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Econometric Analysis of China–ECOWAS agricultural products trade

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ABSTRACT: *Agriculture trade remains the economic fulcrum of most African countries as the continent continues to host the largest percent of arable land. This research analyzed the Economic Community of West African States (ECOWAS) and China's agricultural products trade determinants based on 19 years (2000-2018) panel dataset of West African countries aggregate agricultural products exports ($) and macroeconomic variables; GDP, population, arable land, language investment, and trade association(WTO)) as predictors. The PPML estimation method was employed due to its prediction accuracy, the size of the data, and potential hetroskadacity issues. With a 78.5% prediction power, the model explained the variation in ECOWAS-China agricultural trade (Exports). GDPj, lnPOPj, lnPOPi, and lnARLj, LndLj, ConfInsj, and WTOij were positive and statistically significant determinants of trade as hypothesized by existing trade literature. In addition, the China's population (lnPOPj) had a value of 0.5877, which is significant at the 5% level, indicating that a 1% increase in the Chinese population significantly increases trade in agricultural products with ECOWAS states. The coefficient of distance (Dij) is -4.4573 statistically significant at the 1% level, indicating that distance between partners impedes trade flow. There are unidentified barriers that delay the progress of trade in agricultural products between ECOWAS and China. Based on the above findings, Investments in ECOWAS arable lands demand urgent attention if significant progress in exports is expected, additionally, governments of both partners should assist Agricultural research and development to identify and rectify stifling trade barriers. Furthermore, as trade between ECOWAS and China has not yet reached its full peak, studies on export determinants of individual Agro-commodities and potentials are needed to enrich literature.*
Key words: *Agricultural products, trade determinants, gravity model, ECOWAS, China.*

Análise econométrica do comércio de produtos agrícolas China-CEDEAO

RESUMO: *O comércio agrícola continua sendo o sustentáculo econômico da maioria dos países africanos, visto que o continente continua a hospedar a maior porcentagem de terras aráveis. Este trabalho analisou os determinantes do comércio de produtos agrícolas de paises do oeste da África ECOWAS e da China com base em um conjunto de dados de painel de 19 anos (2000-2018) dos países da África Ocidental, agregando exportações de produtos agrícolas ($) e variáveis macroeconômicas (PIB, população, terras aráveis, investimento linguístico e associação comercial (OMC)) como preditores. O método de estimativa PPML foi empregado devido à sua precisão de previsão, o tamanho dos dados e possíveis problemas de heteroscedasticidade. Com um poder de previsão de 78,5%, o modelo explicou a variação do comércio agrícola Comunidade Económica dos Estados da África Ocidental (CEDEAO) -China (Exportações). GDPj, lnPOPj, lnPOPi e lnARLj, LndLj, ConfInsj e WTOij foram determinantes positivos e estatisticamente significativos do comércio, conforme hipotetizado pela literatura comercial existente. Além disso, a população chinesa (lnPOPj) teve um valor de 0,5877, o que é significativo ao nível de 5%, indicando que um aumento de 1% na população chinesa aumenta significativamente o comércio de produtos agrícolas com os estados da Comunidade Económica dos Estados da África Ocidental (CEDEAO).O coeficiente de distância (Dij) é -4,4573 estatisticamente significativo no nível de 1%, indicando que a distância entre os parceiros impede o fluxo comercial. Existem barreiras não identificadas que atrasam o progresso do comércio de produtos agrícolas entre a Comunidade Económica dos Estados da África Ocidental (CEDEAO) e a China. Com base nas conclusões acima, os investimentos em terras aráveis da Comunidade Económica dos Estados da África Ocidental (CEDEAO) exigem atenção urgente se houver progresso significativo nas exportações. Além disso, os governos de ambos os parceiros devem ajudar a pesquisa e o desenvolvimento agrícola a identificar e retificar as barreiras comerciais sufocantes. Além disso, como o comércio entre a Comunidade Económica dos Estados da África Ocidental (CEDEAO) e a China ainda não atingiu o seu pico, são necessários estudos sobre os determinantes das exportações de produtos agrícolas individuais e potenciais para enriquecer a literatura.*
Palavras-chave: *produtos agrícolas, determinantes do comércio, modelo gravitacional, ECOWAS, China.*

INTRODUCTION

Over the last decades, Sustained interest in China-African economic ties has resulted in hundreds of media stories and opinions, dramatic assertions, and robust misconceptions, but surprisingly evidence about the reasons of the growing agricultural exports from key economic states of West Africa (ECOWAS) is limited (MIAO et al., 2020; VILLORIA, 2009; ZHANG

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et al., 2010). Although, some studies (FUKASE & MARTIN, 2016; KONINGS, 2007) purport that agricultural imports from Africa as insignificant in volume as compared with China's exports to the region, CHATHAM HOUSE (2020) data shows that except for oilseeds and crude oil, import of fish aquatic resources, gums, and rubber among other agricultural products exports from the ECOWAS region exceeds $1.2bn. Figures 1 and 2 explore the overall performance of ECOWAS agricultural imports and exports whilst figure 3 shows ECOWAS imports to China for the past 18 years. Furthermore, the agricultural trade flow (export and import) and the market share is in table 1. Reaching a high peak in 2012, Agricultural exports have exhibited seasonal growth since 2000 to date. This growth does not come as a surprise since most African States are heavily reliant on Agricultural exports earnings. However, to fully understand the myths surrounding this trade relation, we draw analogies from both recent findings and evidence from early trade theologians.

