ESJ Social Sciences Peer-reviewed

Effect of Regional Integration on Intra-Regional Informal Agricultural Trade in West Africa

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Doi:10.19044/esj.2025.v21n25p199

Submitted: 05 August 2025
Accepted: 31 August 2025
Published: 30 September 2025

Cite As:
Kligue, A.K. & Yovo, K. (2025). *Effect of Regional Integration on Intra-Regional Informal Agricultural Trade in West Africa*. European Scientific Journal, ESJ, 21 (25), 199. https://doi.org/10.19044/esj.2025.v21n25p199

Abstract

This research analyzes the effect of regional integration on informal intra-regional agricultural trade in West Africa[1], based on an augmented gravity model, over the period 2010–2022. It assesses the significant impact of the Common External Tariff (CET) of the Economic Community of West African States (ECOWAS) and the gradual implementation of the African Continental Free Trade Area (AfCFTA) on informal agricultural trade among West African countries. The results reveal a significant correlation between these integration initiatives and a marked decline in informal agricultural trade, thereby raising crucial questions about the effective inclusion of these key actors within regional economic integration frameworks.

Keywords: Regional integration, Informal agricultural trade, ECOWAS CET, AfCFTA, ECO-ICBT

Introduction

West Africa remains one of the least integrated regions in the world, with low intra-community agricultural trade (Gammadigbe, 2017). The impact of regional integration on international trade continues to generate a great deal of interest in the literature on regional trade. It has become a key priority in the development strategy of Africa, where free trade among member countries

[1] In this research, West Africa is defined as the ECOWAS countries, excluding Cape Verde.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

is one of the cornerstones of Agenda 2063[2]. Intra-regional trade occupies a strategic position in West Africa and the Sahel due to its decisive impact on food security and economic development in the states of the region (CILSS and FSIN, 2025). However, it accounts for only a small share of the continent's total trade, estimated at just 16% (UNCTAD 2024). Carrère (2013) highlights the particular importance of regional trade - particularly agricultural products - as a lever for poverty reduction, improved food security, and economic development. For their part, Coulibaly and al. (2015), (Diop, 2007) and Gbetnkom and Avom, (2005) confirm the positive effects of regional integration on agricultural trade.

However, a key question remains: can trade really be a lever for development and an effective tool for poverty reduction in Africa? This question is particularly relevant when considering that the level of intra-African trade remains relatively low, accounting for only 16% of the continent's total trade in 2018, according to UNCTAD (2024). This weakness invites us to question not only the intensity but also the nature of the trade that underpins current development policies on the continent. Indeed, a significant part of intraregional trade in Africa is based on informal exchanges, which are totally or partially outside the institutional and statistical frameworks of states. In West Africa and the Sahel, food trade between countries in the region is an important - yet often overlooked - pillar of food security. This trade, far from being insignificant, is estimated to be worth nearly 10 billion US dollars each year - about six times the volume reported by official data. The majority of these exchanges escape formal statistical collection systems (CILSS and FSIN, 2025). This strong predominance of the informal sector creates major challenges, particularly with regard to regulation and the production of reliable statistical data.

In view of the above, the preponderant role of informal trade in agricultural products appears to be a central issue in the development of public policies in West Africa. Several studies have demonstrated the relationship between the level of regional integration and the intensity of trade within this region (Kpemoua, 2023; Gammadigbe, 2017; Carrère, 2013; Agbodji, 2007). However, few studies have specifically examined the effects of regional integration on informal agricultural trade in West Africa. After several years of implementing regional strategies to boost agricultural trade, several crucial questions are emerging: What is the real impact of regional integration on intra-regional informal agricultural trade? More specifically, what are the respective effects of the implementation of the ECOWAS Common External

[2] Agenda 2063 is the African Union's strategic vision for the inclusive and sustainable development of the continent by the year 2063.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Tariff (CET) and the African Continental Free Trade Area (AfCFTA) on informal agricultural flows?

The objective of this article is to analyze the relationship between regional integration and informal agricultural trade in West African countries. Its contribution can be broken down into three main points. First, it assesses the impact of regional integration on the dynamics of informal trade in the region. Second, it enriches the existing literature by complementing previous studies, which have mainly focused on the relationship between regional integration and formal agricultural trade. Finally, this research aims to provide public decision-makers with a better understanding of the issues related to intra-regional informal agricultural trade, with a view to formulating more effective and appropriate development policies.

