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RESEARCH ARTICLE

Effect of Trade Openness on Food Security in Economic Community of West African States Region

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This study investigates the impact of trade openness on food security in the ECOWAS trade zone. The study relied on the system GMM approach to analyze the impact of trade openness on overall and disaggregated components of food security in the ECOWAS trade zone during the period 2014 and 2021. Annual time series data were sourced from the Food and Agriculture Organization, World Bank Metadata base, and World Integrated Trade Solution. Major findings from the study reveal that trade openness has a significant positive impact on overall food security indicators. However, trade openness has not significantly impacted food availability and access in the ECOWAS region during the period investigated. This finding informs the conclusion that trade openness tends to lose its potency as an important policy tool for achieving greater food security in the ECOWAS trade zone when its impact is considered on a disaggregated scale; hence, the desirability of trade openness as a policy tool in improving food security of ECOWAS member countries is only to the extent of being a complement policy and not a substitute to existing national food and agricultural policies and programs.

Keyword: Food security, food availability, food access, trade openness, ECOWAS, Generalized Method of Moment

JEL Classifications: F13, F14, F18

Hunger is, arguably, one of the toughest challenges facing the modern world, as 735 million people are currently grappling with hunger as a manifestation of food insecurity (Food and Agriculture Organization [FAO], 2023). The pangs of hunger manifests most in Africa, which is the world's poorest continent (FAO et al., 2019). Even though there has been a remarkable achievement in the fight against hunger on the global scale since early 2000s, the level of hunger in Africa is considered a protracted global emergency (Bonuedi et

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al., 2020). In this light, severe cases of food insecurity, according to reports on The State of Food Security and Nutrition in the World, are recorded in Africa (FAO, 2019; 2023).

Evidently, efforts in the way of Sustainable Development Goals (SDGs) suggest that the world has not slept on the realities of rising food insecurity. However, the menacing rate of increase in the prevalence of undernourishment (PoU), especially in sub-regions of Africa that was reported by FAO et al. (2019), raises questions on how to attain a world that is free of hunger by the year 2030 as an objective of the SDG2 (United Nations, 2015). It is argued that food insecurity is not a production problem but that of supply (Shaw, 2007), as current global food output is believed to be enough to feed 10 billion people, which is 20% above the current global population of 8 billion (Population Reference Bureau, 2022). Moreover, despite the numerous challenges in the African food and agricultural sector, recent trends in Feed Africa (2021) show food production to have risen by 26% between 2015 and 2020. This fundamental contradiction of a parallel rise in food production and hunger and malnutrition at the same time seems to suggest the insufficiency of food production diversification in eradicating food insecurity in Africa (Bonuedi et al., 2020).

Although the worst cases of food insecurity and vulnerability to global food prices are felt in the West African sub-region (Ugwuja & Chukwukere, 2021), hunger in this region is argued to be more of a structural problem (Maur & Shepherd, 2015). Several economic, political, and environmental factors (such as market instability, tribal, religious, and intra-state conflicts), climate variabilities are believed to be among the important proximate causes of rising food insecurity in West Africa (Deutsche Gesellschaft fur Internationale Zusammenarbeit, 2023). In addition to these factors, trade-distorting policies that limit the free movement of agricultural resources and output are among the ultimate causes of rising food insecurity in the West African region (Mukhtar, 2017). Major characteristics of agricultural output in the West African region are that they are perishable, income inelastic, and beset by poor storage and processing. For these reasons, trade in agricultural output is very sensitive to time variations (Fox & Jayne, 2020). Moreover, a volatile agricultural supply chain tends to exacerbate poor agricultural income, poverty, and food insecurity, which are the limiting consequences of poor trade facilitation (Maur & Shepherd, 2015).