The traditional gravity model explains the variations in trade based on economic size and distance (TINBERGEN, J. 1962). However, with the advancement and dynamics in trade, several possible microeconomic and macroeconomic indicators have been discovered to influence trade among individuals and groups of trade partners (ABOULEZZ, 2016; AKOWUAH et al., 2020; NASRULLAH et al., 2020; NGOMA, 2020; VU et al., 2020). In the context of China and Africa bilateral trade, factors such as language investment (YEBOAH et al., 2021), WTO membership, (LIEN et al., 2019; SHAHRIAR et al., 2020) institutional quality (DIDIER & HOARAU, 2021; GOLD & RASIAH, 2021) economic agreement and trade agreements (GUAN & IP PING SHEONG, 2020) have shown significant influence on the volume and direction of trade respectively. For agricultural trade, H. SEN ZHANG et al., (2010) found out similarities and possible potentials between China and African States based on ongoing cooperation that seeks to promote agricultural trade.

Although, the aforementioned studies employed the extended gravity model in Analyzing China and Africa trade, are still missing ingredients that demands further investigation. Therefore, the present study seeks to address multiple gaps and in doing so makes a vital contribution. First, the study extends the limited work on the drivers of China - west Africa Agricultural trade using the current trade data; Secondly, no previous research to the best of the authors' knowledge and through search in the peer-reviewed database has empirically analyzed ECOWAS agricultural exports to China within the same time frame, despite the existing level of Agricultural cooperation between the two economies. Moreover, existing literature on trade determinants is only limited to the Sub-Saharan African region other than regional trade blocks (VON ESSEN, 2017) which forms the basis of our research question;

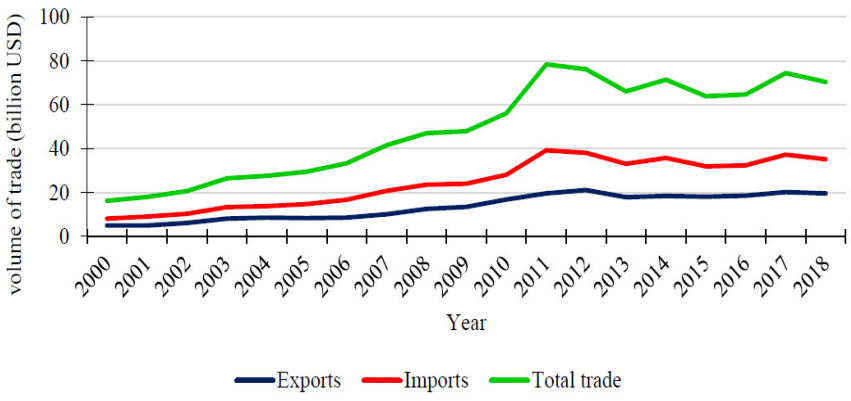

Figure 1 - Trends of Economic community of West African states (ECOWAS) Agricultural Products trade from 2000-2018.
Source: (UN COMTRADE DATABASE).

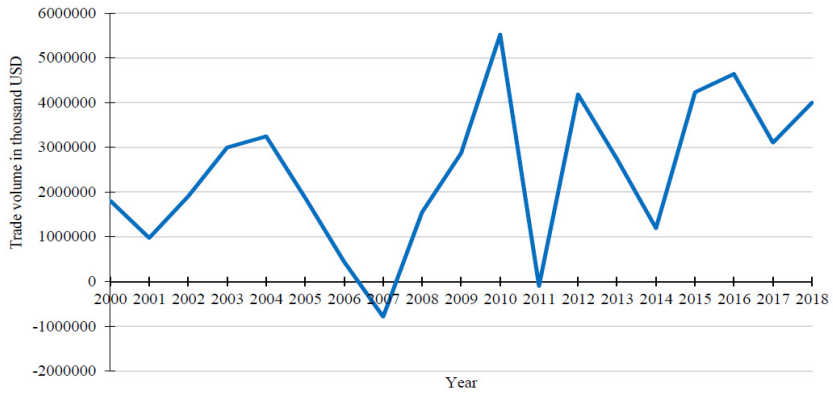

Figure 2 - Economic community of West African states (ECOWAS) global agricultural products trade balance.
Source: (UN COMTRADE DATABASE).

"What and why influences ECOWAS and China Agricultural trade"? To address this pressing question, we adopted the PPML estimation as suggested by SANTOS SILVA & TENREYRO (2006) due to its distinct advantages over OLS. First, the PPML addresses heteroscedasticity to unsure unbiased estimates and allows for zero-trade observations (LATEEF et al., 2018; TADESSE & ABAFITA, 2021). Finally, language variable has often been defined in different criteria other than the number of Confucius institutions in partner countries hence based on the extended gravity model; this study analyzed the drivers of this important trade flow by uniquely substituting the number of Confucius institutes in ECOWAS countries as language variable.

Considering the proportion of Africa's arable land resource (76%) to the rest of the world and China's growing influence in Africa, this research is of paramount interest in enriching literature and policymakers as the determinants uncovered will propel strong policy formulation regarding China and Africa future Agricultural trade policies.

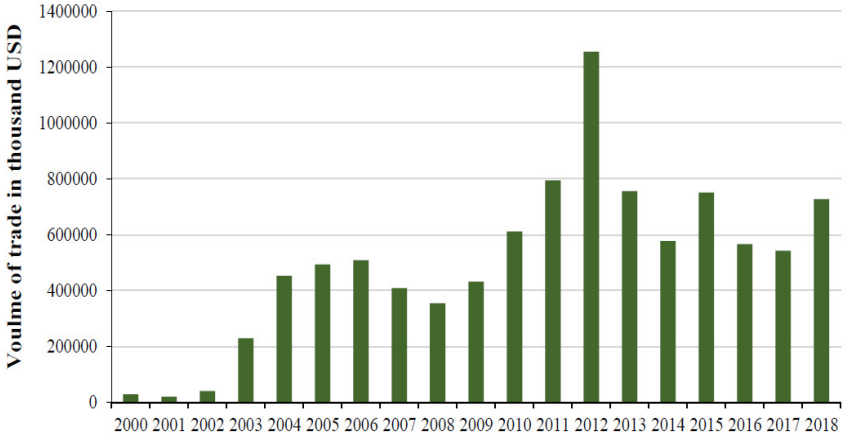

Figure 3 - Economic community of West African state-China (ECOWAS) agricultural products exports performance (2000-2018).

