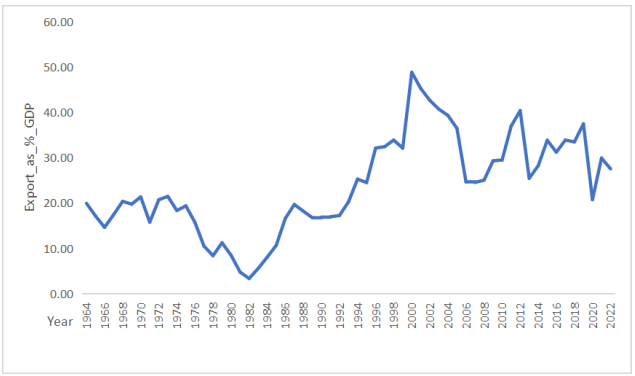

Figure 2. Ghana's Total Export as a Percentage of GDP, 1964–2022.
Source: Authors' computation using WDI of the World Bank Data, 2023.

From 1964 to 1982, the export value as a percentage of GDP fluctuated within a range (**Figure 2**). It varied between 3.34% (in 1982) and 21.45% (in 1973). During this period, Ghana experienced both high and low levels of export value relative to its GDP. In the late 1980s and early 1990s, Ghana's export value as a percentage of GDP generally remained in the range of 16% to 20%. There was a slight increase in the mid-1990s, with values exceeding 20% and peaking at 32.41% in 1997. From the late 1990s to the early 2000s, there was a significant increase in export value as a percentage of GDP, reaching its highest point of 48.80% in 2000. This period marked a notable expansion in Ghana's export sector relative to its GDP. After 2000, the export value as a percentage of GDP experienced a gradual decline. It remained above 30% until 2015 but decreased further in subse-

Table 2. Unit of Measurement.

Variables	Unit of Measurement
RGDP ➔ real gross domestic product	GH₵
NGTRADE ➔ Ghana export to Nigeria	GH₵
EGROWTH ➔ Export growth rate in Ghana	Percentage
GHAINF ➔ Inflation rate in Ghana	Percentage
RMWAGE ➔ Real minimum wage in Ghana	GH₵
GHAPOP ➔ Ghana's population	Number of people

NOTE: GH₵ = Ghanaian cedi (1 USD = 15.45 GH₵ as of July 2024).

quent years. In recent years, there has been some fluctuation in the export value as a percentage of GDP. In 2019, it reached 37.45%, showing a temporary increase. However, in 2020, it dropped to 20.72% before recovering to 29.91% in 2021. The data for 2022 indicates a value of 27.53%. The analysis highlights periods of both growth and decline in the export sector. High export values as a percentage of GDP, signify the sector's significant contribution to Ghana's economic output during those times. However, the subsequent decline suggests challenges or changes that affect export performance.

4.2. Input-Output Analysis

4.2.1. Backward Linkage Impacts

The backward linkages arising from Ghana-Nigeria exports for the domestic economy of Ghana in 2017, 2018, and 2019 are presented in **Table 3**. The backward linkage values indicate the initial, indirect, and total effects on industries within the Ghanaian economy resulting from the export of food and live animals (allocated to the agriculture industry) and beverages and tobacco (allocated to the manufacturing industry) to Nigeria. These linkages provide insights into the extent to which these exports stimulate economic activities and output in various industries.

In 2017, the initial effect of the export of these commodities led to indirect effects that propagated throughout the economy, resulting in a total backward linkage impact of 151.585 million cedis. Similarly, in 2018 and 2019, the total backward linkage impacts were 190.139 million cedis and 155.850 million cedis, respectively. These results signify that the exports of food and live animals, as well as beverages and tobacco, have substantial economic spillover effects, influencing a broad range of sectors beyond agriculture and manufacturing.

The significant backward linkage impacts underscore the role of these exports in promoting economic diversification by stimulating activities across various sectors. This can lead to a more resilient and less dependent economy. Also, the positive linkages suggest that each unit of export in the agricultural and manufacturing sectors generates multiple units of economic activity in other industries. This can contribute to higher GDP growth and enhanced economic resilience.

