OPEN ACCESS
Saudi Journal of Economics and Finance
Abbreviated Key Title: Saudi J Econ Fin
ISSN 2523-9414 (Print)|ISSN 2523-6563(Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage:http://saudijournals.com

Original Research Article

Does Regional Integration Insulate Member Countries from External Spillovers? Studying Trade Shock Transmission between ECOWAS and the Global Economy

James Kelechi Obinna (PhD) [1*], Isiwu George Duhu (PhD) [2]

[1]National Health Insurance Authority, Abuja, Nigeria
[2]Department of Economics, Enugu State University of Science and Technology (ESUT), Enugu, Nigeria

DOI: 10.36348/sjef.2023.v07i06.004 | **Received:** 29.12.2022| **Accepted:** 02.02.2023| **Published:** 23.06.2023

***Corresponding author:** James Kelechi Obinna
National Health Insurance Authority, Abuja, Nigeria

Abstract

To ascertain if regional economic integration insulates member countries from external spillovers, this work studied the transmission of trade shocks between ECOWAS and the global economy. It adopted the Diebold and Yilmaz (2009) network approach using quarterly data from 1986Q1to 2019Q4 for selected countries. Data were subjected to preliminary tests using the Phillip-Peron unit root test to establish the order of statonarity and Johansen co-integration test to establish existence of co-integration among variables. Following results of preliminary tests, the underlying VAR model was estimated in error correction form. The forecast error variance decompositions (FEVDs) were subsequently generated and used to build generalized trade linkage measures for analysis. Result of the analysis show that ECOWAS economies are highly linked to the global economy, and are net receivers of trade shocks. The study recommends ECOWAS countries diversify to heavy industrial manufacturing, fashion out uniform trade policies to insulate the region from potential trade shocks.

Keywords: ECOWAS, Global Economy, Trade Shock, Network Approach, Trade Linkage Measures.

INTRODUCTION

Increasing globalization and economic integration raises a number of important issues. Primarily, it exposes countries to external spillovers or shocks. The uncertain impact of such shocks causes great anxiety to economic policy makers and managers world over. The concern also raises interest in understanding the relationship of external shocks and policy responses which is the missing link between trade and economic growth. International trade linkages generate demand and supply side spillovers across countries. In some instances, on the demand side, a consumption or investment in one country can result in increased demand for imports, thereby boosting economies abroad. Furthermore, international trade can induce macroeconomic fluctuations in a small open economy by two channels: one channel is through trade in goods and services, and the other one is by trade in financial assets.

In African economies, these two channels have distinctive important roles in shaping domestic economic activities: first, the volume of international trade, on average, accounts, for more than half of the aggregate output in these countries. Moreover, a narrow range of primary commodities constitutes a significant fraction of their exports, and their main imports items are intermediate inputs and capital goods. Their export earnings are highly unstable in nature due to recurrent and sharp fluctuations in the prices of primary commodities. Second, most of the African countries have huge debt profiles as such a significant fraction of their export revenues are used for purposes of debt servicing. These make African countries extremely vulnerable to changes in world interest rate.

Trade agreements among member countries of the regional trade blocs are gathering momentum because globalization remains contentious subject due to the mixed benefits and opportunities it presents to participating countries. In particular, it makes countries vulnerable to external shock. Granted that shocks often occur, and granted further that African countries have largely significant trade linkage with the rest of the world, thereby exposing them to global trade shocks.

Across the continent, the intra- regional economic community's trade varies considerably, reflecting factors such as differences in the level of economic integration and in the sizes of the regions.

ECOWAS is a regional and economic union of fifteen countries located in West Africa. These countries are Benin, Burkina Faso, Cape Verde, Cote d'ivoire, the Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. These countries comprise an area of 5, 114,162km² (1,974,589 sqm) and in 2015 had an estimated population of 377,437million (UNDESA, 2017). Established in May, 1975, the goal of the body is to achieve "collective self-sufficiency" for its member states by creating a single large trade bloc by building a full economic and trading union. Despite efforts at regional trade integration, ECOWAS countries still trade more with other parts of the world pre-dominantly Europe, the America's and Asia. In 2016 intra-ECOWAS trade constituted 10.7% of total trade of the group with 5.6% being with the rest of Africa and 83.7% with the rest of the world (UNCTAD, 2019). The trade complementarity index measures the trade interactions among a group of countries. Low figures indicate a low correspondence or match between the export supply and import demand among the regional economic communities members. The trade complementarity index for ECOWAS in 2016 was 19.8% compared to 85.9% for European Union, 80.3% for NAFTA (North America Free Trade Agreement), 73.2% for ASEAN (Association of South East Asian Nations), 44.5% for SADC (Southern African Development Community), 39.7% for COMESA (Common Market for East and Southern Africa) and 39.1% for MERCOSUR (Southern Common Market for its Spanish initials) (UNCTAD 2019).

The total export value of ECOWAS from 2013-2019 was $754,965.34 comprising of $688,645.00 or 91.2% extra regional exports and $66,320.34 or 8.8% intra- exports (computed from Africa trade statistics, 2020). The imports segment follows similar trend with 90.6% of total imports being from outside the bloc and 9.4% being from within the bloc.

The heavy dependence on extra-regional trade makes ECOWAS vulnerable and less insulated to trade shocks coming from outside the region. Park and Shin (2014) stressed that though interconnectedness among economies could engender shared prosperity, it nonetheless encourages the rapid propagation of real and financial contagion through the global economic and financial system. An in-depth knowledge of how trade shocks are propagated across countries is important for policy purposes.

Identifying the channels of international propagations is also crucial, for example, in designing policies to sterilize undesirable disturbances, it is important to know not only whether shocks have domestic or external origin but also whether transmission occurs through financial markets or through trade in goods.

Clearly, the existing literature appears quite scanty on the trade shock transmission between ECOWAS as a regional economic bloc and the rest of the global economy. This study seeks to establish the degree of trade linkage between ECOWAS and the global economy, determine the key countries outside the region that dominate trade in ECOWAS and hence with greatest capacity to spread trade shocks to ECOWAS region, identify ECOWAS countries that are most vulnerable to global trade shocks emanating from the rest of the global economy and determine regional trade bloc/s in the rest of the world with the potential to spread trade shocks to ECOWAS region.

2. REVIEW OF RELEVANT LITERATURE

2.1 Conceptual Literature

2.1.1 Trade Shocks

Izurieta and Vos (2010) defined trade shocks as net gains or losses from trade caused by changes in international prices and in volume of goods and services that are traded internationally. It relates to shifts in global markets typically outside of individual countries.

Trade shocks are divided into price and volume effects. The net earnings from trade equal export revenue minus import expenditure and changes therein are influenced by both price and volume effect. Consequently, the analysis of trade shocks may involve the estimation of four components (i) the effect of a change in international prices of exported goods. (ii) The effect of a change in the international prices of imported goods (iii) the effect of a change in the volume (quantities) of exports demanded by the rest of the world (iv) the effect of a change in the volume of imports demanded from the rest of the world.

This study will conceptually adopt the above definition and will use aggregate information on global trade and prices linking that to the composition of trade of individual counties in ECOWAS and ECOWAS as a whole.

2.1.2 Trade Shock Transmission Mechanism

Transmission mechanism refers to the propagation of shocks from one country to another through international trade in goods and services. Trade shocks may be as a result of barriers raised by governments, such as tariffs of protective nature. A shock in a country of origin may be driven by different domestic or external factors like political instability, fiscal contraction, banking crisis, etc. This may cause a drop in aggregate demand in the country and implies that the epicenter country may reduce its imports from other countries and/or its investment in financial assets issued by other countries. Thus, the transmission of

global shocks as modeled by Starnini, Boguna and Serrarno (2019), each country is classified in three mutually exclusive states: vulnerable to receive the shock for the first time, active if it has accumulated distress and is able to propagate it, or inactive when it can receive distress from its partners but cannot propagate it anymore. Initially, all countries are in vulnerable state except for the epicenter country, which is active. The susceptibility or resilience of trading partners & regions to shocks depends on its role in the global value chains and the type of shock hitting the economy.

2.2 Theoretical Literature

Issues relating to global trade and its fallouts which include trade shocks and its transmission have been widely studied by scholars with theories and hypotheses put forward to explain them. Some of these theories and hypotheses are:

2.2.1 The Crisis- Contingent and Non-Crisis Contingent Theories

Rigobon (1999) advanced two broad classes of theories relating to propagation of shocks. They are crisis contingent and non-crisis contingent.

The Crisis-Contingent theories are based, primarily on multiple equilibrium, endogenous liquidity and political contagion viewpoints. In general they imply that propagation of shocks is exacerbated by, and contingent upon crises. The Non-crisis contingent theories are based around the role of trade, monetary policy coordination, learning and aggregate shocks such as international interest rates, aggregate shifts in risk aversion, random liquidity shocks and world demand. The theory majorly implies that the methods by which shocks are transmitted during both tranquil periods and crisis periods are similar and that positive and negative shocks have asymmetric effects. This theory was first developed by Gerlach and Smets (1995) and extended by Corsetti, Pesenti, Roubini and Tille (2000).