Table 1 - Trends of Economic community of West African states (ECOWAS) agricultural products trade (2000-2018).

Year	Exports	Imports	Trade balance	ECOWAS exports to China	Market Share in China	ECOWAS Partners	% Growth
2000	4951780632	3145367896	1806412736	28900532	0.58363918	13	
2001	4964753400	3987654178	977099222	20450321	0.41191011	11	10.56
2002	6120000000	4213765895	1906234105	40982000	0.66964052	12	15.43
2003	8123767000	5127658430	2996108570	229000000	2.81888932	12	28
2004	8520567312	5276589098	3243978214	453000000	5.3165474	11	4.1
2005	8297534210	6430098765	1867435445	494000000	5.95357594	12	6.7
2006	8541287490	8100076590	441210900	508000000	5.94758109	12	12.99
2007	10000000000	10787626590	-787626590	408980000	4.0898	13	24.9
2008	12532987600	10987234167	1545753433	355230786	2.83436637	14	13.12
2009	13436574879	10568723410	2867851469	431780500	3.21347147	14	2.1
2010	16787690000	11265437000	5522253000	611278965	3.64123334	14	16.86
2011	19554387100	19650000000	-95612900	793986721	4.06040198	14	39.75
2012	21134260000	16950542000	4183718000	1254398000	5.93537697	15	-2.86
2013	17900000000	15156034760	2743965240	756310870	4.22520039	12	-13.2
2014	18467432876	17276543090	1190889786	577000000	3.1244191	13	8.13
2015	18076876850	13845000000	4231876850	750500000	4.15171274	13	-10.69
2016	18487695000	13846123000	4641572000	566486900	3.06412941	14	1.29
2017	20156478932	17050568300	3105910632	543286500	2.69534427	14	15.07
2018	19587965789	15589756400	3998209389	727500000	3.71401506	14	-5.45

The growing population, improved route for transportation and China's language investment in ECOWAS have significant (positive) influence on the volume of trade aside from common trade association (WTO membership) as hypothesized by other trade literature. In another vein, China's population growth and arable land size present potential opportunities for increased imports from the ECOWAS region. Moreover, the geographical distance, which signifies trade barriers as reported in original gravity model literature, has similar negative repercussions per our current findings. The other sections of the research are structured as follows; the literature review and summary, Materials and methods, data analysis, Results and discussion, and conclusion.

Literature review

The gravity model

The gravitational theory of trade stems its roots from the early works of Isaac Newton's gravity concept far back in 1687. The original concept, which estimated the gravity of objects, based on their Mass and the relative distance was later fused into international trade by TINBERGEN (1962) and later extended by LINNEMANN (1962). In their theory, the economic Mass of a country was represented by GDP whereas distance denoted the Geographical distance between the economies involved. Later, BECHDOT & NIEDERCORN (1969) also investigated the empirical authenticity of the gravity model in the context of utility theory.

In 1979, ANDERSON (2003), derived the first equation of the gravity model by applying the product differentiation model. Since then, several confirmatory works have been done with varying outcomes. BERGSTRAND (1985, 1989, and 1990) applied the microeconomic foundations of trade through models of monopolistic competition. DEARDORFF (1995), also proved that the model was consistent with neoclassical models derived in

a defective competition framework. However, VAN WIN COOP & ANDERSON (2003) disagreed that there is no theoretical basis for the estimated equations of the gravity model. notwithstanding, after many years of its application the model's efficiency still holds much validity and continues to be applied in international trade applying different modifications.

Application of gravity model in agricultural trade

Though some studies SHAKUR (2012), WANG et al., (2014) have predicted China's potential of minimizing agricultural imports based on its growing extensive production output, intrinsic and extrinsic constraints in sustainable food production coupled with population growth and changing consumer demands have rather lead to increased imports over the years.

Applying the gravity model based on 23-year panel data (1990-2013), HASINER & YU (2019) observed that though other factors; common language, Free trade agreement, GDP may be significant, the quality of institutions and the closeness of trade partners in the case of China's meat imports are the most important propellers of trade engagement. Moreover, SHAHRIAR et al., (2019) also employed the Heckman and PPML estimation techniques in analyzing China's pork trade with 31 trading partners from 1997-2016. According to their results, not only does the institutional quality and geographical distance matter in China's meat imports, but also land area, GDP, exchange rate, and common language influence export flows of Chinese pork.

Additionally, WEN et al., (2013); LATEEF et al., (2018); J. ZHANG et al., (2019) have reported the significance of FTA in Agricultural trade. Apart from distance which had an inverse impact, Nasrallah et al., (2020), J. ZHANG et al., (2019), & LATEEF et al., (2018) reported out that GDP and Population have a significant influence on trade. Also, WANG et al., (2014), LATEEF et al., (2018); J. ZHANG et al., (2019); SUN & LI (2018) have observed the positive impact of trade associations (WTO) and common boarder on Agricultural trade.