To achieve this objective, the rest of the article is structured as follows: Section 2 describes the methodology adopted; Section 3 presents the results; Section 4 discusses the results; and finally, Section 5 concludes the study and outlines the economic policy implications.

Methodological approach

This research relies on the gravity model as an econometric framework to analyze trade flows. This model - both intuitive and robust - allows us to estimate and forecast bilateral trade based on the economic characteristics (such as GDP) and geographical features (like distance) of trading partners.

Inspired by Newton's fundamental law of universal gravitation, the gravity model has been adapted for economic use to capture flows between entities. Although it long lacked strong theoretical foundations, its rigor has progressively increased thanks to the contributions of Tinbergen (1962); Anderson (1979) (for microeconomic underpinnings); Bergstrand (1985); Deardorff (1995); Evenett and Keller (1998) (drawing on international trade theory); and most notably Balchin, Hoekman & Martin (2021), who emphasize transaction costs and trade facilitation. The theoretical and empirical validity of the model has been reinforced by the pioneering works of Eaton and Kortum (2002), Anderson and van Wincoop (2003), Melitz (2003), Santos Silva and Tenreyro (2006), Head and Mayer (2014), as well as Costinot and Rodríguez-Clare (2014).

Widely employed today, the gravity model is instrumental in analyzing a range of economic phenomena. It has been used to study the effects of regional integration on West African trade - Beke & N'Guessan (2021), Shobande & al. (2018), Carrère (2013), Agbodji (2007), Carrère (2004), Afesorgbor (2013) & Gbetnkom & Avom (2005) - as well as to evaluate foreign direct investment (Keller & Yeaple, 2009; Kleinert & Toubal, 2010).

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In its simplest form, the basic gravity equation was devised by Tinbergen (1962) and is presented as follows for any pair of countries (i, j):

$$com_{ij} = G * \frac{(Y_i Y_j)^{\beta 1}}{(Dist)^{\beta 2}} \quad (1)$$

Where :
com_{ij} represents the value of bilateral trade between country i and country j;
Y_i and Y_j represent the Gross Domestic Product (GDP) of countries i and j respectively;
$Dist_{ij}$ measures the distance between country i and country j;
G, β_1 and β_2 are coefficients; β_1 is assumed to be positive, while β_2 is assumed to be negative.

In this research, an extended gravity model is used: in addition to the traditional variables and regional integration variables, other variables capturing the effects of the private sector and government programs/projects are introduced into the model. Thus, the extended gravity model to be estimated is as follows:

$$\begin{aligned} Export_{ijt} = {} & \beta_0 + \beta_1 lnGDPhab_{it} + \beta_2 lnGDPhab_{jt} + \beta_3 lnPop_{it} + \beta 4 lnPop_{ij} + \\ & \beta_5 lnDist_{ij} + \beta_6 FronCom_{ij} + \beta_7 Enclav1_{ij} + \beta_8 CET_{ijt} + \\ & \beta_9 WAEMU_{ij} + \beta_{10} ExportWAEMU_{ij} + \beta_{11} lnPotVin_{it} + \\ & \beta_{12} lnPotVin_{jt} + \beta_{13} InvesPriv_{it} + \beta_{14} InvesPriv_{ij} + \\ & \beta_{15} PartBugAgro_{it} + \beta_{16} lnPartBugAgro_{ij} + \beta_{17} AfCFTA_{ijt} + \varepsilon_{ijt} \end{aligned} \quad (2)$$

The variable $Export_{ijt}$ is the dependent variable. It represents the flows of informal intra-regional trade in agricultural products between two countries, i and j. The choice of exports is motivated by the quality and availability of data (Houssou 2023, Gbetnkom and Avom, 2005) and is sourced from the *ECOWAS Informal Cross-Border Trade* (ECO-ICBT) database, a quadripartite management platform that brings together ECOWAS, CILSS[3], WAEMU[4], and WACTAF[5] as part of a regional coordination initiative.