2.2.2 The Trade Linkage Hypothesis

The trade linkage hypothesis was put forward in the work of Kose and Yi (2001). It states that in the presence of direct trade links, the trade balance and other macroeconomic fundamentals of an economy can be influenced when a crisis in a partner economy leads to a fall in income and demand for imports in the partner's economy. It suggests that if an economy has many distinct trading partners, then there are several ways through which shocks emanating from somewhere can reach it, and there are more avenues through which it can diffuse the impact of such shocks.

2.2.3 The Monsoonal Effects Hypothesis

The monsoonal effects hypothesis is credited to the early work of King and Wadhwani (1990), The hypothesis suggests that a common or global shock can induce contagion so that recessions or major policy changes in advanced economies like changes in commodity prices (e.g. oil price) can induce crises and huge capital outflows from developing economies (Moser, 2003; Claessens and Forbes, 2004). The hypothesis is backed by the findings of Gentile and Giordano (2012).

2.3 Empirical Literature

Canova and Marrinan (1998) studied sources and propagation of international output cycles: common shocks or transmission? It used a multi country model with production and consumption interdependencies. The study considered two sources of disturbance and compared three channels of propagation. The findings show that technology disturbances which are mildly correlated across countries are more successful than government expenditure disturbances in reproducing actual data. It further shows that the presence of a common component to the shocks and production interdependencies appear to be crucial in quantitatively matching the properties of the data. The study in its policy recommendation discouraged the removal of trade barriers across US, Japan, and Germany since it is unlikely to change the way outputs, recessions & expansions spread across the study countries. It also discourages restricting trade practices.

In examining the role of external shocks in explaining macroeconomic fluctuations in African countries, Kose and Riezman (1999) in a study titled "trade shocks and macroeconomic fluctuations in Africa" adopted a quantitative stochastic, dynamic, multi-sector equilibrium model of a small open economy calibrated to represent a typical African economy. In the framework, external shocks was modeled as fluctuations in prices of exported primary commodities, imported capital goods and intermediate inputs and a financial shock modeled as fluctuations in the world real interest rate. Results of their study indicate that while trade shocks account for roughly 45 percent of economic fluctuations in aggregate output, financial shocks play only a minor role. Furthermore, the results shows that adverse trade shocks induce prolonged recessions.

Studying China's rise, asymmetric trade shocks and exchange rate regimes, Caselli (2019) used an index of exports similarly to represent different levels of exposure to Chinese trade competitions. It adopted a Ricardian framework. The study results show that countries with exports similar to those of China experience a loss of competitiveness compared with countries with a different trade structure and that countries with a fixed exchange rate and with relatively high similarity to China experience real appreciation.

In another related study, Cakir and Kabundi (2011) studied Trade Shocks from BRIC to South Africa. They applied a global vector autoregressive model (global VAR) to investigate the degree of trade

linkages and shock transmission between South Africa and BRIC countries (Brazil, Russia, India and China). The results suggest that trade linkages exist between the focus economies but the magnitude differs between countries. The study concludes that shocks from each BRIC country have considerable impact on South African real imports and outputs.

Similarly Ekeocha & Ogbuabor (2020) researched on trade shock transmission between selected African economies, the BRIC and the rest of the global economy. The study aimed at understanding the likely disposition of African economies towards trade shocks. The study adopted the network approach of Diebold and Yilmaz (2009) by constructing a generalized trade linkage measures at various degrees of aggregation. The results indicate that trade linkage between Africa and the rest of the global economy is quite substantial with total trade linkage index having an average value of 87%. The result further shows that China, USA, Japan, EU and Canada dominate Africa's trade and therefore have the potential to spread trade shocks to it. Furthermore, the results further indicate that apart from the BRIC, other regional trade blocs such as Americas, Europe and Asia play influential roles in Africa's trade. Overall the findings show that African economies are predominantly net receivers of trade shocks originating from dominant sources.

Greenwood-Nimmo, Nguyen and Shin (2015) developed a technique to evaluate macroeconomic connectedness among entities in sophisticated multi-country and global macroeconomic models. They adopted a methodology that is highly adaptable and can be applied to models with approximate vector autoregressive representation. They applied the technique to a global VAR model containing 169 macroeconomic and financial indicators for 25 countries. They derived vivid representations of the connectedness of the system and found that the US, the Eurozone and the crude oil market have dominant influence over conditions in the global macroeconomy. Furthermore, they established that China and Brazil are also globally significant economies. In a cross-country study Ogbuabor *et al.,* (2016) measured the real and financial connectedness of selected African economies with the global economy. The study adopted a network approach using the log of real output and real output volatility to capture real connectedness while the log of real equity returns and real equity returns volatilities are used for financial connectedness analysis. The results show that USA, EU, and Canada dominate Africa's equity markets while China, India and Japan dominate Africa's real activities. The results further suggest that African economies are predominantly small open economies deeply interconnected but systemically unimportant and vulnerable to headwinds emanating from the dominant economies in the overall global economy. The study recommends that monetary authorities and other financial regulators in Africa should coordinate policies towards safeguarding the continent from future crisis. It further suggests deliberate policy efforts should target the diversification of African economies as a form of insurance against future shocks.

In a country specific study, Park and Shin (2014) evaluated the connectedness of the Korean economy with the global economy between 1980Q2 and 2012Q3 using an underlying global VAR model. The findings indicate that the US, Europe, China, the ASEAN group and the global energy markets exert dominant influence on Korean economy. Domestic conditions were found to be important on the short to medium term, whereas external conditions exert dominant influence on Korean economy on the long run.

2.4. Gap in Literature

A review of available empirical literature reveals that while studies have been carried out to measure connectedness of COMESA (Common Market for East & Southern Africa) and the Global economy (Ogbuabor *et al.,* 2020), trade shock transmission between selected African countries, the BRICS and the rest of the global economy (Ekeocha and Ogbuabor, 2020) and the real and financial connectedness of selected African countries with the global economy (Ogbuabor *et al.,* 2016) no study has attempted to measure trade shock transmission between ECOWAS as a regional trade bloc and the global economy. This study seeks to fill this gap by studying the pattern of trade shock between ECOWAS and the rest of the global economy. It will follow the methodology of Ogbuabor *et al.,* (2016, 2018, and 2020) and Ekeocha and Ogbuabor (2020)

3. MATERIALS AND METHODS

3.1 Data and Sources

The data for this study consists of the log of exports, log of imports, and log of total trade for the period 19860Q1-2019Q4. The choice of this period is based on data availability for some of the ECOWAS economies. The ECOWAS countries selected are Benin, Burkina Faso, Cote D'ivoire, Ghana, Guinea Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. These countries together contribute 94% of ECOWAS trade volume. The countries selected from the rest of the world are those that have significant level of trade with ECOWAS countries. They include: USA, Brazil, UK, Germany, Netherlands, Belgium, Spain, France, Italy, China, India, Korea Rep, Japan, Thailand, South Africa, Morocco, Mauritania, Egypt and India. The selected African economies together with South Africa account substantially for Africa's GDP.

The entire data were taken from the World Development Indicators (WDI) based on the following indicator names: exports of goods and services (constant 2010 US$) as measure for exports; imports of

goods and services (constant 2010 US$) as measure for imports; and exports plus imports as measure for total trade (or simply trade).

3.2 Model Specification

This study utilized the network approach of Diebold and Yilmaz (2009) as adopted by Ogbuabor *et al.*, 2016, 2018; Ekeocha & Ogbuabor (2020) based on its ability to transparently use the size and direction of shocks to construct directional and non-directional trade linkage measures over a given forecast period. According to Ogbuabor *et al.*, (2016), studies using this approach have four common features, namely: (i) they are generally based on connectedness measures distilled from forecast error variance decompositions (FEVDs) of an approximating vector autoregressive (VAR) model; (ii) they measure the direction and strength of linkages among entities in the system; (iii) they can identify systemically important entities in the system; and (iv) they can study the patterns of shock propagation among countries in the system. In what follows, the underlying vector autoregressive model for this study and the construction of the generalized trade linkages measures (GTLMs) are presented to guide the relevant analysis.

The major objective of this study is to examine the propagation of trade shock between ECOWAS and the rest of the global economy. Following Ogbuabor (2016, 2018 and 2020), Z_t will denote log of total trade for all the countries selected for this study so that Z_{jt} stands for the logged total trade of the j-th country in the system, with $j = 1, 2, \dots, N$ and N is the number of countries selected for the study (which is 30). In line with Diebold and Yilmaz (2009), the trade linkage measures for this study are built from the normalized generalized forecast error variance decompositions (NGFEVDs) of an underlying p-th order VAR model for the $N\ x\ 1$ vector of endogenous variablesZ_t.

The VAR (p) model is specified as follows:

$$Z_t = \alpha_z + \sum_{j=1}^{p} \Phi_j Z_{t-j} + \varepsilon_t, \qquad (1)$$

Where α is $Nx1$ vector of intercepts; Φ_j is $N\ x\ N$ coefficient matrix; p is the lag order; and the residuals $\varepsilon_{it} \sim iid(0, \sum_{\varepsilon,ii})$ so that$\varepsilon_t \sim (0, \sum_{\varepsilon})$, where $\sum_{\varepsilon}$ is positive definite covariance matrix. The Schwarz Information Criterion was adopted to determine the optimal VAR lag order of one for this analysis.