There is strong empirical evidence to support the argument in favor of trade openness as an important means of eradicating food insecurity in West Africa where food insecurity is seen as a regional emergency (Deutsche Gesellschaft fur Internationale Zusammenarbeit, 2023). An increase in food trade is not only inevitable in view of the current environmental sustainability concerns (Hendrix 2011), but domestic food prices are highly dependent on international food trade (von Braun & Paulino, 1990). It is further argued that intra-regional trade openness is one of the most promising means of eradicating food insecurity in the West African sub-region (Bonuedi et al., 2020). Since its creation in 1975, the Economic Community of West African States (ECOWAS) has succeeded in making countries in West Africa more open to intra-regional food trade (Ademola, 2018), through its policies and programs. Some notable programs in this direction include: (a) the establishment of the Economic Community of West Africa Agricultural Policy (ECOWAP) in 2005 with the main objective of mobilizing sub-regional agricultural policy collaboration to achieve regional food security, (b) ECOWAS food reserve policy in 2013 to complement efforts by member states in their response to the food crisis, and (c) the MALABO declaration 2014 and 2023 with the main objective of poverty reduction, ending hunger, and tripling intra-Agrican trade (ECOWAS, 2008; Staatz et al., 2017). Despite these efforts, studies by Torres and van Seters (2016) and Ikechi et al. (2022), have revealed that intra-regional food trade is still very low among ECOWAS member countries, with only about 8% to 13% due to intra-regional food trade. Due in part to a colonial trading legacy and a trade pattern constituting primary unprocessed food crops with low-income elasticity of demand, ECOWAS member countries are largely disinterested in food trade amongst themselves but have become relatively more open to global trade (Ikechi et al., 2022). Overall, this has caused a volatile trade environment around the region's food systems, translating into high degrees of hunger and malnutrition (Clapp, 2016).

Empirical studies (Ibitoye & Ibitoye 2020; Mary, 2019 and Tinta et al., 2018) have investigated the hypothesized association between food security and openness in Africa with conflicting outcomes. Although Ibitoye and Ibitoye (2020) found food

security to be a positive function of trade openness, Mary (2019) and Tinta et al. (2018) have found a weak relationship between food security and trade openness. Despite these efforts, there seems to be a blind spot in existing literature. Previous research is silent on the pathways through which trade openness transmits its impact on food security. Most of the previous attempts have relied on a one-dimensional approach to measuring trade openness, which is the de facto trade volume relative to the gross domestic product (trade/GDP) measure of trade openness. Even though this approach measures openness in terms of the overall impact of various degrees of structural, geographical, and technological intensities, with no attempt to determine their relative contribution (Fuji, 2019), it falls short in accounting for the extent of a country's prevailing regulatory environment which reflects the level to which a country is willing to be open to international trade (Gräbner et al., 2020). The understanding of these two distinct indicators of openness suggests that implications from the de facto indicator can strongly differ from those that measure the policy and regulatory environment aspects of openness (Martens et al., 2015). Moreover, regression outcomes from trade/GDP indicators have been criticized on the basis of country size bias (Feenstra, 2015), endogeneity concerns (Frankel & Romer, 2000), and ambiguities and unclear interpretations (Martens et al., 2015). Furthermore, no significant attention has been dedicated to analyzing the impact of intra-regional trade policy on food security in the ECOWAS region.

This paper is an attempt to bridge this lacuna in the literature by presenting empirical evidence on the impact of trade policy indicators of openness on food security in ECOWAS trade zone. A panel dataset for 15 ECOWAS member countries over the 2014–2022 period is adopted to reflect the period of active commitment of ECOWAS to food and nutrition security. Unlike Ibitoye et al. (2018), Fusco et al. (2020), Sun and Zhang (2021), and other related studies that focused on the conventional Trade/GDP measure of trade openness, this paper examines the beneficial effects of ECOWAS trade reforms, which are aimed at easing and speeding the free-flow of goods within the region on food security, while relying on the new trade openness index by Gräbner et al. (2020) as primary explanatory variable. Furthermore, adopting the FAO (1996) multidimensional approach to food security, food security outcomes are measured using both dimension-specific and composite indicators.

This paper, therefore, addresses two important questions. First, which dimensions of food security are most impacted by intra-regional trade openness in the ECOWAS region? Second, which form of trade openness requires more attention to facilitate the achievement of food security in the ECOWAS region? Findings from this paper are relevant to directing ECOWAS trade agreements for the realization of the SDG2 objective of eradicating hunger by the year 2030.

The rest of this paper is structured as follows: following this introduction, the next section accounts for conceptual, theoretical, and empirical literature reviews. Section three of this paper discusses the materials and methods of analysis to be used, and section four presents and discusses the empirical findings of the paper. Finally, section five concludes the paper with policy implications of the findings.