The GDP per capita of the exporting country and its importing partner ($GDPhab_i$, $GDPhab_j$), along with the population size of the exporting country i and the importing country j (Pop_{it}, Pop_{jt}), are indicators that reflect the size of each country's economy and, consequently, its capacity to offer a market

[3] Permanent Interstate Committee for Drought Control in the Sahel.
[4] West African Economic and Monetary Union (WAEMU).
[5] West African Association for Cross-Border Trade, in Agro-forestry-pastoral, Fisheries products and Food

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

for agricultural trade. The distance between countries i and j, represented by the variable $Dist_{ij}$, serves as a proxy for the cost of transporting agricultural products between them. Geographical proximity, captured by the common border variable ($FronCom_{ij}$), facilitates trade in agricultural products between neighboring countries. The absence of maritime openness ($Enclav1_{ij}$) of at least one of the two trading partner countries makes it possible to measure the effect on the participation of landlocked countries in informal bilateral trade in agricultural products in the ECOWAS zone.

To estimate the impact of corruption on trade, the variable representing the payment of bribes or unofficial fees to control agents ($lnPotVin_{it}$, $lnPotVin_{jt}$) is used. The variable representing the share of the national budget allocated to agricultural investment by countries ($PartbugAgro_{it}$, $PartbugAgro_{jt}$) captures the effects of agricultural programs and policies implemented by the countries on informal intra-regional trade flows. The share (in percentage) of private sector gross fixed capital formation, which reflects the weight of private investment in the economy, is also included in the model. It encompasses gross expenditures by the private sector (including private non-profit organizations) on newly added domestic fixed assets. This variable is denoted by ($InvesPriv_{it}$, $InvesPriv_{jt}$) and is used to measure the contribution of private sector investment to informal intra-regional agricultural trade.

The Common External Tariff variable (CET_{ijt}) is a key variable of interest, capturing the effects of the implementation of the ECOWAS Common External Tariff (CET) in 2015. The variables *WAEMU* and *ExportWAEMU* are included to capture the specific effects of the West African Economic and Monetary Union (WAEMU). The effects of the gradual implementation of the African Continental Free Trade Area (AfCFTA), launched in 2018, on informal trade flows are captured by the AfCFTA variable.

Estimation method

Several tools and techniques have been used to measure the relationship between regional integration and informal agricultural trade (IAT) in West Africa. The empirical literature is extensive and highlights both the challenges and limitations associated with certain estimation techniques. Our choice of estimation method is informed by these limitations. The estimation of gravity equations using Ordinary Least Squares (OLS) and its variants has been widely employed in empirical studies. However, this approach presents certain drawbacks, particularly due to the logarithmic transformation of the gravity model and its inability to account for zero trade flows (Beke and N'Guessan, 2021). According to Head and Mayer (2013), a key limitation of this method lies in its handling of zero flows: excluding these observations can

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result in a loss of valuable information and biased gravity coefficients. To overcome these limitations and to better capture the specific effects of trade facilitation policies and the Common External Tariff (CET) implemented by ECOWAS, we adopt the Poisson Pseudo Maximum Likelihood (PPML) estimator. This method, applied to the multiplicative form of the gravity model proposed by Santos Silva and Tenreyro (2011), offers a robust solution to the issue of zero trade flows. In addition, it is robust to heteroscedasticity and provides consistent estimates in the presence of data dispersion.

Data source

This research covers a panel of fourteen (14) countries in the ECOWAS region, with the exception of Cape Verde, which is excluded due to the unavailability of export flow data in the database used. The selected countries are: Benin, Burkina Faso, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. The data cover the period from 2010 to 2022 and include a total of 2,366 observations of informal agricultural trade flows among ECOWAS member states. Data were collected based on availability and originate from various sources, depending on the variable. Most of the data are classified as non-official or informal. In particular, data on informal agricultural exports and bribe payments come from the ECO-ICBT. Although valuable, the ECO-ICBT database presents certain methodological limitations. Its geographical coverage remains partial, with only 64% of border posts included, according to OACTAH officials, which excludes a significant portion of unmonitored informal trade flows. Moreover, data collection relies on traders' self-reported information, exposing the dataset to declarative biases and approximate estimations. Despite these limitations, the database remains a useful tool for identifying major trends in informal trade in West Africa.