On the part of Africa's Agricultural export trend, several pertinent findings concerning what influences export from individual African States have been recorded in literature. For instance, VON ESSEN (2017) reported that a 1% increase in the GDP of an SSA country (Sub-Saharan Africa) should lead to a 0.28% increase in its export of agricultural commodities to China. Similarly, a 1 % increase in infrastructure would lead to a 0.12 % increase in agricultural commodity exports to China. VON ESSEN (2017) also found that the more arable land there is, the higher the possibility of supplying more agricultural commodities. GDP, natural resource endowment, institutional quality, and infrastructure have been identified as determinants of Chinese imports from SSA countries.

NIGHT (2015) evaluated Kenya's cattle exports to international partners over 23 years using panel data (1990-2013). The findings showed that Kenya's GDP, importer's per capita GDP, and Kenya's per capita GDP were all major predictors of Kenya's livestock exports to global partners. ABDULLAHI et al., 2021, investigated Nigeria's cocoa exports using panel data covering 24 years and Nigeria's 36 global trading partners. Using the PPML, the results indicated that export flows of Nigerian cocoa are favorably correlated with trade association (WTO membership), exchange rate, GDP, colonial ties, and EU, while per capita GDP, distance, landlocked status, and AU have a negative correlation with exports.

EBAIDALLA & ABDALLA (2016) identified the determinants of Sudan agricultural exports with 31 global trading partners from 1995 to 2011. GDP, population size, and infrastructure play a favorable and substantial influence in increasing exports performance while distance was found negative and significant on exports performance. Moreover, BAKARI & MOHAMED (2018) observed that GDP has a weak correlation with agricultural exports.

POTELWA, LUBINGA, & NTSHANGASE (2016) assessed the elements that influence South Africa's agricultural exports to global markets using panel data from 2001 to 2014. It was revealed that, as South Africa's and importers' GDPs rise, agricultural exports rise as well. The increase of agricultural exports to its trading partners is unaffected by distance and political stability. The population of the importer and the export capacity of the exporter had a favorable impact on the growth of South Africa's agricultural exports to its trading partners.

The above studies have highlighted the determinants of China's Agricultural exports to major trading partner countries with possible determinants. In the case of Africa's exports, a significant number of individual countries exports have also been examined in both current and previous literature. However, based on the growing tides between China and Africa, which have sprouted various cooperation forums such as SADC, FOCAC among others and the controversies surrounding China- Africa trade, this present study significant in providing possible

answers. Additionally, there appears to be limited study focusing on the ECOWAS Agricultural trade with China hence this study will also prove vital in filling such literature gap. Table 2 summarizes key literature findings based on the Agricultural imports of China and exports of Africa between 1995 to 2019.

MATERIALS AND METHODS

In this study, the regression analysis according to ABDULLAHI et al., 2021 was employed using a panel data of agricultural exports from 15 West African countries. Those are Nigeria, Ghana, Benin, Cote d'Ivoire, Niger, Mali, Togo,

Table 2 - Literature summary.

Citation	Objective	Dataset	Independent variables	Estimation procedures
LATEEF, TONG, and RIAZ, (2018)	Exploring the Gravity of Agricultural Trade in China–Pakistan Free Trade Agreement	Panel data of 110 countries from 2001-2014	GDP, Population, Distance, exchange rate, Agricultural land, language, border, common colonizer, FTA, China-Pakistan dummy	PPML
J. ZHANG et al., (2019)	An Assessment of Trade Facilitation's Impacts on China's Forest Product Exports to Countries Along the "Belt and Road" Based on the Perspective of Ternary Margins	Panel data of 13 countries 2007-2016	GDP, Population, Distance, Exchange rate, openness, Boarder, FTA, SCO, CAFTA, APEC	2-Stage least square (2SLS)
SHAHRIAR, QIAN, and KEA, (2019)	Determinants of Exports in China's Meat Industry: A Gravity Model Analysis	Panel data of 31 pork importing countries 1997-2016	GDP, exchange rate, Distance, common language, country land area, WTO, Belt, and Road initiative, common borders, landlocked	Poisson pseudo maximum likelihood (PPML)
HASINER and YU, (2019)	When institutions matter: a gravity model for Chinese meat imports	Panel data of 194 countries from 1999-2013	Distance, GDP, institution, FTA, WTO, Agricultural land, common language, contiguity	Fixed effect vector
NASRULLAH et al., (2020)	Determinants of forest product group trade by gravity model approach: A case study of China	Panel data from 2001-2018	GDP,population,distance,FDI,Exchange rate, Forest area, global economic crisis, OECD,APEC, Language,CVD/AD	Random effect
YEBOAH et al., (2021)	Forest Trade Nexus between FOCAC members and China	Panel data FOCAC Forest Exports to China 2000-2018	Language,investment,GDP ,population, Transportation cost,Institutional quality,Infrastructure,distance,Forest land,WTO,	OLS
ABDULLAHI et al., (2021)	Nigeria's Cocoa Exports	Nigeria and 36 global trade partners ( )	GDP, Per capita GDP, Per capita difference, Exchange rate, Distance, landlocked, common border, language, EU, AU, WTO, RTA, and geographical location	GLS and PPML

Source: Authors compilation based on relevant literature synthesis.

Guinea, Burkina Faso, Guinea Bissau Senegal, Carbo Verde, Gambia, Guinea Bissau, and Sierra Leone. The countries were selected based on the continuous agricultural trade relations between China and these West African countries. Nineteen years of panel data of exports of agricultural products to China from these 15 countries were collected, starting from 2000-2018. Both dependent variable and independent variable were obtained from the reputable database as elaborated in table 3 below:

Models Specification

The model of gravity elucidates the flows of trade as a log function of income and distance between countries. It forecast that bilateral trade is significantly influenced by distance (negative) and income (positive) which can be expressed mathematically as:

$$Export_{ij} = \beta_0 G_i + \beta_1 G_j + \beta_2 D_{ij} + \beta_3 \quad (1)$$

Where $Export_{ij}$ = Exports flow from country j to i, G_j and G_i = GDP per capita of both countries, whilst D_{ij} = geographical distance between country i and j.