Literature Review

Conceptual Review

Food Security

Food security is conceptualized in different contexts, both in policy and empirical research. The most well-known and widely accepted definition of the concept is the multidimensional perspective developed by the United Nations' FAO. It defines food security as a situation where all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 1996). Empirical researchers have also conceptualized food security relying on different approaches. For example, the entitlement perspective by Sen (1981) saw food security as one among many other primary objectives of a household. Following the right-based perspective, Das (2016) defined food security as a situation where all households have physical and economic access to adequate food for all members, and where households are not at risk of deprivation of this basic access, which is linked to the larger question of the survival of humanity. Another definition is the sustainable livelihood perspective by the Committee on Food Security (2000), which defined food security as material and social resources, capabilities, and activities required for a particular means of living.

Having reviewed the various perspectives, the working definition of food security for this study is the FAO (1996) multidimensional definition. This definition has been chosen based on the fact that in addition to being the most accepted and, hence, a de facto clearing-house definition of food security, it allows researchers to easily find context for their proxies, in addition to being the UN recognized definition, which is identified as one of the 17 ongoing sustainable development goals (United Nation, 2015).

Trade Openness

The term trade openness has always been defined to represent free trade, trade liberalization, and globalization. An increase in the size of the traded sector of a country is regarded as trade openness. This implies the extent to which an economy allows the importation of foreign goods and services and the exportation of locally produced goods and services and productive resources (Pigka-Balanika, 2013). Trade openness has also been defined as a measure of the intensity of a country's engagement in global trade, usually determined by taking the ratio of total trade volume to the GDP (Ikechi et al., (2022).

Although the conceptual debate on trade openness bothers more with its measurement than its definition, there has been a search for new measures of openness since Sachs and Warner (1995). Growing out of criticisms against the trade/GDP measure based on the premise that it fails address the extent to which a country is willing to be open to trade through its regulatory environment (Gräbner et al., 2020). Sachs and Wagner (1995) developed a binary index as an alternative to the trade/GDP index. Their index was based on five criteria, the absence of which a country is termed open to trade and vice versa. These criteria include tariff barriers, non-tariff barriers, differences in official and black-market exchange rates, and trade-related socialist policies.

Criticizing the approach by Sachs and Wagner (1995) on the basis of being too dichotomous (Rodriguez, 2000), a more nuanced approach was employed by Jaumotte et al. (2013) that measures rather directly changes in regulatory trade frameworks of an economy. Their openness index was based on two criteria: ratio of tariff to import and average unweighted rate of tariff. Even though the Jaumotte et al. (2013) index is econometrically considered robust and more reliable than the Sachs and Wagner (1995) index, it was criticized by Gräbner et al. (2020) as offering too limited and restrictive IMF internal data that is not publicly available and making data replication not an easy task. It was in view of this non-replicability of the Jaumotte et al. (2013) index that Gräbner et al. (2020) developed their trade openness index to complement the weaknesses of past indexes. Following closely the tariff-based approach of Jaumotte et al. (2013), Gräbner et al. (2020) based their data on data from the World Bank's World Integrated Trade Solution (WITS) databank, which is readily available and replicable.

Several past studies in this area, including Ibitoye et al. (2018), Fusco et al. (2020), and Sun and Zhang (2021), have relied on the traditional de facto trade/GDP index to measure the impact of trade policy on food security, this study adopts the newly developed de-jure index by Gräbner et al. (2020). This index measures the index as 100 minus the average of (a) the most effectively applied tariff (MET) rates and (b) the weighted average of the most-favored nation (MFN) tariff rates. Even as the Gräbner et al. (2020) data is available for 1988–2018, its replicability provides an opportunity for this paper to contribute to the ongoing debate on effective measures of trade openness in the West African context, hence a major contribution of this research.