Information on GDP per capita (in current US dollars) and the share of private investment in the national economy is sourced from the World Bank's World Development Indicators (WDI, 2024). Institutional and geographical variables - such as the distance between the capitals of partner countries, the presence of a common border, the absence of maritime access for one of the trading countries, joint membership in WAEMU, as well as the exporter's exclusive membership in the union - are drawn from the database of the Centre d'Études Prospectives et d'Informations Internationales (CEPII). Demographic data (population) are obtained from the United Nations Conference on Trade and Development (UNCTAD-NTM) database. Information on the share of the national budget allocated to the agricultural sector is taken from the Regional Strategic Analysis and Knowledge Support System (ReSAKSS), which is now part of the pan-African organization AKADEMIYA2063. Finally, data relating to the implementation of the ECOWAS Common External Tariff

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(CET) and the creation of the African Continental Free Trade Area (AfCFTA) were collected by the author.

Results

This section presents the results of the research analysis. The first part focuses on the descriptive analysis, while the second part presents the econometric estimates of the gravity model.

Descriptive analyses

Share of informal agricultural exports within West Africa in 2023

This analysis is based on several complementary data sources. Information on informal agricultural trade (IAT) is drawn from the ECO-ICBT. Statistics on formal trade in agricultural commodities are extracted from the UNCTAD database, while data on trade in agri-food products are obtained from the TradeMap platform developed by the International Trade Centre (ITC). Far from being mutually exclusive, formal and informal agricultural exports in West Africa appear to be complementary, reflecting the dual nature of trade dynamics in the region.

Figure 1 : Export of agricultural raw materials

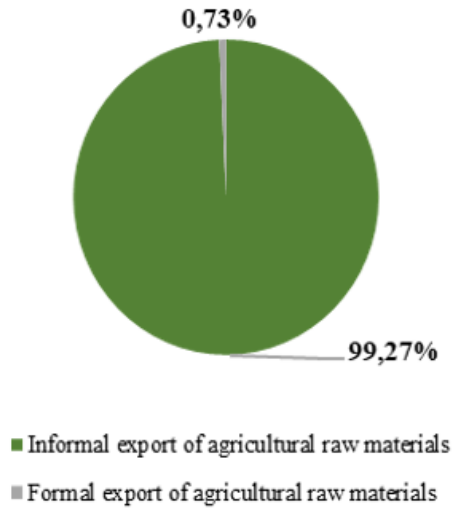
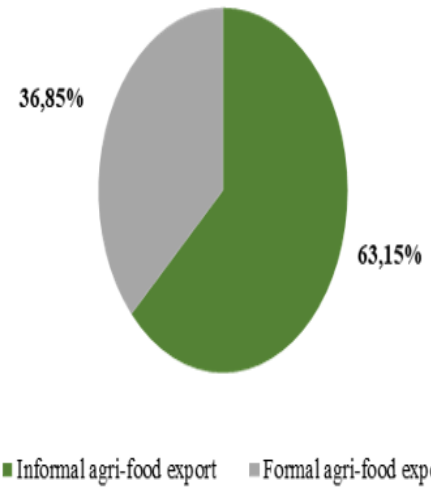


Figure 2 : Agri-Food Exports



Source: Author's calculations based on data from ECO-ICBT, UNCTAD, and ITC[6] (2025)

In West Africa, trade in agricultural commodities mainly involves vegetable food products, oilseeds, citrus fruits, livestock products, cash crops, and others. Overall, the results indicate that informal trade circuits are more significant than formal exchanges in the region. In 2023, informal exports of

[6] Information on informal trade comes from the ECO-ICBT platform, information on formal trade in agricultural commodities comes from UNCTAD, while formal agri-food exports come from the ITC platform.

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agricultural commodities within West African countries accounted for 99.27% of total agricultural commodity trade, compared to only 0.73% for official exports (Figure 1).

Regarding agri-food products, trade between countries includes agricultural raw materials, locally processed raw products, as well as semi-industrial and industrial products. In these exchanges, informal trade dominates strongly. In 2023, 63.15% of total trade in agri-food products among West African countries originated from unofficial trade. Within the informal circuit, the products are often subjected to minimal processing such as drying, smoking, juice production, milk processing, and similar treatments (Figure 2).