The linear representation of the model is as follows:

$$LnExport_{ij} = a + \beta_1 logG_i + \beta_2 logG_j + \beta_3 logD_{ij} \quad (2)$$

According to the generalized gravity model of trade, the volume of exports between two countries, ($Exports_{ij}$), is a function of their GDPs, populations, and distance, population, and other set of dummy variables that either help or hinder trade between two countries.

$$Exports_{ij} = \beta_0 + \beta_1 G_i + \beta_2 G_j + \beta_3 P_i + \beta_4 p_j + \beta_5 D_{ij} + \beta_6 V_{ij} + \varepsilon_{ij} \quad (3)$$

$$LnExport_{ij} = a + \beta_1 lnG_i + \beta_2 lnG_j + \beta_3 lnP_i + \beta_4 lnp_j + \beta_5 lnD_{ij} + \beta_6 V_{ij} + \varepsilon_{ij} \quad (4)$$

Where $Exports_{ij}$ means exports flow from country i to j, G_i and G_j represent GDP per capita of both countries, P_i and P_j denotes population of country i and j, D_{ij} represents their geographical distance between the nearest port of the two countries, V_{ij} represents other variables that may influence agricultural exports. ε_{ij} means error term, β's are the model parameters.

The PPML model for this research work is expressed as:

$$Lnexportij = a_0 + \beta_1 ln(GDP * GDP) + \beta_2 ln(POP_i + POP_j) + \beta_3 lnD_{ij} + \beta_4 lnEXC_{ij} + \beta_5 lnARL_j + \beta_6 InfraS_j + \gamma_1 Lndl_{ij} + \gamma_2 Conf Ins_{ij} + \gamma_3 WTO_{ij} + \varepsilon_{ij} \quad (5)$$

Where $Export_{ij}$ stands for total exports of agricultural products from ECOWAS members to China from 2000 to 2018 signifying our dependent variable. The independent variables were elucidated as follows:

Ln (GDP_i x GDP_j) stands for the GDP value of the trading partners, which shows the size of

Table 3 - Variables description.

Variables	Description	Data sources	Unit
Exportsij	Exports of Agricultural products (ECOWAS to China)	UNCOMTRADE	USD
GDPj	Gross domestic product of ECOWAS	World Bank	USD
GDPi	Chinese Gross domestic product (importer)	World Bank	USD
POPij	Trade Partners population	World Bank	persons
Dij	Distance between ECOWAS and China	CEPII	nautical miles
ARLj	Arable Land	World Bank	hectares
EXCij	Exchange rate value of partners	WDI	USD
InfraSj	Infrastructural development (mobile cellular subscriptions)	world bank (WDI)	per 100 persons
LndLj	Exporters Landlocked countries	CEPII Database	dummy(1/0)
ConfInsj	exporting countries Chinese Confucius institutions	<www.digmandarin.com>	dummy(1/0)
WTOij	World trade organization (WTO)	<www.wto.org>	dummy(1/0)

Source: authors computation based on related literature.

the economies and trade volume of ECOWAS nations and China. ln (Pop_{it} x Pop_{jt}) represents the population of both ECOWAS nations and China which signifies the market size of the partners. ln (EXC_{ij}) accounts for partners' exchange rate value signifying the currency value of both ECOWAS nations and China. ln (ARLj) represents the arable land of ECOWAS indicating agricultural product supply potential. The expected sign of the aforementioned independent variables together with their coefficients should have positive signs. Also, ln (D_{ij}) accounts for the geographical distance between ECOWAS nations and China, signifying the transportation costs of agricultural products from West Africa to China with an expected negative sign together with its coefficient. Also, three dummies were included in the equation as part of the explanatory variables. $InfraS_j$ represents ECOWAS infrastructural development. The dummies include; ln(Landlockedij) indicate whether the ECOWAS exporting nation has sea access or not (where 1 means landlocked while 0 means otherwise), ln ($ConfIns_j$) represent whether exporter country has Confucius institution or not (where 1 means Confucius institution while 0 means otherwise) indicating common language among the partners thereby bridging the gap of the language barrier. While ln (WTO_{ij}) represents whether ECOWAS and China are World trade organization members (1 = WTO membership, 0 = otherwise). ln ($ConfIns_j$) and ln (WTO_{ijt}) should have expected positive signs while ln ($Landlocked_j$) is identified as an impediment factor of trade expected to have a negative sign.

The Heckman selection model is made up of two equations: sample selection (eq. 6, 7) and outcome selection (eq. 8). The sample selection model is as follows:

$$t^*_{ijt} = \eta' + Z_{ijt} + \mu_{ijt} \quad (6)$$

Where t^*_{ijt} represents a latent variable and it is not observed but we do observe if countries trade or not, such that $t_{ijt} = 1$ if $t^*_{ijt} > 0$ and $t^*_{ijt} = 1$, if $t_{ijt} = 0$ and denotes a vector variable that affects t^*_{ijt}. μ_{ijt} is the error term. Apart from the above-mentioned variables, other variables ijt may influence t^*_{ijt} in this study. The study has included certain dummies in addition to the other independent variables to see how the Chinese Confucius institutions, landlocked countries, and WTO membership affect agricultural products exports.