4.2.2. Forward Linkage Impacts

The results for forward linkages arising from Ghana-Nigeria exports for the domestic economy of Ghana in 2017, 2018, and 2019 are presented in **Table 4**. The forward linkage values indicate the initial, indirect, and total effects on industries within the Ghanaian economy resulting from the export of food and live animals (allocated to the agriculture industry) and beverages and tobacco (allocated to the manufacturing industry) to Nigeria. These linkages provide insights into the extent to which these exports stimulate economic activities and output in various industries.

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Table 3. Backward Linkage Impacts in Million Ghana Cedis Arising from Ghana-Nigeria Export for the Domestic Economy of Ghana for the Year 2017–2019.

		2017			2018			2019		
No.	**Industry**	**Initial Effect**	**Indirect**	**Total**	**Initial Effect**	**Indirect**	**Total**	**Initial Effect**	**Indirect**	**Total**
1	Agriculture	11.000	128.060	139.060	11	127.9439	138.9439	11	103.3826	114.3826
2	Mining	0.000	0.000	0.000	0	0	0	0	0	0
3	Manufacturing	7.833	4.692	12.525	32.018	19.17739	51.19539	25.934	15.53334	41.46734
4	Electricity, gas and steam	0.000	0.000	0.000	0	0	0	0	0	0
5	Water supply and sewage	0.000	0.000	0.000	0	0	0	0	0	0
6	Construction	0.000	0.000	0.000	0	0	0	0	0	0
7	Wholesale and retail trade	0.000	0.000	0.000	0	0	0	0	0	0
8	Transport and storage	0.000	0.000	0.000	0	0	0	0	0	0
9	Hotels, restaurants and food services	0.000	0.000	0.000	0	0	0	0	0	0
10	Information and communication	0.000	0.000	0.000	0	0	0	0	0	0
11	Finance and Insurance	0.000	0.000	0.000	0	0	0	0	0	0
12	Real Estate Services	0.000	0.000	0.000	0	0	0	0	0	0
13	Business Services	0.000	0.000	0.000	0	0	0	0	0	0
14	Public Administration	0.000	0.000	0.000	0	0	0	0	0	0
15	Education	0.000	0.000	0.000	0	0	0	0	0	0
16	Health and Social Work	0.000	0.000	0.000	0	0	0	0	0	0
17	All Other Services	0.000	0.000	0.000	0	0	0	0	0	0
	Total for Whole Economy	18.833	132.752	151.585	43.018	147.1213	190.1393	36.934	118.916	155.85

Source: Authors' computation (2023), using OECD 2018 Data.

The significant forward linkages highlight the interdependence of industries within the Ghanaian economy. The positive effects emphasize how the demand for agricultural and manufacturing exports triggers increased economic activity across diverse sectors. The findings suggest that the initial impact on the agriculture and manufacturing sectors generates indirect and total effects across various industries. This multiplier effect can lead to enhanced economic growth and value creation.

4.2.3. Total Impacts, Power of Dispersion and the Sensitivity of Dispersion

Total impacts, power of dispersion, and sensitivity of dispersion results for the years 2017, 2018, and 2019 are presented in **Table 5**. The total impacts provide an understanding of the overall influence and ripple effect of the initial effect on various industries within the economy. In the context of backward linkage impact (BLI), the initial effect in the agriculture industry has a significant impact on other industries, contributing to the total economic activity. The same can be observed in the forward linkage impact (FLI) for both agriculture and manufacturing. These results indicate that changes in the export of food and live animals (agriculture) and beverages and tobacco (manufacturing) have far-reaching effects on the economy, impacting a range of industries.

The power of dispersion index (PDI) reflects how strongly changes in the initial effect propagate through the economy. In both backward and forward linkages, a higher power of dispersion suggests that changes in the initial effect have a greater influence on other industries. The Sensitivity of Dispersion Index (SDI) measures the relative vulnerability of industries to changes in the initial effect. A higher value implies that an industry is more sensitive to changes in the initial effect. In this case, agriculture and manufacturing exhibit significant power and sensitivity of dispersion, highlighting their pivotal roles in driving economic impacts and influencing other industries.