Diebold and Yilmaz (2009) network approach requires that after estimating the underlying VAR model, the forecast error variance decompositions (FEVDs) are then generated and used to build linkage measures. In this study, the interest is in the shocks to the disturbances, ε_{jt} in the country-specific equations. Hence, following Pesaran and Shin (1998), as adopted by Ekeocha & Ogbuabor (2020) this study adopts the generalized forecast error variance decompositions (GFEVDs). This is to ensure stable results when variables are re-ordered. The model is defined as:

$$GFEVD(Z_{it};\ \varepsilon_{jt}, H) = d_{ij}^{gH} = \frac{\sigma_{\varepsilon,jj}^{-1} \sum_{h=0}^{H-1} (e_i' \Theta_h \Sigma_{\varepsilon} e_j)^2}{\sum_{h=0}^{H-1} (e_i' \Theta_h \Sigma_{\varepsilon} \Theta_h' e_i)} \qquad (2)$$

where $i, j = 1, \dots, N$; $H = 1, 2, \dots$ is the forecast horizon; $e_i(e_j)$ is $N\ x\ 1$ selection vector whose i-th element (j-th element) is unity with zeros elsewhere; Θ_h is the coefficient matrix multiplying the h-lagged shock vector in the infinite moving-average representation of the non-orthogonalized VAR; $\sum_{\varepsilon}$ is the covariance matrix of the shock vector in the non-orthogonalized VAR; and $\sigma_{\varepsilon,jj}$ is the j-th diagonal element of $\sum_{\varepsilon}$ (i.e. the standard deviation of ε_j). This study adopted a maximum forecast horizon of 20 quarters in order to ensure that the long-run results are better captured .To ensure that the percentage interpretation of the GFEVDs sum up to unity, this study follows Diebold and Yilmaz (2014) to adopt the normalized GFEVDs (NGFEVDs) given by:

$$\tilde{D}^g = \left[\tilde{d}_{ij}^g\right] \quad , \quad \text{where} \quad \tilde{d}_{ij}^g = \frac{d_{ij}^g}{\sum_{j=1}^{N} d_{ij}^g} \quad , \quad d_{ij}^g = GFEVD(Z_{it};\ \varepsilon_{jt}, H) \qquad (3)$$

By construction, $\sum_{j=1}^{N} \tilde{d}_{ij}^g = 1$ and$\sum_{i,j=1}^{N} \tilde{d}_{ij}^g = N$, so that the total sum of the generalized forecast error variance share of each variable is normalized to 100%.

Construction of the Trade Linkage schematic and Generalized Trade Linkage Measures (GTLMs)

To achieve the objectives of this study, various trade linkage measures will be used. These generalized trade linkage measures are distilled from the trade linkage schematic constructed using the forecast error variance decompositions. The trade linkage schematic details the shocks transmitted and received by individual countries in the system. By so doing, it becomes easy to explain the fraction of shocks accruing to each country in the system from other countries.

Table 1: Trade Linkage Schematic

Variables	Z_1	Z_2	⋯	Z_N	From Others
Z_1	d_{11}	d_{12}	⋯	d_{1N}	$\sum_{j=1}^{N} d_{1j}, j \neq 1$
Z_2	d_{21}	d_{22}	⋯	d_{2N}	$\sum_{j=1}^{N} d_{2j}, j \neq 2$
⋮	⋮	⋮	⋱	⋮	⋮
Z_N	d_{N1}	d_{N2}	⋯	d_{NN}	$\sum_{j=1}^{N} d_{Nj}, j \neq N$

To Others	$\sum_{\substack{i=1 \\ i \neq 1}}^{N} d_{i1}$	$\sum_{\substack{i=1 \\ i \neq 2}}^{N} d_{i2}$	…	$\sum_{\substack{i=1 \\ i \neq N}}^{N} d_{iN}$	$\frac{1}{N}\sum_{i,j=1}^{N} d_{ij}, i \neq j$

Source: Adapted from Diebold and Yilmaz (2014) and Ekeocha & Ogbuabor (2020). Note: For simplicity, each time series variable in this table Z_{jt} is written as $Z_j, j = 1, 2, \ldots, N$.

To construct the Generalized Trade Linkage Measures (GTLMs) for this study, the Normalized Generalized Forecast Error Variance Decompositions (NGFEVDs) for the vector of endogenous variables Z_t obtained from equation (3) is used to cross-tabulate the trade linkage table shown in Table 1. The sum of each row in Table 1 is normalized to 100% in line with equation (3). The columns details the shocks received by the respective countries in the system ,while the rows shows shocks transmitted from each country to other countries in the system respectively. This table is now adopted in defining the various generalized trade linkage measures (GTLMs) and their relationships. The generalized trade linkage measures adopted in this study are as follows:

1. ***Own-Effect*** ($\boldsymbol{H_j}$), also known as the heatwave, is defined as the shock a country exerts on itself. It is located at the intersection of the row and column for each country on table 1 above. By construction it is given as:
$$H_j = d_{jj} \qquad (4)$$
2. **From-Effect** ($\boldsymbol{F_j}$) this measures the total directional linkage from other variables (countries) in the system (i.e. the *from-effect*) to a particular country Z_{jt}. This means that the *from-effect* can be used to capture the role each individual economy in the system plays in a given ECOWAS economy, and it is computed in this study by aggregating the spillovers (shocks) from all the economies in the system to a given ECOWAS economy across all horizons. Hence, the economy contributing the highest of such aggregate spillover is deemed to play a dominant role in the particular ECOWAS economy. It is defined as:
$$F_j = \sum_{i=1, i\neq j}^{N} d_{ji} \qquad (5)$$

Thus, $H_j + F_j = 1 \forall j$. (i.e. own -effect plus from -effect equals one).

3. ***To-effect***($\boldsymbol{T_j}$)defines the total spillover or total contributions of $\boldsymbol{Z_{jt}}$ to all other variables i.e. it measures the total shock transmitted by each ECOWAS economy to other economies in the system, thereby showing the impact or influence of that particular ECOWAS economy on other economies in the VAR system. It is defined as:
$$T_j = \sum_{i=1, i\neq j}^{N} d_{ij} \qquad (6)$$
4. ***Net-Effect*** ($\boldsymbol{N_j}$) is defined as the to-effect minus the sum-effect. the *net-effects* establishes the net transmitters/receivers of shocks in the system over time it is given as:
$$N_j = T_j - F_j \qquad (7)$$

The aggregate net-effect in the system is zero since all shocks transmitted are received.

Thus $\sum_{j=1}^{N} N_j = 0$. (i.e. Net effect in the systems must be equal to zero)

5. ***Total Trade Linkage Index***($\boldsymbol{TTLI}$) or *total-effect* is defined as:
$$TTLI = \frac{1}{N}\sum_{j=1}^{N} F_j = \frac{1}{N}\sum_{j=1}^{N} T_j \qquad (8)$$

It is used to evaluate the degree of trade linkage/shock transmission between ECOWAS and the rest of the global economy.This measure captures the grand total of the off-diagonal elements in Table 1, that is, the sum of the "From Others" column or "To Others" row.

6. ***Dependence Index.*** Measures the dependence of the **j**-th variable (or **j**-th economy) on external shocks and the influence of the **j**-th variable (or **j**-th economy) on the system as a whole. i.e it measures the extent of dependence of each country in the system to other countries. It is defined as:
$$D_j^H = \frac{F_j}{H_j + F_j}, \forall j = 1,2, \ldots, N \qquad (9)$$

The dependence index fall between 0 and 1 i.e $0 \leq D_j^H \leq 1$. such that if $D_j^H \to 1$, then conditions in the j-th economy is open, deeply interlinked and sensitive to external conditions, but if $D_j^H \to 0$, then the j-th economy is less sensitive to external shocks.

7. ***Influence Index***: measures the extent to which the j-th economy in the system influences or is influenced by external shocks. It is expressed as:
$$I_j^H = \frac{N_j}{T_j + F_j}, \forall j = 1,2, \ldots, N \qquad (10)$$

where$-1 \leq I_j^H \leq 1$. For a given horizon H, the j-th economy is a net receiver of trade shocks if$-1 \leq I_j^H < 0$, that is, if the index has a negative value; a net transmitter of trade shocks if$0 < I_j^H \leq 1$, that is, if the index takes a positive value; and neither a net receiver or transmitter of trade shocks if $I_j^H = 0$. A priori expectation is that ECOWAS economies, which are relatively small open economies would be located close to the point (1,-1), while overwhelmingly open but highly influential and dominant economies like the USA, China and Japan would be located close to the point (1,1).

3.3 Technique of Evaluation

To ensure that there are enough observations for the analysis, the data was converted from annual to quarterly using Eview's quadratic match average

option. To scale down the data and remove noise from the series, the entire quarterly series were indexed to 2010 base year and logged prior to estimation. The series was subjected to stationarity test using the Phillip-Peron unit root test to determine their order of integration. Based on the order of integration, the appropriate co-integration test was conducted as part of the empirical procedures in this study.