Selection model:

$$t^*_{ijt} = \eta 0 + \eta 1 ln(GDP * GDP) + \eta 2 ln(POPi + POPj) + \eta 3 lnDij + \eta 4 lnEXCij + \eta 5 lnARLj + \eta 6 InfraSj + \eta 7 Lndlij + \eta 8 Conf Insij + \eta 9 WTOij + \mu_{ijt} \quad (7)$$

Outcome model:

$$Lnexportsij = a_0 + \beta_1 ln(GDP * GDP) + \beta_2 ln(POP_i + POP_j) + \beta_3 lnD_{ij} + \beta_4 lnEXC_{ij} + \beta_5 lnARL_j + \beta_6 InfraS_j + \gamma_1 Lndl_{ij} + \gamma_2 Conf Ins_{ij} + \gamma_3 WTO_{ij} + \varepsilon_{ij} \quad (8)$$

In econometrics, independent variables selection is a challenging task. AMEMIYA, (1980) states that the selection of regression analysts should be based on economic theory as well as statistical logic. In the estimations of the econometric model, the omitted variables may lead to biased and incorrect conclusions (WOOLDRIDGE, 2002). Model misspecifications can be caused by two factors: (1) incorrect functional form, and (2) invalid assumptions on the distribution of the disturbance term (BERA & JARQUE, 1982). Moreover, we must consider the model's correct specification, functional forms, and regressors. We selected the relevant variables for the specification of the empirical gravity model based on the above principles and instructions, as well as previous empirical studies and trade theories.

RESULTS AND DISCUSSION

4.1 Descriptive statistics and test of multicollinearity

Based on the summary descriptive statistics from table 4, we obtained an overview of the variables presented in the study and examined data normality before the PPML estimation. On average ECOWAS exports $30.47 worth of Agricultural commodities to the Chinese territory between 2000 and 2019 with the highest and lowest trade volume of 37.5 and 25.4 respectively. Although, the current volume of exports is less than 1% of the global share of agricultural products trade, the average volume far exceeds the total ECOWAS exports of the year 2000 (CHATHAM HOUSE, 2021). This makes it worthwhile studying the contributing factors enhancing this trade. Similarly, the average performance of economic growth indicators such as GDP and population of both ECOWAS and China reveals a potential growth of agricultural trade as elaborated in table 4 compared to the last two decades, the economic performance of the ECOWAS sub-region has improved significantly primarily due to increased trade activities (OSABUOHIEN et al., 2019). With the normality of data, the jarque-bera test result rejected the null hypothesis of normal series distribution because all the variables were statistically significant at 1% with exception of Exportsij, which was statistically significant at 5%.

Table 4 - Descriptive statistics.

Variables	Exportsij	GDPj	GDPi	POPj	POPi	Dij	EXCij	ARLj	InfraSj	LndLj	ConfInsj	WTOij
Minimum	25.3762	8.5684	12.0276	5.6316	9.1014	3.7881	0.2676	4.6435	1.9208	0	0	0
Maximum	37.4653	11.7547	13.1429	8.2919	9.144	4.1177	6.8993	7.5682	2.1447	1	1	1
Mean	30.47	9.77	12.64	6.91	9.12	4.06	2.38	6.3	1.9621	0.78	0.86	0.91
Std. Dev	2.68	0.69	0.37	0.6	0.01	0.08	0.84	0.72	0.8421	0.41	0.35	0.28
Skewness	0.36	0.73	-0.28	-0.07	-0.11	-2.57	-0.67	-0.51	-1.4541	-1.37	-2.04	-2.94
Kurtosis	2.72	3.39	1.6	3.19	1.89	8.54	7.41	2.9	4.889	2.87	5.77	9.66
J-bera test	6.67	25.4	25.2	0.63	14.21	631.97	235.64	11.69	133.2856	82.89	236.75	875.51
Sig	**	***	***	***	***	***	***	***	***	***	***	***

, * represents 5% and 1% level of significance respectively.

Multicollinearity test

To examine the linear relationship between the variables in the model, correlation analysis was conducted. The GDPj, GDPi, POPj, POPi, EXCij, ARLj, InfraSj, ConfInsj and WTOij have positive correlation with dependent variable at 0.918, 0.582, 0.760, 0.578, 0.007, 0.651, 0.207, 0.245 and 0.062 respectively. In addition, Dij, ARLi, and LndLj are negatively correlated with the dependent variable (Exportsij) table 5.

4.2 Cross-sectional dependency test and Panel unit root test

Cross-section dependence has to do with the impact of shocks in one country on another country when both countries belong in the panel data set (DE HOYOS & SARAFIDIS, 2006). The cross-sectional dependence was analyzed using PESARAN CD, PESARAN Scaled LM, and Breusch-pagan LM tests (PESARAN, 2020) as is shown in table 6. However, the PESARAN CD test failed to reject the null hypothesis, indicating that there is no cross-sectional dependence.

Panel unit root test

To avoid spurious regression which may lead to wrong forecast, Three-panel unit root tests; Augmented Dicky Fuller (ADF- Fisher Chi-square), Levin, Lin Chu (LLC), and Philip perron (PP- Fisher Chi-square) were conducted to check stationarity (PESARAN, 2012, 2020). The test results are presented in table 7. The table showed that all the variables are statistically significant and stationary at first difference which implies that all the variables are integrated in order (I(I)).

4 Agricultural products export determinants

The estimated result of the gravity model using PPML is presented in table 8 showing agricultural products exports determinants. The model fitness test revealed a 78.5% variation of ECOWAS agricultural products exports to China explained by eleven economic variables captured in the equation. The magnitude and direction of influence uncovered demonstrated the reasons of ECOWAS-China agricultural trade.