Theoretical Review

The theoretical justification for the relationship between trade and food security has its roots in trade theory. Traditional trade theories like Adam Smith (1776) absolute advantage, Ricardo (1871) comparative advantage, and neoclassical Hecksher (1919) and Ohlen (1933) model are of the opinion that differences in factor endowment are the major explainers for international trade. This group of theories has the policy implication that specialization rather than diversification of international production leads to static and dynamic gains from trade. Hence, the more open an economy is, the more gains it acquires from international trade (Lam, 2015; Carrere et al., 2020). Therefore, food security as a welfare gain from international trade is a function of trade openness (Rangasamy, 2003).

Owing to their simplicity, popularity, and general appeal of traditional trade theories, their assumptions and conclusions have become subject to harsh criticisms against the backdrop of new theoretical and empirical evidence. Modern trade theorists believe that

the policy implications of traditional trade theories are based on fragile grounds. New trade theorists such as Grubel and Lloyd (1975) and van Long and Soubeyran (1997) showed that economies of scale, more than factor endowment, justify international trade with the major trade implication being that strategic trade policy such as tariff and export subsidy are necessary for a country to maximize potential external economies of scale. Hence, the analytical thrust of these theories justifies trade intervention as a way of achieving food security.

Even though the modern trade theory was able to account for and explain some of the important complexities of international trade, their conclusions have been rejected mainly on the ground that they find their strength in political economy rather than empirical evidence (Bernard & Jason, 1999). A new stream of empirical evidence in the early 2000s following Melitz (2003) added value to the arguments in favor of trade openness by revealing new sources of gains from trade, such as the increase in productivity (Redding, 2011). Such an increase in productivity is explained by an intra-industry reallocation of productive resources in favor of large firms that are best positioned to maximize existing and potential economies of scale and market heterogeneity (Carrère et al., 2011). Hence, these theories have a major implication that exploring and reinforcing the extensive margin of trade through trade facilitation, such as reduction in costs of regulation and certification and commitment to international trade agreements, are important in maximizing gains from trade (Costantini & Melitz, 2008; Melitz, 2003).

This paper favors the theory by Melitz (2003) as the framework on which its analysis shall be based. This is justified to the extent that among contending theories, its key assumptions, such as market imperfection and heterogeneity, best explain the structure of ECOWAS food markets, which are mostly characterized by many smallholder farmers participating in spot transactions and few large-scale exporters who take advantage of existing economies of scale (Sakho-Jimbira & Hathie, 2020). Moreover, the major policy implication of exploring extensive margin of trade, as in the Melitz (2003) theory, best guides the current intra-regional agricultural trade integration agenda of ECOWAP.

Empirical Review

The empirical relationship between trade openness and food security in the regional context has received a reasonable amount of attention. Researchers are, however, inconclusive as to the extent to which trade openness impacts food security in the regional context. Gnedeka and Wonyra (2022) investigated the effect of trade openness on food security in 37 countries of Sub-Saharan Africa, covering the 2004 to 2018 period using the GMM technique. Findings from this study show trade openness accounts for significant positive improvements in the region's food security, whereas political instability is found to strongly affect food security negatively. Ly et al. (2021), investigated the impact of international trade openness on food security in 10 Southeast Asian countries for the period 2000–2015 using fixed (FE) and random effect (RE) models as well as feasible generalized least squares model (FGLSM) for panel data regression. The findings by Ly et al. were contrasted by that of Sun and Zhang (2021), who found a u-shaped relationship between trade openness and the four pillars of food security after investigating the effects of trade openness, geographical, cultural and institutional indicators, and world price shocks on food availability, access, utilization and stability for the period 2001–2018 in Central Asian countries using the GMM and least-squares (LS) procedures. Sun and Zhang (2021) concluded in favor of a reasonable protectionist trade policy of food self-sufficiency because only beyond a certain threshold can trade openness impact positively on food security.

An earlier study by Bonuedi et al. (2020) investigated the impact of trade facilitation on food security in 45 countries in Africa during the 2006–2015 period. Estimating panel data using the first-difference instrumental variable (FDIV) estimation technique, the authors found food availability and access to food to be truncated by lengthy time for export and import and higher requirements for documentation in Africa. A similar study, Ibitoye and Ibitoye (2020) had attempted to investigate the determinants of intra-ECOWAS food trade and their effects on food security for the period 1970–2018 using an augmented gravity model (GM). The results, among other things, showed a significant positive relationship between food trade and the level of openness, local production level, and GDP of ECOWAS trading countries. They concluded that although an increase in the local food consumption in the exporting country reduces the quantity of food available for trade, an increase in the local consumption of food in the importing country has a positive effect

on trade flows and, therefore, increases food security. An earlier study by Ibitoye et al. (2018), relying on the overall openness index (OPI), regional intensity of trade index (RIT), and the Herfindahl index (HI), revealed that even though food trade diversification became higher after the regional trade treaty, food trade among ECOWAS member states is still relatively very low despite the existence of the free trade area. This explains why food insecurity persists in the region.