The network approach of Diebold and Yilmaz (2009) requires that after estimating the underlying VAR model, the forecast error variance decompositions (FEVDs) are then generated and used to build Generalized Trade Linkage Measures (GTLM). In this study, the interest is in the shocks to the disturbances, in the country-specific equations. As a robustness check, the GTLM and underlying model was estimated and computed separately for exports and imports.

The generalized trade linkage measures distilled from the NGFEVDs were computed over a 20-quarter forecast horizon. The choice of this forecast horizon is to ensure that the long-run patterns in the results are more robustly accounted for. The Normalized Generalized Forecast Error Variance Decompositions (NGFEVDs) distilled from this estimation based on Equation (3) were used to compute the Generalized Trade Linkage Index Measures (GTLMs).

4. RESULTS AND FINDINGS

4.1 Unit Root and Co-Integration Test Results

Based on results of the unit root test which is shown on appendix (1) it was established that all the series in this study are integrated of order one, I(1). This means that it is necessary to conduct co-integration test in order to determine if the series have a stable long-run relationship or otherwise. Based on the order of stationarity, the Johansen co-integration was conducted and the results shown on appendix (2) the results indicate that the Trace statistic and the Max-Eigen statistic are higher than the 5% critical value in all the cases. Furthermore, the probability value of the variables ranged from 0.0000 to 0.0001 which is lower than the 5% critical value (0.05) of the variables. From the values of the Trace statistic, Max-Eigen statistic, the probability values and the asterisk sign the null hypothesis of no co-integration is rejected at 5% level of significance and the presence of co-integration is established. In order words, the series have a stable long-run relationship. This warrants that the model will be estimated in its error correction form (VECM) thereafter, the generalized trade linkage measures were computed based on the number of horizons earlier mentioned.

4.2 Trade Linkage between ECOWAS and the Global Economy

The first specific objective of this study seeks to determine the degree of trade linkage between ECOWAS and the global economy. This study computed the total trade linkage index based on Equation (8) following the estimation of the underlying model based on the total trade data. Robustness check was conducted by estimating the model using the logs of exports and imports. The results are presented in Table 2 which reports for total trade estimation. Panels 2 and 3 report for exports and imports estimations, respectively.

Table 2: Total Trade Linkage Index (%)

Horizon	Panel 1: Total Trade	Panel 2: Exports	Panel 3: Imports
1	81.9777	81.2675	82.7463
2	82.6678	81.7998	83.0705
3	83.5778	82.8081	83.4551
4	84.4730	83.9028	84.0504
5	85.3662	84.7900	84.8309
6	86.2891	85.4070	85.6314
7	87.1264	85.9016	86.3302
8	87.7795	86.4371	86.8900
9	88.2392	87.0091	87.3157
10	88.5487	87.5342	87.6433
11	88.7650	87.9649	87.9090
12	88.9339	88.2962	88.1292
13	89.0789	88.5449	88.3054
14	89.2051	88.7338	88.4385
15	89.3115	88.8861	88.5354
16	89.4015	89.0216	88.6088
17	89.4856	89.1514	88.6732
18	89.5761	89.2770	88.7390
19	89.6810	89.3939	88.8102
20	89.8002	89.4960	88.8849
Average	**87.4642**	**86.7812**	**86.8499**

Source: Author.

The results in Table 2 show that the *Total Trade Linkage Index* changed gradually from the short-run (i.e. at horizon 1) until the long-run (i.e. at horizon 20). From the main model in Panel 1, it can be seen that the *Total Trade Linkage Index* ranges between 81.98% and 89.80%, while the average value is 87.46%. This shows that the degree of trade linkage between ECOWAS and the rest of the global economy is 87.46%, which is quite considerable. The robustness checks in Panels 2 and 3 did not differ considerably from these estimates. Hence, the estimates indicate that ECOWAS maintains considerable trade linkage with its key trade partners in the rest of the global economy and may be prone to trade shocks emanating from them. Ogbuabor *et al.*, (2020) also obtained similar linkage measure between the COMESA region and the rest of the global economy.

4.3 Establishing the Key Countries Outside the Region that Dominate Trade in ECOWAS and Hence with Greatest Capacity to Spread Trade Shocks to ECOWAS Region

To establish key countries outside the region that are dominating trade in ECOWAS, and hence have the greatest capacity to spread trade shocks to ECOWAS region, this study uses the *from-effect* estimates based on equation (5). The *from-effect* details the degree of shocks being transmitted to respective ECOWAS economies from the rest of the global economy. Table 3 shows the *from- effect* linkages of ECOWAS countries.

Table 3: From-effect trade linkage of individual ECOWAS countries (Total Trade)

Country	Benin	Burkina Faso	Cote d'Ivoire	Ghana	Guinea Bissau	Mali	Niger	Nigeria	Senegal	Sierra Leone	Togo
USA	2.0858	1.2594	0.4208	4.2447	2.4947	2.4576	1.2330	3.3650	2.8623	1.0164	0.8872
Benin	23.9944	7.1314	5.5638	0.8310	1.0733	3.5571	1.4556	0.6525	0.9789	4.6838	0.1335
Burkina Faso	5.5123	31.5954	1.9366	0.4955	1.4795	0.2938	0.7779	1.4337	0.4514	1.1924	0.8924
Cote d'Ivoire	9.6167	0.4941	17.8887	1.9266	5.0360	3.4224	1.2977	1.1317	3.1176	2.1939	1.2307
Ghana	1.8167	1.3122	1.4276	17.0607	2.2603	1.9124	0.8714	0.5235	0.5998	0.7492	0.2507
Guinea Bissau	1.6168	0.9880	3.0046	1.0072	30.1302	0.2528	2.9146	1.3903	0.1354	16.0595	0.3075
Mali	6.6702	1.4901	4.0425	2.8750	0.3372	12.1683	0.3907	2.7714	3.9730	6.4134	2.3587
Niger	1.9446	3.7147	5.1842	1.4478	4.9894	0.5914	16.4565	1.4798	2.2577	4.4681	5.8480
Nigeria	2.4565	1.0707	2.1983	1.5435	1.4130	4.7347	1.6204	9.8957	2.5041	2.2986	3.2028
Senegal	2.3310	2.2193	8.8018	2.3644	2.2398	7.0257	4.4036	2.9564	7.9560	0.2995	5.8066
Sierra Leone	2.3739	1.6076	0.7415	0.3417	7.8766	2.1774	3.0750	0.2868	0.1108	31.9003	0.1495
Togo	1.9672	1.7499	2.8891	1.7827	0.6725	2.2072	5.4381	2.2883	3.0066	1.4371	15.3659
Egypt	0.5618	2.5615	1.9129	2.9134	2.3510	2.8861	1.4516	1.9150	2.8389	4.2428	1.4194
Eswatini	2.9193	1.6905	1.4420	1.5489	0.8655	0.5346	1.0217	1.1488	0.6302	3.9184	0.6056
Mauritania	3.0027	2.4204	0.5874	6.6879	2.3954	3.0398	2.6436	1.1109	2.3450	2.8078	1.1538
Morocco	2.8285	1.8384	5.0349	3.3966	1.1091	5.6657	4.1818	4.5428	6.7954	0.4299	5.4230
South Africa	1.6908	1.5161	0.9248	4.8847	2.8656	3.5085	1.2725	4.4742	3.7210	1.7585	1.5833
Belgium	1.6425	1.9985	4.2818	2.7484	1.1279	4.1333	5.8262	5.4801	6.2745	0.9032	6.6118
India	1.0640	1.1287	3.2169	1.3954	1.6213	1.3463	2.0188	3.7906	3.3869	0.2644	1.4632
Korea	3.7156	1.4840	0.5535	2.1444	7.2274	1.3951	0.9192	4.4931	1.3346	1.6039	0.7614
Germany	2.0913	3.1667	4.7994	3.6531	1.0822	5.2767	6.2016	5.7828	6.6090	0.7657	7.8469
France	1.1242	2.2457	4.9779	3.0577	0.9859	3.8722	7.4129	4.9655	6.6636	0.6204	8.5037
Italy	0.8846	2.4013	3.9441	3.8674	0.8806	3.9439	6.7871	5.2929	5.7928	0.7575	6.5310
Spain	1.4335	3.4862	4.4279	3.6473	1.2908	3.8952	7.0950	5.8893	5.6372	0.8994	8.0314
UK	1.2642	2.4465	1.6077	4.3836	1.8610	3.4193	3.6914	4.5822	4.3903	0.4737	3.0909
Brazil	2.5537	10.7507	0.7372	4.7578	3.1050	2.0169	1.3169	1.1786	1.3387	2.8514	0.2723
China	2.1255	1.1953	0.2322	4.3503	3.1177	2.0558	0.9336	3.8075	2.5490	1.0136	1.0867
Netherlands	2.5695	2.2525	5.8690	3.7950	1.4622	5.6211	5.5447	5.4359	7.0997	1.3558	7.4103
Japan	3.1174	1.4233	0.6901	3.2337	2.3801	2.9621	0.8939	3.9696	2.4032	0.9918	0.7900
Thailand	3.0247	1.3607	0.6609	3.6137	4.2687	3.6264	0.8531	3.9648	2.2362	1.6297	0.9816
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 3 reports the main results based on the total trade estimation. We find that each of Germany, Spain, and Netherlands contribute at least 2.5% to the NGFEVDs of eight ECOWAS countries; while each of UK, France, Italy, and Belgium contribute at least 2.5% to seven ECOWAS countries. This suggests that Europe is an important source of trade shocks to ECOWAS. The results further indicate that USA and Thailand contribute at least 2.5% to five ECOWAS countries; while China and Japan contribute similarly to four ECOWAS countries. India and Korea contribute at least 2.5% to three ECOWAS countries. Specifically, the results show the huge trade relationship between the Asian giants and Nigeria. This is shown in the 3.81% and 3.79% contributions from China and India to Nigeria, respectively. South Africa contributed at least 2.5% to the NGFEVDs of five ECOWAS countries, which is consistent with its position as an important trading partner to most ECOWAS countries.