Similar to ANH et al., 2021; BEKELE & MERSHA, 2019; GUAN & IP PING SHEONG (2020), the Population of China (POPi) positively influences the volume of exports. In value terms, a unit increase in the population of China will increase trade volume by 4.03%. This demonstrated how the growing demand for resources to satisfy China's ever-increasing populace could transform trade deals in favor of the ECOWAS sub-region. The arable land size of ECOWAS (ARLj) (LATEEF et al., 2018) plays a significant positive role in the volume of exports from the region. The results showed that a unit increase in the arable land size of the ECOWAS countries would contribute to an increase in the volume of Agricultural exports to mainland China by 3.56%. It is therefore, not surprising that China is the second biggest net importer of arable land use in intermediate trade whiles the ECOWAS region is an important exporter of intermediate arable land trade (WU et al., 2018). Again Access to sea route (LndLj), language investment by China (DIG MANDARIN, 2020; YEBOAH et al., 2021) (ConfInsj), and common trade group (WTOij) (SHAHRIAR et al., 2019; VU et al., 2020) significantly drives the volume of exports

Table 5 - Multicollinearity test.

	Exportsj	GDPj	GDPi	POPj	POPi	Dij	EXCij	ARLj	InfraSj	LndLj	Confsj	WTOij
Exportsj	1											
GDPj	0.918	1										
GDPi	0.582	0.311	1									
POPj	0.76	0.856	0.107	1								
POPi	0.578	0.314	0.978	0.109	1							
Dij	-0.298	-0.063	0	-0.175	0	1						
EXCij	0.007	-0.08	0.073	0.02	0.081	-0.198	1					
ARLj	0.651	0.725	0.048	0.944	0.046	-0.24	0.119	1				
InfraSj	0.207	0.566	0.315	-0.029	0.413	0.07	-0.075	-0.134	1			
LndLj	-0.21	-0.045	-0.012	-0.245	-0.015	0.697	-0.234	-0.428	-0.122	1		
ConfInsj	0.245	0.27	0	0.151	0	-0.117	-0.176	-0.011	-0.162	0.279	1	
WTOij	0.062	0.114	-0.135	0.108	-0.119	-0.075	-0.066	0.13	-0.131	-0.088	0.021	1

from the ECOWAS region. Whilst these results are synonymous with other findings, the magnitude of influence differs in this current study. For instance, an increase in the number of Confucius institutes will cause a 0.39% increase in trade volume whereas access to the sea route and WTO accounted for 0.47% and 0.77% increase in ECOWAS exports respectively.

Similar to SUN, HUANG, & YANG (2014) analyses of China imports, the GDP of China (GDPi) will impede the volume of ECOWAS exports (-2.59%) to China since larger economies are more attracted to trade with their counterparts than weaker economies which explain China's high imports from America, Canada, Russia, and Brazil than the African region. On the contrary, VON ESSEN (2017) revealed that agricultural trade flow from Sub-Saharan Africa region to China is enhanced by the GPD's of both economies.

Moreover, the volume of exports is negatively influenced by the level of infrastructural development in ECOWAS (InfraSj), geographical distance between ECOWAS-China (VON ESSEN, 2017; YANG et al., 2020; ZHANG & LI, 2009) (Dij), and the exchange rate of both partners (EXCij) (GUAN & IP PING SHEONG, 2020). A unit increase in infrastructural development will significantly decrease the volume of trade by -1.474 percent. Currently, there are few Agricultural-manufacturing industries therefore exports from the region are mainly unprocessed raw agricultural materials with a perishability rate, which are difficult to transport via long-distance sea route to China. With the gradual industrialization growth in Africa, most raw materials will be processed and exported to other closer regions like Europe, which is fairly closer to most ECOWAS countries than China.

Table 6 - Cross-sectional dependency test.

	Breusch-pagan LM	Pesaran Scaled LM	Pesaran CD
Statistic	200.4345	8.1118	1.0391
df	91		
Prob	0.0000	0.0000	0.2988

Table 7 - Panel unit root test.

Variables	Probability	LLC	ADF	PP
Exportsij	Level	-9.5568***	120.608	68.6819***
	First difference	-5.5076***	110.879***	315.578***
GDPj	Level	-3.0566	23.6541	60.4078***
	First difference	-6.7116***	109.426***	706.226***
GDPi	Level	-1.9831*	6.4015	5.3985
	First difference	-8.4583***	86.9029***	221.575***
POPj	Level	-4.7716	42.0446	62.1221**
	First difference	-9.6834***	115.488***	73.025***
POPi	Level	-5.2781*	14.0855**	84.9395**
	First difference	-3.3717***	41.4272**	79.5326***
Dij	Level	-0.1061	1.5545	1.592
	First difference	-1.9753*	4.8788*	9.3023**
EXCij	Level	-1.8003*	41.2858	24.2237
	First difference	-6.866***	72.899***	109.006***
ARLj	Level	-2.7833**	45.491*	74.1868***
	First difference	-7.4885***	95.1698***	173.343***
ARLi	Level	1.1835	15.2807	18.5752
	First difference	-7.3076***	58.2461***	124.493***
InfraSj	Level	-11.3105***	153.179**	1018.12***
	First difference	-5.7372***	58.5545***	86.5243***

*, **, *** represents 10%, 5% and 1% level respectively.

Additionally, the population of China, which has shaped china's food trade and consumption pattern for the past decades, was also found significant in this study (LIU & WANG, 2018; ZENG et al., 2021). The results suggested that China's population would significantly account for a 4.03% rise in the volume of Agricultural exports from the ECOWAS sub-region. Finally, our results backed the evidence that the ECOWAS region has mainly relied on intensive manual labor force for most agricultural production processes; therefore, its population serves as a driving factor for the growth and development of agricultural productivity and exports, which will lead to a 0.58% rise in the volume of exports.