4.2.4. Economic Impacts from the Final Demand Shocks

The economic impacts from the final demand shocks arising from Ghana-Nigeria exports for the years 2017, 2018, and 2019 (**Table 6**) demonstrate varying trends. In 2017, the total impacts were recorded at 151.585 million Ghana cedis. As of 2018, there was a notable increase of 25.47%, resulting in a total impact of 190.139 million Ghana cedis. However, in 2019, there was a decrease of 18.05%, with total impacts reducing to 155.850 million Ghana cedis.

These findings indicate the dynamic nature of the economic impacts resulting from the export shocks. The increase in total impacts from 2017 to 2018 suggests a positive effect on the economy due to the export activities. This growth could be attributed to factors such as increased demand for Ghanaian exports in the Nigerian market or improved trade relations between the two countries. On the other hand, the reduction in total im-

Table 4. Forward Linkage Impacts in Million Ghana Cedis Arising from Ghana-Nigeria Export for the Domestic Economy of Ghana for the Year 2017–2018.

		2017			2018			2019		
No.	**Industry**	**Initial Effect**	**Indirect**	**Total**	**Initial Effect**	**Indirect**	**Total**	**Initial Effect**	**Indirect**	**Total**
1	Agriculture	11.000	115.241	126.241	11.000	118.209	129.209	11.000	95.315	106.315
2	Mining	0.000	1.194	1.194	0.000	3.007	3.007	0.000	2.443	2.443
3	Manufacturing	7.833	11.283	19.116	32.018	18.508	50.526	25.934	15.109	41.043
4	Electricity, gas and steam	0.000	0.496	0.496	0.000	0.770	0.770	0.000	0.629	0.629
5	Water supply and sewage	0.000	0.111	0.111	0.000	0.135	0.135	0.000	0.111	0.111
6	Construction	0.000	0.145	0.145	0.000	0.167	0.167	0.000	0.137	0.137
7	Wholesale and retail trade	0.000	0.508	0.508	0.000	0.565	0.565	0.000	0.464	0.464
8	Transport and storage	0.000	1.942	1.942	0.000	2.540	2.540	0.000	2.081	2.081
9	Hotels, restaurants and food services	0.000	0.029	0.029	0.000	0.051	0.051	0.000	0.042	0.042
10	Information and communication	0.000	0.165	0.165	0.000	0.366	0.366	0.000	0.298	0.298
11	Finance and Insurance	0.000	0.883	0.883	0.000	1.722	1.722	0.000	1.403	1.403
12	Real estate services	0.000	0.203	0.203	0.000	0.251	0.251	0.000	0.206	0.206
13	Business services	0.000	0.220	0.220	0.000	0.475	0.475	0.000	0.387	0.387
14	Public administration	0.000	0.022	0.022	0.000	0.029	0.029	0.000	0.024	0.024
15	Education	0.000	0.013	0.013	0.000	0.014	0.014	0.000	0.012	0.012
16	Health and social work	0.000	0.292	0.292	0.000	0.299	0.299	0.000	0.246	0.246
17	All other services	0.000	0.005	0.005	0.000	0.013	0.013	0.000	0.011	0.011
	Total for whole economy	18.833	132.752	151.585	43.018	147.121	190.139	36.934	118.916	155.850

Source: Authors' computation (2023), using OECD 2018 Data.

Table 5. Total Impacts in Million Ghana Cedis and the Power of Dispersion and the Sensitivity of Dispersion Arising from Ghana—Nigeria Export for the Year 2017–2019.