The results in Export and import panel (appendix 3) are quite consistent with trade results for

instance, in export panel; we find that the patterns of bilateral trade between Nigeria and the rest of the world are well captured. USA contributed 6.69% to Nigeria's NGFEVDs while China contributed 4.07%, India 5.53%, UK 4.62%, Japan 7.36%, and South Africa 4.53%. These contributions aptly reflect the roles of these economies in Nigeria's trade. From Europe, we find that Germany, Belgium, France, and Spain contribute 3.60%, 4.74%, 3.37% and 3.52% to Nigeria, respectively. Apart from Nigeria, which is the largest ECOWAS country by trade and GDP, the influential trade partners of ECOWAS also contribute remarkably to other countries in the sub-region. For instance, USA contributed 2.74% to Senegal, while China contributed 3.04%, UK 5.33%, Spain 5.66%, Italy 5.92%, France 7.02%, Germany 6.49%, Belgium 6.46%, India 3.13%, South Africa 3.86% and Morocco 5.48%.

These findings are also consistent with the patterns of macroeconomic linkages obtained by recent studies in Africa; particularly Ogbuabor *et al.,* (2016, 2020) which identified USA, Europe, China, and Japan as likely sources of global shocks.

4.4 ECOWAS Countries Most Vulnerable to Global Trade Shocks Emanating from the Rest of the Global Economy

To establish the ECOWAS countries that are most vulnerable to global trade shocks emanating from the rest of the global economy, this study computed the *net-effects* linkage of Equation (7) for all the ECOWAS countries included in the sample. Recall that a country is said to be vulnerable to trade shocks if its *net-effect* linkage is negative. Table 4 shows the results of the *net-effect* linkage. As before, Panel 1 reports the main results based on the total trade estimation, while Panels 2 and 3 report the robustness checks based on the exports and imports estimations, respectively.

Table 4: Net-effect linkages of the countries

	Panel 1: Total Trade			Panel 2: Exports			Panel 3: Imports		
Country	**From-effect**	**To-effect**	**Net-effect**	**From-effect**	**To-effect**	**Net-effect**	**From-effect**	**To-effect**	**Net-effect**
USA	92.5848	115.5323	22.9474	92.4432	116.6831	24.2398	92.0454	96.6240	4.5786
Benin	76.0056	37.5195	-38.4861	77.7989	34.9152	-42.8837	78.6986	70.8503	-7.8483
Burkina Faso	68.4046	21.1848	-47.2198	75.4329	35.7598	-39.6731	82.8102	33.2790	-49.5313
Cote d'Ivoire	82.1113	44.4819	-37.6294	86.1232	43.9576	-42.1656	70.6531	51.1162	-19.5368
Ghana	82.9393	35.2291	-47.7102	79.4369	31.5353	-47.9016	84.2412	53.2036	-31.0376
Guinea Bissau	69.8698	42.5214	-27.3484	65.4549	23.8270	-41.6279	78.6873	42.1619	-36.5253
Mali	87.8317	59.7499	-28.0818	81.6891	35.8006	-45.8885	88.2350	104.9165	16.6816
Niger	83.5435	53.8553	-29.6882	87.3739	66.9728	-20.4010	77.8444	48.5144	-29.3300
Nigeria	90.1043	71.8341	-18.2702	89.3770	63.7013	-25.6757	78.0545	48.0372	-30.0173
Senegal	92.0440	90.4151	-1.6289	91.7406	82.6324	-9.1083	91.2546	112.6353	21.3807
Sierra Leone	68.0997	23.7581	-44.3416	68.4329	50.2740	-18.1589	77.0114	40.6530	-36.3584
Togo	84.6341	51.6531	-32.9810	85.6568	73.2218	-12.4350	83.1094	72.5574	-10.5520
Egypt	89.1261	68.1209	-21.0052	88.0017	56.1260	-31.8758	85.4316	63.1218	-22.3099
Eswatini	83.4813	43.8326	-39.6487	71.4592	44.7375	-26.7216	81.8744	48.5693	-33.3052
Mauritania	88.2840	83.1483	-5.1357	85.3381	64.8266	-20.5115	84.3631	50.0106	-34.3524
Morocco	93.3608	120.0947	26.7340	93.1634	106.7892	13.6258	91.6606	118.3438	26.6832
South Africa	93.0463	127.2701	34.2237	92.8617	113.8370	20.9752	92.7132	112.8809	20.1677
Belgium	93.1531	127.8476	34.6945	92.8322	144.4991	51.6669	92.4773	129.7691	37.2919
India	92.0029	93.5973	1.5945	91.3514	120.2341	28.8827	90.3863	63.4044	-26.9820
Korea	91.3985	104.5809	13.1823	91.6806	104.2963	12.6157	89.7873	88.2698	-1.5175
Germany	92.6940	140.6587	47.9647	92.6261	144.1782	51.5521	91.8958	138.8638	46.9679
France	92.8499	127.4357	34.5858	93.0367	137.1240	44.0872	91.8822	130.8242	38.9419
Italy	92.8020	131.3716	38.5695	92.4623	135.7507	43.2884	92.0417	128.3885	36.3468
Spain	92.1305	132.9734	40.8429	91.6946	136.4668	44.7722	91.5155	133.5891	42.0736
UK	93.0697	124.4020	31.3323	93.0275	121.8730	28.8455	92.3756	109.9913	17.6157
Brazil	88.7364	78.4669	-10.2695	85.6961	65.3576	-20.3385	87.4954	62.7269	-24.7685
China	92.7966	117.0687	24.2721	91.7454	108.2549	16.5096	91.9618	110.0426	18.0808
Netherlands	92.8460	142.3415	49.4956	93.2586	137.8726	44.6140	91.6671	146.4658	54.7987
Japan	92.1928	106.2940	14.1012	91.0429	100.8283	9.7854	92.6208	99.0861	6.4653
Thailand	91.7829	106.6871	14.9042	91.1959	101.1018	9.9059	90.7017	96.5997	5.8980

Source: Author.

In Panel 1, we find that all the ECOWAS countries recorded negative net-effect linkage, indicating that they are all net receivers of trade shocks. The same pattern is also observed in Panels 2 and 3, except that in Panel 3, Mali and Senegal recorded positive net-effects. Specifically, we see that the countries of ECOWAS most exposed to trade shocks are Ghana, Burkina Faso, Sierra Leone, Benin and Cote D'ivoire with their respective net- effects linkages measured between -37.6 to -47.2 across all panels. This study therefore concludes that all the ECOWAS countries are predominantly net receivers of trade shocks, and are therefore, vulnerable to trade shocks emanating from the influential economies in the system. This finding is consistent with Ogbuabor *et al.,* (2016, 2020) which also reported that African economies are vulnerable to shocks originating from the dominant and influential economies.

4.5 Trade Blocs in the Rest of the World with the Potential to Spread Trade Shocks to ECOWAS Region

To determine other trade blocs in the rest of the world with the potential to spread trade shocks to ECOWAS region, this study disaggregated the *from-effect* of Equation (5) for each ECOWAS country by region. The regions are: Europe (which is made up of Belgium, Germany, France, Italy, Spain, UK, and Netherlands); Asia (which consists of China, India, Korea, Japan and Thailand); Americas (which comprises Brazil and USA); other African countries outside ECOWAS (which includes Egypt, Eswatini, Mauritania, Morocco and South Africa). The results of this regional disaggregation are presented in Table 5 which reports for total trade. The *own-effects* and the contributions from other ECOWAS countries are also included Table 5 so that it sums up to 100% in line with the normalization in Equation (3).

From the result, we find that Europe, Asia, and the Americas trading blocs are making substantial contributions to each ECOWAS country's NGFEVDs. The contributions from Europe ranged from 5.78% to 48.03%; while the contributions from Asia ranged from 5.08% to 20.03%. The Americas contributed at least 4% to eight ECOWAS countries; while other African countries outside ECOWAS contributed at least 10% to each ECOWAS country. These contributions cannot be called negligible. They indicate that outside Africa, the Europe, Asia, and the Americas have the capacity to propagate considerable trade shocks to ECOWAS. The results using exports and imports values (appendix 4) are consistent with this finding.