According to Tinta et al. (2018), who analyzed the causal impact of intra-regional integration through trade value chain on economic growth and food security of ECOWAS member countries, the overall economic growth of ECOWAS member countries is not dependent on international trade but increase in food security of each of the countries is directly linked to regional trade integration. Hence, there is a need to strengthen regional trade integration as an important vector to better stimulate the potential of each country to move from discontinuous to sustained growth and food security. This view is supported by Oke et al. (2017), who found strong support for food importation to African countries to reduce their levels of food insecurity situations after finding an insignificant nexus between agriculture value added per worker and food security.

Even with the strong support for trade openness as an important driver of food security in developing countries, some important studies have highlighted shortcomings of trade in achieving food security. For example, Mary (2019) investigated how food trade openness affects extreme hunger in the context of developing countries using a two-step approach: (a) a reverse causal impact of hunger on food trade openness and (b) a causal residual food trade approach found too much openness and reliance on food importation increase the situation of hunger and undernourishment recorded in developing countries. This finding is supported by the work of Bezuneh and Yiheyis (2014), who empirically examined the short- and long-run impacts of trade openness on food security in selected 36 developing countries and found a weak association between openness and food security.

Methodology

The aim of this paper was to analyze the effect of trade openness on food security for a cross-section of countries in the ECOWAS trade zone. A strongly balanced annual panel data set of 15 ECOWAS member countries including Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo spanning 2014–2021 is used. Coverage of the ECOWAS region is justified by the need to investigate the interaction between trade and food security following the gradual shift of focus by developing countries from trade globalization towards trade regionalism following the collapse of the Doha Development Agenda (DDA) in 2008 (Kernohan & Edwards, 2006). Moreover, in addition to data availability for all cross sections, the period of analysis is further justified by the need to investigate the period of active policy commitment of ECOWAS towards food security with the formation of ECOWAP in 2014. Informed by panel characteristics of cross-section (N) greater than time (T), we follow Fusco et al. (2020) to adopt a dynamic panel approach. The system GMM estimator proposed by Blundell and Bond (1998) is used to demonstrate the dynamic relationship between trade openness and food security and to overcome the problem of inconsistencies of estimators as a result of the introduction of lagged dependent variables. The system GMM further has the advantages of fitting large variances, overcoming endogeneity problems, and fitting unbalanced panels where there are a large number of cross sections (N) and relatively short periods (T) (Afeez, 2012). Even though the original system GMM by Blundell and Bond (1998) and later, Roodman (2009) have the limitation of potential deviations from mean stationarity if variables are close to a random walk (Afeez, 2012), we overcome this problem by estimating our model using the *xtdpdgmm* command developed by Kripfganz and Schwarz (2019) on the STATA software. Moreover, this technique is preferred to Roodman (2009) *xtabond2* for its ability to not only detect but also eliminate perfect collinear instruments from the transformed level instruments (Inuwa et al., 2021).

The dynamic model in Equation (1) is built based on the work of Fusco et al. (2020).

$$FS_{i,t} = \alpha + \beta FS_{i,t-1} + \beta_1 TO_{i,t} + \beta_2 CV_{i,t} + \beta_1 \mu_i + \lambda_t + \varepsilon_{i,t}\ i = 1, \ldots 15, t = 1, \ldots 8 \quad (1)$$

where *FS* is food security measured by the composite indicator proxied by the prevalence of undernourishment