CONCLUSION

In an attempt to unravel the what's and why's of ECOWAS-China Agricultural products trade, the above empirical analysis led to the following conclusion;

(1) Although, the findings demonstrate the existence of bilateral trade between ECOWAS and China, the high cost of transporting goods because of the geographical distance between ECOWAS and China serves as an impediment to trade flow. Whist this results aligns with trade literature, compared to most European ports' proximity to most African states, it takes approximately 15 days more from China's closest seaport to the nearest ECOWAS country, which limits the possibility of a trade. The PPML results revealed that a unit increase in distance may lead to a decline in trade volume by -4.45%. additionally, China's GDP is negatively significant which suggested that trade volume will decline by -2.59 for a unit increase in Economic growth (GDP) since larger economies trade with each other, it is not surprising that China focuses more on trading with the USA, Australia, Russia, and other larger states.

Similar to other studies, the level of Infrastructural development greatly influences trade

Table 8 - Poisson pseudo maximum-likelihood (PPML) estimated result.

Variables	Coefficient	Std Error	Prob
Constant	-34.03	0.0025	0.000***
GDPj	8.281	2.7307	0.5843
GDPi	-2.599	1.5671	0.000***
POPj	0.5877	0.4463	0.0091**
POPi	4.032	1.8722	0.000***
ARLj	3.56	5.6785	0.000***
EXCij	-3.452	9.3906	0.8919
Dij	-4.4573	0.9771	0.000***
LndLj	0.477	0.238	0.0461*
ConfInsj	0.3945	0.1786	0.0281*
WTOij	0.7747	0.2125	0.0003***
InfraSj	-1.474	8.12	0.000***
----------Log-likelihood----------		-3045827613	
----------Observations----------		266	
R-Square	0.785		
----------F- Statistics----------			0.000***

*, **, *** represents 10%, 5% and 1% level respectively.

volume. Characterized by weak processing and manufacturing industries, African States account for the highest primary Agricultural exports to wealthier regions like the USA, Europe, and China who are well endowed to further process into furnished goods. From the regression results, A unit change (improvement) in the infrastructural growth of ECOWAS states will likely decrease the exports of the Agricultural products by (-1.47%). This phenomenon provides a key to why China trades with ECOWAS; although, barriers such as the volume of products and distance are currently not favorable.

(3) With one of the fastest middle-income earners population growth, China's population explains why ECOWAS Agricultural exports make way to the Chinese market despite the stifling trade barriers. The finding suggested that a unit increase in China's population will consequently translate to increased trade volume by 4.03%. This result meets the simple demand-supply assumption in that, a growing population will require equivalent growing food supplies to feed individuals and industrials; however, with limited arable lands in China, the ECOWAS regions remain a potential spot for supplementary agricultural raw materials. However, an increase in the population of ECOWAS will hamper the volume of exports to China.

The impact of trade openness facilitates negotiations and positive mutual agreements between trade partners. In previous studies, China's accession to WTO has shown a positive effect on both volume, the number of trade partners, and products traded. In this current study, similar conclusions were reached with a positive (0.77%) and significant (0.0003) effect of WTO membership of both partners on the volume of trade.

(5) More uniquely, the number of Chinese Confucius institutes in ECOWAS countries play a positive and significant role as far as Agricultural trade between the two partners is concerned. This forms a foundation for further trade growth since the common language remains one of the key fulcrums of bilateral trade as purported in several studies. We concluded that the growing number of Confucius institutions in most ECOWAS countries accounts for improved negotiations hence growth in trade volume.

Policy implication

The policy proposals presented below aimed to guarantee that ECOWAS Agricultural trade ties with

China are not influenced by resource-seeking goals, but rather by a mutually beneficial relationship that aligns with the objectives of the ECOWAS regional trade block:

Stimulating Agricultural trade growth through Strategic direction of FDI

Contrary to the forms of Agricultural products exported to the European market and the United States, The level of primary products from ECOWAS to China are mainly limited to unprocessed commodities which are difficult and costly to transport. Since distance increases trade cost and consequently affects the volume of trade, Chinese direct investments towards ECOWAS should be directed towards upgrading Agro-industries to increase the manufacturing of semi and processed agro commodities that meet China's growing dynamic demand. This will enhance and expand the scope and volume of Agricultural trade whilst contribute towards job creation, the rapid transformation of the Agricultural industries; and consequently economic growth.

Intensifying trade associations and cooperation forums for win-win Economic benefits.

Again since trade associations such as WTO have been proven to positively enhance Agricultural trade, we suggested similar impacts to be derived from ongoing China-Africa trade negotiations and cooperation agreements. FOCAC and China-Africa Agricultural cooperation represent such forums where fair deals on Agricultural trade development may be enhanced in exchange for industrial and economic development.

Capitalizing on resource advantage and reversing challenges for trade growth

Finally, ECOWAS State should capitalize on the arable land size, which has not received the needed attention and investments though a positive driver of Agricultural exports. We there propose that to derive optimum economic benefits from favorable arable land sizes in ECOWAS States, prevailing challenges such as poor irrigation, road network, technical expertise, low level of research and technology and government support systems should be given maximum attention to intensify production levels and export volumes.

DECLARATION OF CONFLICT OF INTERESTS

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

Conceptualization: BNA, MD and FKY. Data acquisition: BNA, FKY and HYI. Design of methodology and data analysis: BNA, FKY and MD. FKY and BNA prepared the draft of the manuscript. All authors critically revised the manuscript and approved of the final version.

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