Table 5: Regional contributions to ECOWAS countries NGFEVDs, Panel 1: Total Trade

Regions	Benin	Burkina Faso	Cote d'Ivoire	Ghana	Guinea Bissau	Mali	Niger	Nigeria	Senegal	Sierra Leone	Togo
Europe	11.0097	17.9974	29.9078	25.1525	8.6905	30.1617	42.5589	37.4287	42.4671	5.7757	48.0261
Asia	13.0471	6.5920	5.3535	14.7375	18.6152	11.3857	5.6185	20.0257	11.9101	5.5034	5.0830
Americas	4.6395	12.0101	1.1580	9.0024	5.5997	4.4746	2.5499	4.5437	4.2010	3.8677	1.1595
Other Africa	11.0031	10.0269	9.9020	19.4315	9.5866	15.6348	10.5713	13.1917	16.3306	13.1574	10.1851
ECOWAS	36.3061	21.7781	35.7900	14.6154	27.3777	26.1749	22.2450	14.9146	17.1353	39.7955	20.1805
Own-Effect	23.9944	31.5954	17.8887	17.0607	30.1302	12.1683	16.4565	9.8957	7.9560	31.9003	15.3659
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Author.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

This study examined the dynamics of trade shock transmission between ECOWAS and the rest of the global economy. The results of the analysis indicates that ECOWAS as a regional trading bloc is highly linked to the global economy. This linkage progressively increased from the short- run to the long - run and averaged at 87.46% across the period examined. This linkage is quite substantial and significant. ECOWAS trade partners from the rest of the global economy have potentials to transmit trade shock to the region. Netherlands, Germany, Spain, Italy, France, Belgium, China, South Africa, UK, USA and Morocco are the top transmitters of trade shock to the ECOWAS region. These countries individual contributions to the NGFEVDS of ECOWAS countries range from 1.1 to 8.5. Furthermore, ECOWAS countries are predominantly net receivers of trade shocks coming from the rest of the global economy hence they are highly vulnerable. The countries of ECOWAS most exposed to trade shock are Ghana, Burkina Faso, Sierra Leone, Benin and Cote D'ivoire with their respective net- effects linkages measured between -37.6 to -47.2 across all panels. Regional trade blocs in the rest of the world have the capacity to significantly propagate trade shocks to the ECOWAS region with Europe, Asia and the Americas being dominant transmitters of shocks to ECOWAS. Europe contributes from 5.77 to 48 to the NGFEVDS of ECOWAS across all panels. Based on the findings of this study, it is concluded that forming a regional economic integration has not prevented ECOWAS countries from being exposed to spillovers from the rest of the global economy. It is recommended that ECOWAS countries being highly linked to the global economy should embark on development of infrastructures like power and roads to encourage heavy industrialization, provide favourable environment for new export oriented Small, Medium and Micro enterprises through tax holidays and cost effective credits. This will increase their local manufacturing capacity, improve raw material value chain, reduce dependence on the global economy and thus lower their level of vulnerability to international trade spillovers. The ECOWAS countries should adopt a uniform and harmonized protective policies in trade with the countries identified as the major transmitters of trade shocks to the region. The ECOWAS protocol on free movement of persons, goods and services should be fully implemented to encourage movement of goods and corresponding services across the region thus reduce exposure to shocks from countries of the rest of the world. ECOWAS countries should implement an 'ECOWAS first' policy which will place stringent

tariffs on foreign products that can be competitively and easily sourced within the region. This will reduce the importation from other regions of goods that can be manufactured within ECOWAS. By so doing, the shock transmittable to ECOWAS from the rest of the global economy (*from-effect* shocks) will be reduced. The ECOWAS trade information system should be strengthened and equipped with adequate technologies to constantly monitor and measure trade developments and shocks coming from other regional trade blocs and quickly transmit same to member countries as early warning signals so they can effectively create buffers to diffuse the potentials or threats of such shocks.

REFERENCES

- African Union (2020) 'Africa trade statistics' African Union Institute of Statistics of African Union Commission.
- Cakir, M. Y., & Kabundi, A. (2011) '*Trade shocks from BRIC to South Africa: A global VAR analysis'* University of Johannesburg Working Paper 250. (Online). https://doi.or/10.1016/j.econmod.2013.02.010
- Canova, F., & Marrinan, J. (1998). Sources and propagation of international output cycles: common shocks or transmission?. *Journal of International Economics*, 46, 133-166.
- Caselli, F. G. (2019). China's rise, asymmetric trade shocks and exchange rate regimes. *Rev. Int. Econ*., 27, 1-35.
- Claessens, S., & Forbes, K. (2004) International financial contagion: the theory, evidence and policy implications. *RBWC, DNB and WEFConference on the IMF's Role in. Emerging Market Economies: Reassessing the Adequacy of its Resources,* November 18-19.
- Corsetti, G., Pesenti, P., Roubini, N., & Tille, C. (2000). Competitive devaluations: toward a welfare-based approach. *Journal of International Economics*, 51, 217-241.
- Diebold, F. X., & Yilmaz, K. (2014). On the Network Topology of Variance Decompositions: Measuring the Connectedness of Financial Firms. *Journal of Econometrics*, 182(1), 119-134. (Online) https://doi.org/10.1016/j.jeconom.2014.04.012
- Diebold, F., & Yilmaz, K. (2009). Measuring financial asset return and volatility spillovers with application to global equity markets. *The Economic Journal*, 119(534), 158-171. (Online) https://doi.org/10.1111/j.1468-0.297.2008.02208.x
- Ekeocha, P.C. and Ogbuabor, J.E. (2020). From multilaterism to polarity. A study of trade shock transmission between selected African economies, the BRICS and the rest of the global economy. *The Singapore Business Review*. DOI:10.1142/5021759082500794
- Gentile, M., & Giordano, L. (2012). Financial contagion during Lehman default and sovereign debt crisis: An empirical analysis on Euro area bond and equity markets. Working Papers No. 72, Department of Economic Research, Commissione Nazionale Per Le Societa E La Borsa (CONSOB).
- Gerlach, S., & Smets F. (1995). Contagious speculative attacks. *European Journal of Political Economy*, 11, 45-63.
- Greenwood-Nimmo, M., Nguyen, V. H., & Shin, Y. (2015). '*Measuring the connectedness of the global economy*' Melbourne Institute Working Paper No. 7/15, Melbourne Institute of Applied Economic and Social Research, The University of Melbourne, Australia, (Online) http://dx.doi.org/10.2139/ssrn.2586861
- Izurieta, A., & Vos, R. (2010). Measuring the impact of global shocks on trade balances via price and demand effects. *World Economic Vulnerability Monitor*. UNDESA.
- King, M. A., & Wadhwani, S. (1990). Transmission of volatility between stock markets. *The Review of Financial Studies*, 3(1), 5–33.
- Kose, A., & Yi, K. (2001). International trade and business cycles: Is vertical specialization the missing link?. *American Economic Review*, 91, 371-375.
- Kose, M. A., & Riezman, R. (1999). *Trade shocks and macroeconomic fluctuations in Africa*. Centre for Study of Globalization and Regionalization (CSGR) Working Paper No. 43/99.
- Moser, T. (2003). What is international financial contagion? *International Finance*, 6(2), 157-.178.
- Ogbuabor, J. E. (2019). Measuring the dynamics of Czech Republic output connectedness with the global Economy. *Slovak Academy of Sciences*, 1070-1089. (Online) https://www.Sav.Sk/index.php?
- Ogbuabor, J. E., Eigbiremolen, G. O., Aneke, G. C., & Manasseh, C. O. (2018). Measuring the dynamics of APEC output connectedness. *Asian Pacific Economic Literature, Crawford School of Economics and Government, the Australian National University*, 32(1), 29-44.
- Ogbuabor, J. E., Orji, A., Aneke, G. C., & Oyun, E. (2016). Measuring the real and financial connectedness of selected African economies with the global economy. *South African Journal of Economics*, 84, 3.
- Ogbuabor, J., Anthony-Orji, O., Manasseh, C., & Orji, A. (2020). Measuring the Dynamics of COMESA output connectedness with the global economy. *Journal of Economic Asymmetries*, 21(2020).
- Park, H., & Shin, Y. (2014). Mapping Korea's *international linkages using generalized connectedness measures.* Working Paper No. 2014-16, Bank of Korea.
- Pesaran, M. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate

models. *Economics Letters*, 58(1), 17-29. (Online) https://doi.org/10.1016/S0165-1765(97)00214-0

- Rigobon, R. (1999). *On the measurement of the international propagation of shocks*. National Bureau of Economic Research, Working Paper 7354.
- Starnini, M., Boguna, M., & Serano, A. M. (2009). The interconnected wealth of nations: shock propagation on global trade-investment multiplex networks. *Scientific Reports (Nature Publisher Group) London*,9, 1-10.
- UNCTAD (2019) '*Key statistics and trends in regional trade in Africa'* United Nations Conference on Trade and Development-Division on International Trade and Commodities.
- UNDESA (2017) 'World population prospects' *United Nations Department of Economic and Social Affairs*.