		2017				2018				2019			
No.	**Industry**	**BLI**	**PDI**	**FLI**	**SDI**	**BLI**	**PDI**	**FLI**	**SDI**	**BLI**	**PDI**	**FLI**	**SDI**
1	Agriculture	139.060	11.028	126.241	10.011	138.944	8.784	129.209	8.169	114.383	8.822	106.315	8.200
2	Mining	0.000	0.000	1.194	0.095	0	0	3.007	0.190	0	0.000	2.443	0.188
3	Manufacturing	12.525	0.993	19.116	1.516	51.195	3.237	50.526	3.194	41.467	3.198	41.043	3.166
4	Electricity, gas and steam	0.000	0.000	0.496	0.039	0	0	0.770	0.049	0	0.000	0.629	0.049
5	Water supply and sewage	0.000	0.000	0.111	0.009	0	0	0.135	0.009	0	0.000	0.111	0.009
6	Construction	0.000	0.000	0.145	0.011	0	0	0.167	0.011	0	0.000	0.137	0.011
7	Wholesale and retail trade	0.000	0.000	0.508	0.040	0	0	0.565	0.036	0	0.000	0.464	0.036
8	Transport and storage	0.000	0.000	1.942	0.154	0	0	2.540	0.161	0	0.000	2.081	0.160
9	Hotels, restaurants and food services	0.000	0.000	0.029	0.002	0	0	0.051	0.003	0	0.000	0.042	0.003
10	Information and communication	0.000	0.000	0.165	0.013	0	0	0.366	0.023	0	0.000	0.298	0.023
11	Finance and Insurance	0.000	0.000	0.883	0.070	0	0	1.722	0.109	0	0.000	1.403	0.108
12	Real estate services	0.000	0.000	0.203	0.016	0	0	0.251	0.016	0	0.000	0.206	0.016
13	Business services	0.000	0.000	0.220	0.017	0	0	0.475	0.030	0	0.000	0.387	0.030
14	Public administration	0.000	0.000	0.022	0.002	0	0	0.029	0.002	0	0.000	0.024	0.002
15	Education	0.000	0.000	0.013	0.001	0	0	0.014	0.001	0	0.000	0.012	0.001
16	Health and social work	0.000	0.000	0.292	0.023	0	0	0.299	0.019	0	0.000	0.246	0.019
17	All other services	0.000	0.000	0.005	0.000	0	0	0.013	0.001	0	0.000	0.011	0.001
	Total for whole economy	151.585		151.585		190.1393		190.139		155.85		155.850	

Note: BLI = backward linkage impact; PDI = power of dispersion index; FLI = forward linkage impact; SDI = sensitivity of dispersion index.

pacts from 2018 to 2019 might be attributed to changing economic conditions, political instability, shifts in trade policies, or fluctuations in market demand.

It is noteworthy that the ratio of impacts to Ghana's gross domestic product (GDP) remained relatively modest, ranging from 0.044% to 0.062%. This indicates that the direct and indirect impacts from these export shocks, although present, are still relatively small compared to the overall size of Ghana's economy.

4.2.5. Field of Influence

The "Field of Influence" results are presented in **Table 7**. These values represent the impact of the initial shock (export) on the total economy, considering the ripple effects through the supply chain. The variations in the field of influence over these years reflect the dynamic nature of Ghana's economy.

In 2018, we observed a notable increase in the field of influence, with a value of 268.898, compared to 214.373 in 2017. This indicates that the shock had a broader impact on other sectors of the economy, beyond the direct export-impacted industries. However, in 2019, the field of influence decreased to 220.405. This reduction suggests that the shock's overall impact on other industries diminished compared to the previous year.

4.3. Impact of Ghana—Nigeria's Trade on Ghana's Economy

Table 6. Economic Impacts in Million Ghana Cedis from the Final Demand Shocks Arising from Ghana-Nigeria Export in Ghana, 2017 to 2019.

Year	Direct Impacts	Indirect Impacts	Total Impacts	Annual Change in Total Impacts (%)	Gross Domestic Product of Ghana	Ratio of Impacts to GDP of Ghana (%)
2017	18.833	132.752	151.585	-	262,797.966	0.058
2018	43.018	147.121	190.139	25.47	308,587.396	0.062
2019	36.934	118.916	155.850	−18.05	356,544.266	0.044

Source: Authors' computation (2023), using OECD 2018 Data.

Table 7. Field of influence from Ghana-Nigeria export for 2017, 2018 and 2019.

Year	Field of Influence
2017	214.373
2018	268.898
2019	220.405

Source: Authors' computation (2023), using OECD 2018 Data.

4.3.1. Pre-Estimation Test

Before the estimation of the impact of Ghana-Nigeria export on Ghana's economy, the included variables (explained and explanatory) in the model were subjected to stationarity tests (see **Table 8**). The decision was made based on the outcome of the ADF test. The ADF uses a parametric autoregression to approximate the structure of the errors [33]. On application of the ADF test, all the variables attained stationarity at various levels.