(PoU) and dimensional indicators including food availability proxied by average dietary energy supply adequacy (DES) and food access, which is proxied by GDP per capita. PoU is justified as the FAO uses it to reflect a threshold below which a country is categorized as food insecure. It has been used by previous researchers such as Bonuedi et al. (2020) to measure composite food security. Moreover, DES and GDP per capita are justified as dimensional measures of food security, and the FAO has used them as flag-ship indicators of food availability and access. Previous studies, including Ibitoye and Ibitoye (2020), Ly et al. (2021), Sun and Zhang (2021), have also used DES and GDP per capita to measure food availability and access. is trade openness measured by the Gräbner et al. (2020) index, which is a tariff-based approach that shows the extent to which trade openness affects food security through its regulatory environment. *CV* is a set of control variables, including food price inflation, population growth, regulatory environment, and political stability, that together signal the potential level of food trade policy applicability in each country. Data for this paper are sourced from FAOSTAT, World Bank, and World Integrated Trade Solution (WITS). The sources and expected behaviors of variables are further explained in Table 1.

Results and Discussion

This section discusses results elicited from the investigation of how food security is affected by trade openness in ECOWAS member countries.

Table 2 presents summary statistics and a correlation matrix of the variables considered in this study. The results revealed that there is a wide difference among

Table 1. *Summary of Data, Measurement, Source, and Expected Sign*

Variable	Measurement	Source	Expected Sign
FAvail	Dietary energy supply	FAOSTAT	+
FAccess	GDP Per capita PPP	FAOSTAT	+
TO	100-Tariff (MET, MFN)	Gräbner et al. (2020)	+
REGQ	Estimated value	WITS	+
PStab	Estimated value	WDI	+
FoodCPI	Estimated value	FAOSTAT	-
POPG	% Weighted average annual	WDI	-

Source: *Authors' Tabulation*

Table 2. *Descriptive Statistic of Variables*

Variable	FScomp	FAvail	FAccess	TO	REGQ	PStab	FoodCPI	POPG
Mean	16.033	116.955	3012.193	86.791	1.258087	-0.614	3559.282	120.081
Std. D	9.298	11.707	1603.856	10.446	7.344	0.751	7689.946	35.198
Minimum	3.800	97.000	1126.800	44.785	-1.639	-2.352	106.899	85.997
Maximum	3.780	142.000	7171.800	93.617	33.654	0.902	32343.550	266.713
lnScomp	1							
lnFAvail	-0.818	1						
lnFAccess	0.023	-0.057	1					
lnTO	0.228	0.165	0.019	1				
lnREGQ	0.197	-0.256	-0.224	0.008	1			
lnPStab	0.361	-0.478	0.341	-0.228	0.261	1		
lnFoodCPI	-0.013	-0.011	0.261	-0.001	0.112	-0.134	1	
POPG	-0.447	0.431	-0.808	-0.022	0.035	-0.604	-0.149	1

Source*: Author's computation using STATA 15 software*

Table 3. *Results of Econometric Estimation*

Variable	**lnFScomp** 1	**lnFAvail** 2	**lnFAccess** 3
lnFScomp $_{t-1}$	-0.284*		
	(0.081)		
lnFAvail $_{t-1}$		-0.563***	
		(0.060)	
lnFAccess $_{t-1}$			0.007
			(0.142)
lnTO	0.216*	0.111	-23.117
	(0.066)	(0.089)	(28.983)
lnREGQ	0.276*	-0.518*	-66.648***
	(0.135)	(0.167)	(16.657)
lnPStab	0.152	2.194	-380.181
	(1.593)	(2.629)	(271.683)
lnFoodCPI	-0.060	0.081*	15.114
	(0.038)	(0.028)	(11.765)
lnPOPG	-6.00*	11.957**	-2003.638**
	(2.281)	(2.825)	(331.278)
Constant	20.554	139.594***	11876.350*
	(12.686)	(7.695)	(5166.573)
F-Statistic	97.210 (0.000)	214.850 (0.000)	268.450 (0.000)
AR(1)	-1.400 (0.163)	-1.770 (0.077)	-0.690 (0.490)
AR(2)	0.240 (0.810)	1.510 (0.130)	-1.630 (0.104)
Hansen	5.630 (0.583)	6.060 (0.533)	5.260 (0.628)