Appendices

Appendix 1: Phillips-Perron Unit Root Test Results Total Trade Data

Variables	PP Test Statistic at levels	5% Critical Values	PP Test Statistic at 1st Difference	5% Critical Values	Order of Integration
BENIN	-3.238711	-3.443450	-6.812581	-2.883073	I(1)
BURKINAFASO	-1.710231	-3.443450	-5.134639	-2.883073	I(1)
COTE D'IVOIRE	-2.122894	-3.443450	-5.453505	-2.883073	I(1)
GHANA	-2.006615	-3.443450	-5.319610	-2.883073	I(1)
GUINEA BISSAU	-1.638417	-2.882910	-6.460582	-2.883073	I(1)
MALI	-1.640244	-3.443450	-7.031221	-2.883073	I(1)
NIGER	-1.556735	-3.443450	-5.848526	-2.883073	I(1)
NIGERIA	-2.326849	-3.443450	-5.561889	-2.883073	I(1)
SENEGAL	-2.124764	-3.443450	-5.561889	-2.883073	I(1)
SIERRA LEONE	-1.914064	-3.443450	-6.314704	-2.883073	I(1)
TOGO	-1.836258	-3.443450	-5.041810	-2.883073	I(1)
EGYPT	-1.800345	-3.443450	-5.233425	-2.883073	I(1)
ESWATINI	-3.027618	-3.443450	-5.454958	-2.883073	I(1)
MAURITANIA	-1.922072	-3.443450	-4.969492	-2.883073	I(1)
MOROCCO	-1.767621	-3.443450	-5.614266	-2.883073	I(1)
SOUTH AFRICA	-1.411429	-3.443450	-5.032754	-2.883073	I(1)
BELGIUM	-2.325010	-3.443450	-5.219287	-2.883073	I(1)
INDIA	-0.841178	-3.443450	-4.955002	-2.883073	I(1)
KOREA REP	-1.812278	-3.443450	-4.971973	-2.883073	I(1)
GERMANY	-2.161610	-3.443450	-5.219008	-2.883073	I(1)
FRANCE	-2.213097	-3.443450	-5.152860	-2.883073	I(1)
ITALY	-2.139970	-3.443450	-5.152860	-2.883073	I(1)
SPAIN	-2.063108	-3.443450	-5.028024	-2.883073	I(1)
UK	-2.098413	-3.443450	-5.130661	-2.883073	I(1)
BRAZIL	-1.519966	-3.443450	-5.629864	-2.883073	I(1)
CHINA	-0.224604	-3.443450	-5.201434	-2.883073	I(1)
NETHERLANDS	-2.108650	-3.443450	-5.223568	-2.883073	I(1)
JAPAN	-2.365551	-3.443450	-5.597631	-2.883073	I(1)
THAILAND	-2.650574	-3.443450	-4.821300	-2.883073	I(1)
USA	-1.607677	-3.443450	-5.355112	-2.883073	I(1)

Appendix 2: Johansen Cointegration Test Results Total Trade

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	Prob.**
None*	0.9999	19619.1100	3066.7758	0.0001
At most 1*	0.9998	17758.5000	2775.9331	0.0001
At most 2*	0.9997	16099.9800	2516.6803	0.0001
At most 3*	0.9995	14505.3200	2267.4099	0.0001
At most 4*	0.9993	13024.1900	2035.8859	0.0001
At most 5*	0.9981	11619.6000	1816.3264	0.0000
At most 6*	0.9963	10393.3100	1624.6380	0.0001
At most 7*	0.9947	9300.3130	1453.7853	0.0001
At most 8*	0.9932	8278.3950	1294.0435	0.0001

At most 9*	0.9890	7306.5160	1142.1235	0.0000
At most 10*	0.9847	6427.6270	1004.7393	0.0001
At most 11*	0.9719	5611.9610	877.2379	0.0001
At most 12*	0.9580	4915.3100	768.3403	0.0001
At most 13*	0.9495	4297.2860	671.7335	0.0001
At most 14*	0.9285	3715.1310	580.7335	0.0000
At most 15*	0.8611	3200.8200	500.3386	0.0001
At most 16*	0.8410	2815.9370	440.1753	0.0001
At most 17*	0.8005	2457.3300	384.1194	0.0001
At most 18 *	0.7713	2142.9940	334.9837	0.0000
At most 19 *	0.7397	1855.3230	285.1425	0.0000
At most 20 *	0.7072	1592.8660	239.2354	0.0000
At most 21 *	0.6648	1353.3360	197.3709	0.0000
At most 22 *	0.6565	1140.2030	159.5297	0.0001
At most 23 *	0.6243	931.8365	125.6154	0.0001
At most 24 *	0.6009	740.9407	95.7537	0.0001
At most 25 *	0.5527	561.8433	69.8189	0.0001
At most 26 *	0.5512	404.9773	47.8561	0.0001
At most 27 *	0.4912	248.7607	29.7971	0.0001
At most 28 *	0.4511	116.9994	15.4947	0.0001
At most 29	0.0002	0.0292	3.8415	0.8643

Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**5% Critical Value**	**Prob.****
None*	0.9999	1860.6080	495.2963	0.0001
At most 1*	0.9998	1658.5220	441.5008	0.0001
At most 2*	0.9997	1594.6630	424.5014	0.0001
At most 3*	0.9995	1481.1310	394.2790	0.0001
At most 4*	0.9993	1404.5910	373.9040	0.0000
At most 5*	0.9981	1226.2830	326.4382	0.0001
At most 6*	0.9963	1093.0010	290.9583	0.0001
At most 7*	0.9947	1021.9180	272.0359	0.0001
At most 8*	0.9932	971.8786	258.7154	0.0001
At most 9*	0.9890	878.8898	233.9616	0.0000
At most 10*	0.9847	815.6654	217.1312	0.0001
At most 11*	0.9719	696.6510	185.4494	0.0001
At most 12*	0.9580	618.0244	164.5189	0.0001
At most 13*	0.9495	582.1547	154.9704	0.0001
At most 14*	0.9285	514.3109	136.9102	0.0001
At most 15*	0.8611	384.8828	102.4563	0.0000
At most 16*	0.8410	358.6079	95.4619	0.0001
At most 17*	0.8005	314.3351	83.6764	0.0001
At most 18 *	0.7713	287.6711	76.5784	0.0001
At most 19 *	0.7397	262.4571	70.5351	0.0001
At most 20 *	0.7072	239.5302	64.5047	0.0001
At most 21 *	0.6648	213.1331	58.4335	0.0000
At most 22 *	0.6565	208.3664	52.3626	0.0001
At most 23 *	0.6243	190.8958	46.2314	0.0000
At most 24 *	0.6009	179.0974	40.0776	0.0001
At most 25 *	0.5527	156.8660	33.8769	0.0001
At most 26 *	0.5512	156.2166	27.5843	0.0001
At most 27 *	0.4912	131.7612	21.1316	0.0001
At most 28 *	0.4511	116.9702	14.2646	0.0001
At most 29	0.0002	0.0292	3.8415	0.8643

Source: Author

Appendix 3:*From-effect* linkage Exports &Imports

Exports

Country	Benin	Burkina Faso	Cote d'Ivoire	Ghana	Guinea Bissau	Mali	Niger	Nigeria	Senegal	Sierra Leone	Togo
USA	0.5059	1.2574	1.0260	2.0038	1.9133	2.9912	1.0461	6.6919	2.7412	1.2986	1.4358
Benin	22.2011	3.4016	1.4866	0.6401	1.4507	2.0833	1.1034	0.5233	0.7668	3.5655	0.4369
Burkina Faso	4.7658	24.5671	2.4295	1.9278	1.9893	0.3659	3.7667	0.5404	1.8186	0.8290	5.1939
Cote d'Ivoire	3.2265	0.3741	13.8768	0.7926	2.7099	4.5291	1.6816	0.7523	3.7563	4.5122	1.4232
Ghana	1.1650	2.9013	0.1787	20.5631	1.7281	0.9319	1.0351	0.2950	0.0739	7.9692	2.2045
Guinea Bissau	2.1694	0.6593	1.0419	2.8764	34.5451	0.1401	2.1647	0.5193	0.4530	2.6360	0.1842
Mali	2.7739	0.9687	3.6824	2.0267	0.9223	18.3109	0.1776	2.3318	2.2457	3.8322	0.1718
Niger	3.6407	5.1324	2.4976	3.5074	6.2552	0.5578	12.6261	0.4616	3.6977	2.9651	5.9552
Nigeria	0.3841	0.9060	1.1136	2.4311	3.1648	6.0071	0.5552	10.6230	1.5996	1.0450	0.5389
Senegal	2.9580	3.0817	9.3271	1.8346	2.2073	7.5350	5.4791	1.7134	8.2594	2.3557	4.6201
Sierra Leone	1.3277	2.1622	2.3832	3.5402	4.4666	2.1989	2.1105	2.0113	0.2801	31.5671	1.3558
Togo	1.6061	4.8132	3.7033	7.1074	2.4461	0.8765	6.4483	2.2324	3.4619	2.7595	14.3432
Egypt	1.4066	0.5597	1.2911	0.2319	1.9410	2.0749	0.6818	1.0497	2.2225	8.2608	0.5861
Eswatini	2.4097	4.2566	2.7351	1.7048	1.1803	0.7905	1.3701	0.2786	0.6639	6.3457	0.4229
Mauritania	1.7556	1.8235	1.8446	2.4644	2.3449	3.7698	0.9205	3.3745	1.8503	1.2563	2.3652
Morocco	6.2174	2.9464	4.5777	2.6941	1.3954	5.5587	4.4250	2.9409	5.4774	1.0733	3.3765
South Africa	2.7110	1.1242	1.6220	1.7510	1.0457	4.0310	2.7410	4.5306	3.8643	0.8928	1.6502
Belgium	5.2828	3.9365	5.5302	4.4234	2.4968	3.1895	6.7731	4.7357	6.4641	1.7833	6.7463
India	3.5563	1.5844	2.7919	3.2768	1.5711	2.0114	2.0889	5.5281	3.1250	1.2498	2.1978
Korea	0.7792	1.1443	1.1803	1.5671	1.7488	1.6366	0.7852	6.2730	2.0148	0.7412	1.6344
Germany	4.8499	5.7456	5.8204	4.0909	2.1305	3.7092	6.0194	3.5951	6.4887	1.0363	6.7054
France	4.0289	4.0469	6.6409	4.4294	2.2681	3.3084	7.0056	3.3699	7.0246	1.3942	6.7797
Italy	5.0501	3.9227	4.7556	5.0287	2.7446	2.8345	7.2945	2.6936	5.9237	1.5340	5.2985
Spain	3.7611	3.9947	4.7853	5.3883	1.8304	2.2634	6.5251	3.5232	5.6555	1.2352	7.6252
UK	1.8252	3.3909	3.8426	3.8144	1.6170	5.0806	4.4129	4.6223	5.3308	0.9934	3.4268
Brazil	1.7450	2.9325	2.1772	1.2049	5.1632	0.9456	0.9696	3.0370	1.1304	0.6758	2.3908
China	0.5402	2.1769	0.7719	2.3350	2.5062	2.4727	2.8115	4.0674	3.0359	2.0418	2.6910
Netherlands	5.0295	4.2811	5.7038	3.1021	1.6337	4.1431	5.8913	3.7628	6.8639	0.8068	6.1069
Japan	1.6037	1.0015	0.4580	1.6646	1.6343	2.8195	0.5746	7.3602	1.8493	2.4707	0.9127
Thailand	0.7235	0.9067	0.7249	1.5773	0.9494	2.8327	0.5155	6.5616	1.8606	0.8736	1.2199
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Imports