The ARDL bounds testing procedure does not require the pre-testing of variables included in the model for unit roots. This is because the procedure is suitable regardless of whether the regressors in the model are purely integrated of order zero (I(0)), purely integrated of order one (I(1)), or mutually cointegrated. However, the application of unit root tests in the ARDL procedure has become necessary to ensure that the variables are integrated of order zero or one and not integrated of order two or beyond. This is important because the computed F-statistics in the ARDL procedure are valid only for variables that are I(0) or I(1) [29]. Based on the outcome (**Table 8**), the variables exhibit different integration orders, and none of them are integrated at order 2 (I(2)). As a result, it is suitable to employ the Autoregressive Distributed Lag (ARDL) Bounds test approach.

4.3.2. ARDL Bound Test for Cointegration

ARDL Bound Cointegration test was employed to ascertain the long-run equilibrium relationship between relevant explanatory variables (Ghana-Nigeria export inclusive) included in the model and Ghana's economy (real GDP) as presented in **Table 9**.

In this study, the number of lags used was decided using the Akaike Information Criterion (AIC); and a value of 3 lags was used. **Table 9** shows that the computed F-statistic exceeds the critical value of the upper bound at a 5% significance level, indicating the presence of cointegration (long-run relationship) among the chosen variables in the model. This suggests that there is a long-run economic relationship between Ghana-Nigeria trade and Ghana's economy.

Following **Table 9**, the estimates of the short-run (**Table 10**) and long-run (**Table 11**) equilibrium relationship between Ghana's exports to Nigeria and Ghana's economy are presented. A short-run analysis was estimated as presented in **Table 10**. The lagged value of the dependent variable in the model (previous year) exhibited a positive and significant relationship with the dependent variable indicating that real GDP adjusted significantly with previous real GDP value in the country. This suggests that there is a degree of persistence or adjustment in the country's real GDP over time, with the previous year's value playing a significant role in shaping the current year's value.

Table 8. Result of Augmented Dickey-Fuller (ADF) Test.

Variables	ADF Stat	Critical Value @ 5%	Prob.	Order	Decision
Rgdp	0.7799	−2.9155	0.9928	Δ I(0)	Not stationary
Rgdp	−3.5006	−2.9155	0.0000***	Δ I(1)	Stationary
NGTRADE	−4.5585	−1.9469	0.0000***	Δ I(0)	Stationary
EGROWTH	−5.2896	−2.9155	0.0000***	Δ I(0)	Stationary
GHAINF	−1.6703	−1.9469	0.0393**	Δ I(0)	Stationary
RMWAGE	−0.8907	−1.9469	0.3258	Δ I(0)	Not stationary
RMWAGE	−8.6653	−1.9469	0.0000***	Δ I(1)	Stationary
GHAPOP	3.9938	−1.9469	1.0000	Δ I(0)	Not stationary
GHAPOP	−11.8645	−2.9177	0.0000***	Δ I(1)	Stationary

Source: Authors' computation using EViews 11

Note: Δ = difference operator; *** and ** mean that figures are significant at 1% (P < 0.01) and 5% (P < 0.01) level of significance, respectively; the interpretation of ADF statistics and critical values is done using absolute values; RGDP = Ghana's real GDP; NGTRADE = Ghana-Nigeria export trade; EGROWTH = export growth rate; GHAINF = Ghana inflation rate; RMWAGE = real minimum wage; GHAPOP = Ghana's population.

Table 9. ARDL Bound Test for Cointegration.

F–statistic →4.1410 **Critical Value Bounds**		
Significance	IO Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

Source: Authors' computation using E-Views 11, 2023.

The key variable in the short-run model is the coefficient of the error correction model (ECM) known as "CointEq(−1)". This coefficient was found to be less than 1, highly significant and negatively signed as expected. Its value of −0.4218 indicates the magnitude of the error correction term and signifies the speed at which adjustments are made towards long-run equilibrium. A negative and significant coefficient suggests that, any deviations from the long-run equilibrium are corrected at a rate of approximately 42.18% in each period. The ECM coefficient indicates the strength and direction of the relationship between the current and lagged values of the variables in the model. It confirms that there is a significant and negative adjustment mechanism operating in the short run, allowing the system to move towards the long-run equilibrium.