Note: ****, **, and * denote 1%, 5%, and 10% levels of significance, respectively.*
Source*: Author's computation using STATA 15 software*

the average value of prevalence of undernourishment proxied for overall food security (16.033), food availability (116.955), and food access (3012.193). The same is seen in their respective minimum and maximum values. Although the average value of trade openness is 86.791, those of trade regulatory quality, food inflation, and population growth rates are 1.258, 3559.282, and 120.089. Moreover, only political stability has a negative average value (-0.614). The correlation matrix in Table 1 signals the magnitude and extent of association among the variables employed. Coefficients of the dependent variables revealed the existence of a negative association between composite food security and food availability and access. all predictor variables are positively correlated with composite food security with the exception of food inflation (-0.013) and population growth rate (-0.447), as trade openness alone exhibits a positive relationship (0.164) with food availability. Moreover, food access is found to be positively correlated with most explanatory variables with the exception of political stability (-0.224) and population growth rates (-0.808). It is worthy of note that although the correlation coefficients of all explanatory variables exhibit marginal association among themselves, suggesting the robustness of instruments, the dependent variables (food availability and composite food security) are found to be highly correlated with a negative coefficient of -0.817.

From Table 3, the second, third, and fourth columns represent the relationship between the three dependent variables (composite food security, food availability, and food access, each representing a different model) and the explanatory variables. Empirical results from model 1 reveal that the coefficient of the lagged dependent variable is positively and significantly associated with its current value itself, implying that previous values of overall food security play a significant role in determining current total food

security in the study area. Similarly, trade openness, which is the main predictor variable of this paper, has a positive and significant impact on composite food security, on average, holding other regressors constant. A percentage change in trade openness is associated with a 0.216% increase in composite food security in the short run at a 10% level of significance. The magnitude of the coefficient further reveals that trade openness and composite food security exhibit a fairly inelastic relationship. This affirms the findings by Bonuedi et al. (2020) and Ly et al. (2021), who also found a positive and significant impact of trade openness on overall food security in the ECOWAS region. However, the inelasticity of the relationship supports the conclusion of Sun and Zhang (2021), who found trade openness to fairly impact food security only to a certain threshold, and Bezuneh and Yiheyis (2014), who found a weak relationship between trade openness and food security.

Moreover, trade environment regulatory quality positively and significantly impacts composite food security. A percentage change in regulatory quality is associated with a 0.276% increase in composite food security in the short-run at a 10% level of significance, on average ceteris paribus. Hence, trade environment regulatory quality and composite food security exhibit an inelastic relationship. Population growth rate, which is a major control variable, is found to have a negative relationship with composite food security. A percentage change in population growth rate is associated with a 6.004% reduction in composite food security in the short-run at a 10% level of significance, on average holding other things constant. Population growth rate and composite food security, therefore, exhibit an elastic relationship. This finding strongly supports Bonuedi et al. (2020), who found that population strongly impacts food security in a negative way in the ECOWAS zone. From the diagnostics of model 1, p-values of AR(1) and AR(2) suggest the absence of first-order and second-order serial correlation, and the Hansen test of over-identifying restrictions also suggests the validity of all instruments used in the model.

Empirical results from model 2 reveal that the coefficient of the first lag of food availability is positively and significantly associated with the current value itself, implying that previous values of overall food security play a significant role in determining current food availability. As for its relationship with the predictor variables, regulatory quality is found to negatively and significantly impact food availability. A percentage change in trade environment regulatory quality is associated with a 0.518% reduction in food availability in the short-run at a 10% level of significance, on average holding other things constant. The magnitude of the coefficient suggests that regulatory quality and food availability exhibit an inelastic relationship. This finding supports that of Ly et al. (2021), who saw economic and trade regulations to strongly impact food availability, but contrasts with the finding in model 1 on the relationship between trade regulations and overall food security.