Country	Benin	Burkina Faso	Cote d'Ivoire	Ghana	Guinea Bissau	Mali	Niger	Nigeria	Senegal	Sierra Leone	Togo
USA	1.1516	1.8735	1.1996	4.2646	1.0313	2.2689	0.2561	0.9656	2.8640	1.0036	0.3215
Benin	21.3014	6.7006	8.7935	3.6832	1.8857	4.3534	4.8055	3.0908	2.1787	5.8416	0.3215
Burkina Faso	4.3627	17.1898	0.9494	1.3897	2.1609	0.7812	1.9315	1.2225	1.3219	0.8758	0.7706
Cote d'Ivoire	8.7473	1.7932	29.3469	2.1133	1.5690	3.0846	3.4233	2.6017	2.0440	3.0589	1.1526
Ghana	2.4655	2.4554	1.5388	15.7588	0.3778	4.9922	1.7446	0.1539	1.9966	3.4685	0.3805
Guinea Bissau	1.2017	2.8024	0.8592	1.4851	21.3127	0.4858	0.7953	5.4863	0.7316	3.9793	0.9787
Mali	8.6277	3.7566	5.2777	8.0704	1.8196	11.7650	1.1504	4.4749	5.1984	2.3702	5.8643
Niger	4.0040	2.4060	2.2984	1.5310	0.1890	0.1554	22.1556	2.1586	0.5735	8.2361	3.5192
Nigeria	7.5143	1.0709	1.8619	1.1474	1.8327	2.8581	1.8448	21.9455	1.4486	0.8985	6.9738
Senegal	3.3431	4.2722	6.1483	4.1812	1.4791	5.9352	3.1967	3.5215	8.7454	1.1748	4.8147
Sierra Leone	4.8357	0.8848	3.2040	1.6668	2.8379	0.6748	8.4123	1.5989	0.2148	22.9886	2.9025
Togo	1.2320	2.0783	2.0951	1.0816	1.5191	3.2003	6.0407	10.0044	2.2779	6.4631	16.8906
Egypt	0.3294	2.0857	5.6464	2.1062	7.8989	0.3531	0.1214	1.9309	2.0301	0.3848	0.3706
Eswatini	1.7362	0.6407	6.4433	0.9180	1.8205	1.2188	0.2598	2.2127	0.7100	0.4315	0.6173
Mauritania	1.2245	3.2448	1.3739	4.0583	1.4711	0.8743	0.9504	0.7366	1.4228	0.7059	0.5668
Morocco	1.9186	3.4962	1.4308	1.8694	2.8050	4.7948	2.5131	2.6600	6.9435	3.0408	5.4845
South Africa	1.3498	2.9981	1.4023	4.5636	2.2237	3.2534	0.3571	1.5012	3.9973	1.2097	1.4678
Belgium	1.5500	2.4973	1.1252	1.8275	2.9926	5.0341	3.9794	3.1298	6.2575	4.2909	5.7448
India	0.7824	1.0714	1.1907	0.8406	6.9030	1.1683	1.1858	0.9788	2.9538	0.5852	1.1796
Korea	1.6120	2.6790	0.5969	3.0861	5.9761	1.4264	1.8348	3.2195	1.3067	2.2446	0.3053
Germany	2.6485	2.9626	1.8617	2.9072	3.2659	6.1664	4.8550	5.1143	6.3769	3.5800	7.4561
France	1.2966	2.1700	1.3523	1.3680	2.9854	4.3514	7.1754	4.3364	5.8980	6.4241	7.8455
Italy	1.4085	1.5173	1.6563	2.3164	4.0144	4.8558	5.7490	4.1055	5.2474	3.5890	6.5071
Spain	2.1766	2.0373	1.7255	2.6453	4.7498	4.9294	5.0966	3.6046	5.3159	3.3655	5.8783
UK	1.1864	1.2695	1.6162	3.6837	2.6374	3.8035	1.5328	1.0033	4.1490	1.8602	2.4487
Brazil	1.9242	9.4521	0.9553	2.1365	1.5922	1.0248	1.3602	0.3627	1.7871	0.5928	0.2261
China	2.5515	3.0257	1.8802	4.6099	2.8396	3.4461	1.0395	0.8144	3.3089	1.5359	1.3503
Netherlands	3.5331	3.7243	3.1162	4.9346	4.1537	6.0984	4.1467	4.2372	6.6798	2.6927	6.9437
Japan	1.8379	3.3559	1.1654	4.0100	1.7158	3.1776	0.5836	0.8678	3.5564	1.0537	0.4213
Thailand	2.1469	4.4882	1.8884	5.7457	1.9398	3.4683	1.5026	1.9598	2.4637	2.0536	0.2958
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: Author.

Appendix 4: Regional contributions to ECOWAS countries NGFEVD (Exports & Imports)

Exports

Regions	Benin	Burkina Faso	Cote d'Ivoire	Ghana	Guinea Bissau	Mali	Niger	Nigeria	Senegal	Sierra Leone	Togo
Europe	29.8276	29.3184	37.0788	30.2771	14.7210	24.5287	43.9220	26.3027	43.7513	8.7831	42.6888
Asia	7.2030	6.8138	5.9269	10.4208	8.4099	11.7729	6.7756	29.7903	11.8856	7.3772	8.6559
Americas	2.2509	4.1899	3.2031	3.2087	7.0765	3.9368	2.0157	9.7289	3.8716	1.9745	3.8266
Other Africa	14.5003	10.7105	12.0705	8.8462	7.9073	16.2250	10.1384	12.1743	14.0785	17.8289	8.4009
ECOWAS	24.0172	24.4004	27.8439	26.6842	27.3401	25.2256	24.5222	11.3808	18.1537	32.4692	22.0845
Own-Effect	22.2011	24.5671	13.8768	20.5631	34.5451	18.3109	12.6261	10.6230	8.2594	31.5671	14.3432
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Imports

Regions	Benin	Burkina Faso	Cote d'Ivoire	Ghana	Guinea Bissau	Mali	Niger	Nigeria	Senegal	Sierra Leone	Togo
Europe	13.7997	16.1783	12.4534	19.6826	24.7992	35.2390	32.5349	25.5310	39.9244	25.8024	42.8242
Asia	8.9306	14.6202	6.7216	18.2923	19.3742	12.6867	6.1463	7.8403	13.5895	7.4730	3.5523
Americas	3.0758	11.3256	2.1549	6.4011	2.6235	3.2937	1.6162	1.3283	4.6510	1.5964	0.5477
Other Africa	6.5585	12.4656	16.2967	13.5155	16.2193	10.4944	4.2018	9.0414	15.1036	5.7727	8.5069
ECOWAS	46.3340	28.2206	33.0264	26.3497	15.6710	26.5212	33.3451	34.3136	17.9860	36.3669	27.6784
Own-Effect	21.3014	17.1898	29.3469	15.7588	21.3127	11.7650	22.1556	21.9455	8.7454	22.9886	16.8906
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**