From **Table 11**, four variables were significantly signed. These are Ghana-Nigeria export trade, export growth rate, inflation rate, and population. Hence, discussions will be based on these significant variables.

- **Ghana-Nigeria Export Trade**

The coefficient indicates that a 1% increase in Ghana-Nigeria export trade is associated with a 0.1017% increase in Ghana's real GDP on the log-run. This implies that export trade between the two countries has a positive impact on economic output, with each percentage point increase in export trade leading to a 0.1017% increase in real GDP. The high level of significance (1% level) suggests that the positive association between Ghana-Nigeria export trade and the dependent variable is not likely due to chance and it is statistically reliable. Consequently, export trade plays a significant role in driving economic expansion and has the potential to stimulate economic growth and output. This finding agrees with Modi [5] who reported that Ghana's total exports have a positive impact on GDP. However, from **Table 10**, the lagged value of Nigeria-Ghana export was negatively signed and significant at 5%. This means that, in the short run, an increase in Ghana-Nigeria export trade is associated with a decrease in real GDP. This suggests that in the immediate term, an expansion of export trade between the two countries may have a dampening effect on overall economic output. The negative coefficient may imply short-term adjustments and transitional effects that could hinder the positive impact of ex-

Table 10. Short-Run Relationship between Ghana-Nigeria Trade and Ghana's Economy.

Variables	Coefficient	Std. Error	t-Statistic	Prob.
D(LNRGDP(−1))	0.7188	0.1300	5.5289	0.000***
D(LNRGDP(−2))	−0.1641	0.1230	−1.2629	0.2150
D(LNGH_NGTRADE)	0.00009	0.0246	0.0367	0.917
D(LNGH_NGTRADE(−1))	−0.0604	0.0263	−2.2955	0.0278**
D(LNEGROWTH)	0.0524	0.0686	0.7644	0.4497
D(LNEGROWTH)(−1))	0.2295	0.0688	3.3359	0.0020***
D(LNGHAINF)	−0.0907	0.0436	−2.0794	0.0450**
D(LNGHAINF)(−1))	0.23433	0.0613	3.8245	0.0005***
D(LNGHAINF)(−2))	0.0073	0.0533	0.1367	0.8921
D(LNGHAINF)(−3))	0.1277	0.0469	2.7239	0.0100***
D(LNRMWAGE)	−0.0332	0.1261	−0.2638	0.7935
D(LNGHAPOP)	−0.9391	8.0962	−0.1160	0.9083
C	0.8008	0.2539	3.1545	0.0033***
CointEq(−1)	−0.4218	0.0813	−5.1863	0.0000***

Source: Authors' computation using E-Views 11.

Note: Dependent Variable = Ghana's real GDP, Explanatory variables ➔ LN = Natural logarithm, GH_NGTRADE = Ghana-Nigeria export trade, EGROWTH = export growth rate, GHAINF = Ghana inflation rate, RMWAGE = real minimum wage, GHAPOP = Ghana's population. *** and ** = coefficient significant at 1% and 5% significance respectively. Cointeg = LNRGDP – (0.01017*LNGH_NGTRADE – 0.7798*LNEGROWTH – 0.9003*LNGHAINF + 0.0492*LNRMWAGE + 0.5575*LNGHAPOP).

Table 11. Long-Run Relationship between Ghana-Nigeria Trade and Ghana's Economy.

Variables	Coefficient	Std. Error	t-Statistic	Prob.
LNGH_NGTRADE	0.1017	0.0272	3.7353	0.0003***
LNEGROWTH	−0.7798	0.3065	−2.5444	0.0155**
LNGHAINF	−0.9003	0.2723	−3.3069	0.0022***
LNRMWAGE	0.0492	0.3758	0.1309	0.8966NS
LNGHAPOP	0.5575	0.3141	1.7746	0.0847*

Source: Authors' computation using E-Views 11.