These results confirm the findings of CILSS and FSIN (2025), which report that "a significant share of intra-regional food trade in West Africa - up to 85% - escapes official statistics." According to the Economic Commission for Africa (ECA, 2023), informal cross-border trade is estimated to account for between 30% and 72% of formal trade between neighboring countries on the African continent. Bouët et al. (2017) further estimate that informal trade in commodities constitutes about 30% of regional trade in West Africa.

This implies that official agricultural trade data considerably underestimate the value of intra-regional trade between West African countries. The substantial gap indicates that, over the years, agricultural trade in West Africa has been shifting toward the informal sector, especially following the COVID-19 pandemic. According to estimates by the African Export-Import Bank (Afreximbank), the informal cross-border trade sector is a major provider of jobs and income for women and young people in vulnerable situations, accounting for 20% to 75% of the working population. It also contributes significantly to regional food and nutrition security by facilitating the transport of food, agro-pastoral, and fishery products to low-production regions (AOCTAH, 2021).

Countries' contribution to intraregional informal agricultural trade in West Africa

Each country participates in these agricultural trade flows through various products. The variability of the region’s agro-ecological zones fosters complementarity between coastal countries, which supply the Sahelian countries with fish products, roots, and tubers, and the Sahelian countries, which, with a surplus of livestock products, export livestock and dry cereals to the coastal countries.

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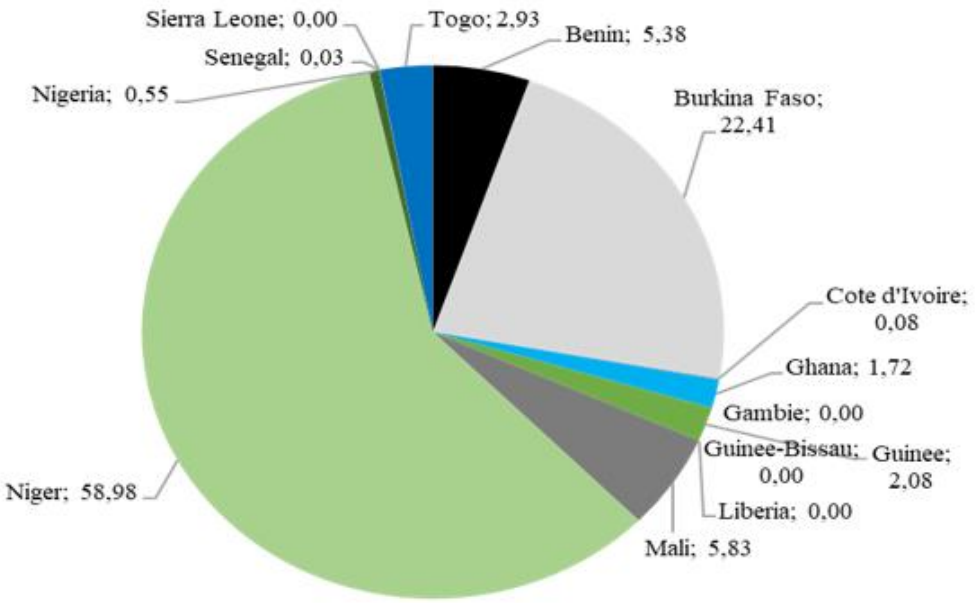
Figure 3: Contribution to Intra-Regional Informal Agricultural Exports in West Africa in 2023



Source: Author's calculations based on ECO-ICBT values (2025)

Niger and Burkina Faso are the driving forces behind intra-regional informal agricultural trade in West Africa. Niger alone accounts for 58.98% of the total value of informal intra-regional agricultural exports within West Africa. Burkina Faso ranks second, contributing 22.41% to intra-regional informal trade in agricultural products. They are followed by Mali and Benin (Figure 3). The relatively high values for Niger and Burkina Faso can be partly explained by strong livestock exports in the sub-region. It is important to note that livestock markets constitute a key link in the dynamics of the livestock meat sector and trade within the sub-region. Niger's most exported products in terms of value are livestock and animal feed, while Burkina Faso's primary export products include livestock, rice, and fish. Furthermore, it should be noted that in West Africa (excluding Cape Verde), the majority of these trade flows - 95.65% - are provided by WAEMU member countries.