Food inflation is found to have a positive and significant impact on food availability. A percentage change in food inflation is associated with a 0.081% increase in food availability in the short-run at a 10% level of significance, on average ceteris paribus. Hence, food inflation and food availability exhibit an inelastic relationship. This finding corroborates that of Fusco et al. (2020), who also showed a positive association between food availability and inflation rate, but contrasts with Bonuedi et al. (2020), who found a significant negative impact of inflation on food availability. Similarly, population growth rate has a positive and significant impact on food availability, where a percentage change in population growth rate is associated with an 11.957% increase in food availability in the short-run at a 5% level of significance, on average ceteris paribus. The magnitude of the coefficient of population growth further reveals that population growth rate and food availability exhibit an elastic relationship. This finding contradicts the expectation of a priori as well as the previous finding by Fusco et al. (2020), who earlier showed that population negatively impacts food availability. The p-values of AR(1) and AR(2) suggest the absence of first-order and second-order serial correlation, and the Hansen test of over-identifying restrictions also suggests the validity of all instruments used in the model.

The fourth column of Table 2 reveals findings from model 3, where regulatory quality is found to negatively and significantly impact food access. A percentage change in trade environment regulatory quality is associated with a 66.65% reduction in food availability in the short-run at a 1% level of significance, on average holding other things constant. The magnitude of the coefficient suggests that regulatory quality

and food availability exhibit an elastic relationship. Population growth rate is found to have a negative relationship with food access. A percentage change in population growth rate is associated with a 2003.63 reduction in composite food security in the short-run at a 5% level of significance, on average holding other things constant. Hence, population growth rate and food access exhibit a highly elastic relationship. This is expected a priori as food access is viewed theoretically by the neo-Malthusians as a negative function of the increase in population (Meadows et al., 1972). From the diagnostics of model 1, p-values of AR(1) and AR(2) suggest the absence of first-order and second-order serial correlation, and the Hansen test of over-identifying restrictions also suggests the validity of all instruments used in the model.

Conclusion and Policy Implication

This study examined the impact of trade openness on food security in the ECOWAS trade region by relying on composite and dimension-specific measures of food security during the 2014–2021 period. The study adopted the novel Gräbner et al. (2020) measure of trade openness and applied the system GMM developed by Kripfganz and Schwarz (2019) Major findings from this study suggest that trade openness tends to lose its potency as an important policy tool for achieving greater food security in the ECOWAS region when its impact is considered on a disaggregated scale. The implication of this is that while trade openness may not significantly affect individual indicators of food security, such as food availability and access, its impact on composite food security implies that the other dimensions of food security (such as food quality, stability, and sustainability) should be exploited through more openness of the ECOWAS the region to intra-regional. However, bearing in mind the argument by Rudloff (2013) that food quality and stability can only be achieved after availability and access to food are reached, the desirability of trade openness as a policy tool in improving food security of ECOWAS member countries is only to the extent of being a complement policy and not a substitute to existing national food and agricultural policies.

Moreover, the findings on the impact of trade regulatory quality on food security are highly sensitive to the quality of the trade environment in the ECOWAS region. Although the significant impact of trade regulation on all measures of food security implies the important role it plays in improving the ECOWAS food market, its negative impact on food availability and access suggests that excessive regulations of the ECOWAS food market, border checks, and requirements hinder the free-flow of important food commodities in the region, hence reducing the level of availability and access to essential food commodities. In light of this conclusion, a full institution of the ECOWAS customs union would help eliminate delays in the movement of essential food items across borders, hence improving food availability and access in the region.

In addition, analysis of this study revealed that population growth has negatively affected food security in the ECOWAS region. With West Africa being the region with the highest population growth rate, the frequency, complexity, and dynamism of West African demography suggest that the ECOWAS food sector is particularly threatened by the population growth rate, which reduces the level of food security in the region. In this context, it becomes important to put policies in place at national and regional levels that will reduce some of the food sector-related problems associated with population growth, such as malnutrition, stunting, rural-urban migration, and disproportionate household income ratio, among others. This could be achieved by removing barriers to contraceptives, improving quality education, eliminating urban-biased policies, and maximizing improved mechanization, storage, and access to farmer's credit.

Future studies could be extended in this area to exploit the limitations of this study by covering a wider range of food security measures, such as food quality, stability, agency, and sustainability, in addition to overall food security measures. This could further clarify the contrary findings elicited in the three models of the study on how trade openness impacts food security in the ECOWAS region. Moreover, the impact of financial openness, which is the second arm of the Gräbner et al. (2020) indicator of economic openness, could also be exploited to determine food security in addition to the trade openness measure in the ECOWAS trade zone. Such an approach could potentially increase the robustness of the findings elicited.

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