Note: Dependent Variable = Ghana's real GDP, Explanatory variables ➔ LN = Natural Logarithm, GH_NGTRADE = Ghana-Nigeria export trade, EGROWTH = export growth rate, GHAINF = Ghana inflation rate, RMWAGE = real minimum wage, GHAPOP = Ghana's population. ***, **, and * = coefficient significant at 1 per cent, 5 per cent, and 10 per cent level of significance respectively. NS= not significant.

port trade on real GDP. Factors such as exchange rate volatility, supply chain disruptions, or initial resource reallocation could contribute to this negative relationship.

- **Export Growth Rate**

The coefficient of the overall export growth rate shows that a 1% increase in export growth rate will reduce Ghana's real GDP by 0.7798% in the long run at a 5% level of significance. However, a 1% increase in export growth rate on the short run will increase real GDP by 0.2295% at a 1% level of significance for the lagged value. The result indicates that in the short term, as the export growth rate improves, it leads to a positive impact on the country's real GDP. This relationship can be explained by the immediate effects of increased export activity, such as higher demand for goods and services, increased employment, and overall economic expansion. However, there is a diminishing effect of the export growth rate on real GDP over time. This can be attributed to factors such as diminishing returns or saturation in export markets, where the initial positive impact on GDP diminishes as the export sector reaches its capacity or faces increasing competition. Additionally, it could reflect the potential vulnerability of Ghana's economy relying heavily on exports, as fluctuations in global demand or changes in trade policies can have adverse long-term effects.

- **Ghana Inflation**

The result indicates that a 1% increase in the inflation rate will lead to a 0.90% and 0.09% decrease in Ghana's real GDP in the long-run and short run, respectively. This finding signifies a consistent inverse relationship between the inflation rate and Ghana's real GDP. The result indicates that inflationary pressures can potentially hinder economic output and activity in the immediate and long term. High inflation erodes the purchasing power of consumers, reducing their ability to

spend and impacting overall economic demand [34].

- **Population**

The coefficient of population shows that there is a positive relationship between population and real GDP in Ghana. Specifically, a 1% increase in Ghana's population is associated with a 0.5575% increase in the country's real GDP at a 10% level of significance. This finding suggests that population growth can have a positive impact on economic output and contribute to overall economic expansion. An increase in population leads to a larger labour force, which can positively affect real GDP. A larger labour force means more workers available for production, potentially resulting in increased productivity and output.

4.3.3. Post Estimation Tests

To assess the normality, stability, and significance of the model, various econometric tests were conducted. These tests are crucial for determining effective economic policy as they guarantee that the deviations in the model follow a normal distribution and that the model remains consistent over time, in line with long-term economic goals and macroeconomic objectives. The Jarque-Bera test results, as illustrated in **Figure 3**, suggest that the errors in the model conform to a normal distribution during the studied period. The normal distribution of errors is highly significant, especially when evaluating the computed econometric equation.

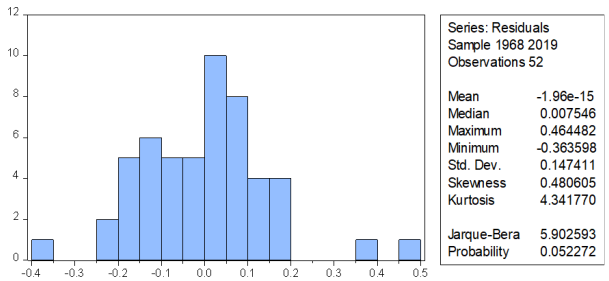

Figure 3. Normality Test of the Model.

To guarantee the dependability of the findings, supplementary post-estimation tests were conducted. The CUSUM and CUSUM of squares tests are the most often employed methods in the field of econometrics for evaluating stability. The results of the CUSUM and CUSUM of squares tests for the model are displayed in **Figures 4 and 5**. The CUSUM test examines the cumulative sum of equation errors in the regression analysis. The graphs display the cumulative accumulation of mistakes, together with the critical lines at the 5% significance level. According to the findings of this study, the equation parameters can be considered stable because the blue lines in the CUSUM and CUSUM of squares are within the range defined by the two red lines. In general, equation parameters are deemed unstable if the sum of recursive errors extends beyond the two critical lines. The difference between CUSUM and CUSUM of squares resides in the use of recursive double errors in the latter, as opposed to recursive errors in the former.

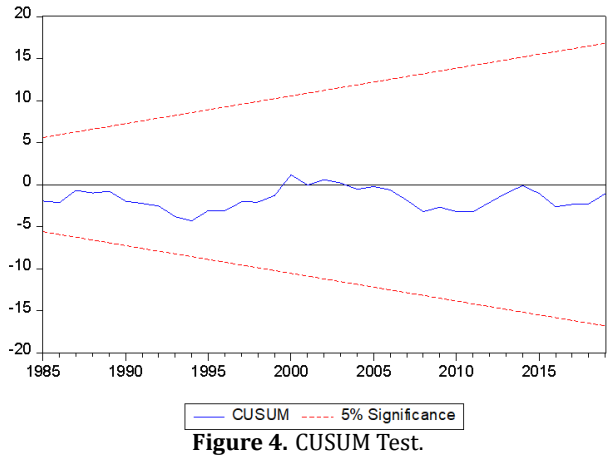

Figure 4. CUSUM Test.

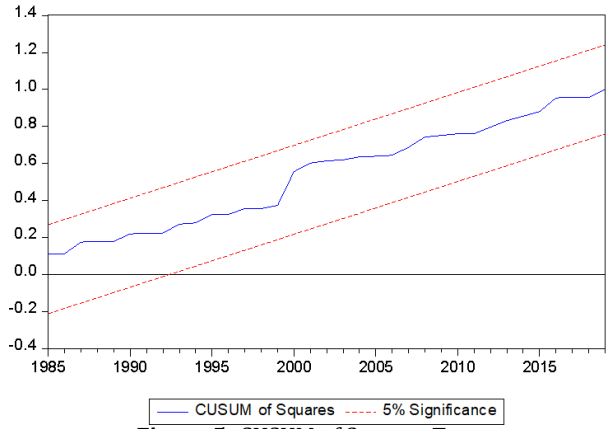

Figure 5. CUSUM of Squares Test.

5. Conclusions and Recommendations

5.1. Conclusions

The analysis of backward and forward linkages, economic impacts, and fields of influence underscores

the role of the agricultural and manufacturing sectors, particularly in export commodities. Ghana-Nigeria trade has a positive and significant impact on Ghana's economy in the long-run. Also, when there are differences in the long run, they are corrected at a rate of about 42.18% per period. Consequently, there is a noticeable and negative adjustment mechanism in the short term, which helps the system move closer to the long-run balance.

5.2. Policy Recommendations

- Strengthening the bilateral trade partnership between Ghana and Nigeria should involve bilateral agreements that streamline agricultural trade, simplifying customs procedures, and reducing trade barriers for agricultural products, given their interconnected trade dynamics.
- Capitalizing on the established positive connections in both backward and forward sectors, collaborative cross-border agro-industrial zones should be explored by Ghana and Nigeria, fostering value addition, processing, and packaging of agricultural products for export.
- Sustained export-led growth and economic development can be achieved through continuous robust policies and strategies in Ghana. This includes prioritizing export-oriented industries, facilitating trade, attracting foreign direct investment, improving infrastructure, and nurturing a conducive business environment.

The policy options emphasize leveraging the established positive connections in both backward and forward sectors. This approach encourages the creation of cross-border agro-industrial zones, fostering value addition, processing, and packaging of agricultural products for export. This innovative strategy aligns with the interconnected trade dynamics between Ghana and Nigeria and promotes regional economic growth and development.

Author Contributions

Conceptualization, M.K.I. and U.M.S.; methodology, U.M.S.; software, U.M.S.; validation, M.K.I.; formal analysis, M.K.I. and U.M.S.; curation, U.M.S.; writing—original draft preparation, U.M.S.; writing—review and editing, M.K.I.; supervision, M.K.I. Both authors have read and agreed to the published version of the manuscript.

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The data presented in this study are available on request.

Conflicts of Interest

The authors declare no conflict of interest.

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