Estimation of the gravity model

The regression results of the gravity model (2), presented in Table 1, show the progressive inclusion of variables to test the impact of the ECOWAS CET and the gradual implementation of the AfCFTA on informal agricultural trade (IAT) in West Africa. The log-linear form of the model allows interpreting the coefficients as elasticities or semi-elasticities of intra-regional trade flows. The main estimate, based on the full model, is reported in column 3. Due to a high correlation (0.625) between the CET and AfCFTA variables

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(Table A4), an additional column 4 was added to better isolate the effect of the gradual implementation of the AfCFTA on IAT.

Table 1: Econometric Results of the Gravity Model Estimation

Variables	**Dependent variable : Export**			
	Equation [1]	Equation [2]	Equation [3]	Equation [4]
Ln (PIBhab$_i$)	1.154 **(0.483) ****	1.429 **(0.694) ****	1.065 (0.690)	2.345 **(1.193) ****
Ln (PIBhab$_j$)	3.772 **(0.824) *****	3.738 **(0.748) *****	2.481 **(0.605) *****	2.392 **(0.626) *****
Ln(Pop$_i$)	0.080 (0.463)	0.161 (0.325)	0.186 (0.318)	-0.208 (0.407)
Ln(Pop$_j$)	-0.542 **(0.285) ***	-1.049 **(0.375) *****	-0.226 (0.231)	-0.317 (0.240)
Ln(Dist)	-1.929 **(1.164) ***	-0.957 **(0.434) *****	-0.616 **(0.301) ****	-0.724 **(0.312) ****
FronCom	1,679 **(0.416) *****	2.782 **(0.679) *****	3.001 **(0.589) *****	2.880 **(0.579) *****
Enclav1	6.333 **(2.636) ****	5.630 **(1.200) *****	4.393 **(0.783) *****	5.021 **(0.943) *****
TEC_CEDEAO		-1.311 **(0.730) ***	-0.971 **(0.560) ***	
UEMOA		-1.570 (0.510)	-1.257 **(0.667) ***	-1.261 **(0.558) ****
ExportUEMOA		0.830 (0.621)	1.324 **(0.546) ****	1.485 **(0.669) ****
lnPotVin i			-0.014 (0.071)	0.110 (0.097)
lnPotVin j			-0.223 **(0.110) ****	-0.237 **(0.129) ***
InvesPriv_i			-0.118 **(0.030) *****	-0.107 **(0.030) *****
InvesPriv_j			0.052 **(0.024) ****	0.058 **(0.025) ****
PartBugAro_i			0.104 (0.102)	0.154 (0.136)
PartBugAro_j			-0.105 (0.064)	-0.127 **(0.059) ****
Zlecaf$_{ijt}$				-1.936 **(0.624) *****
Constant	-7.285 (5.852)	-10.71 **(6.173*)**	-9.49 **(5.532) ***	-15.19 **(8.311) ***

Notes: Standard deviations in parentheses, *significant at 10%; **significant at 5%; ***significant at 1%.

Source: Author's estimate (2025)

Overall, the estimation results indicate that the traditional gravity model variables - such as the income levels of exporting and importing countries, the geographical distance between them, and the existence of a

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shared border - generally yield coefficients consistent with theoretical expectations.

The analysis of the effect of the level of development, measured by GDP per capita, reveals no significant influence on informal agricultural trade for exporting countries. However, this indicator is highly significant and positively correlated at the 1% level for importing countries. Specifically, a 1% increase in the partner country's GDP per capita is associated with an estimated 2.48% increase in its demand for informal agricultural products within the West African region. Regarding the distance variable, the results are consistent with the predictions of the gravity model and previous empirical studies. A 1% reduction in travel time and related costs leads to a 0.6% increase in informal agricultural trade. This confirms that distance remains a major barrier to bilateral trade flows, reinforcing the inverse relationship between distance and trade intensity, as highlighted by Agbodji (2007). Moreover, sharing a land border between two countries emerges as a key factor. The intensity of trade between countries that share a common border is approximately 20[7] times higher than that between non-neighboring countries. Lastly, the results concerning landlocked status reveal an unexpected effect, contrary to theoretical expectations. While it is commonly assumed that the lack of access to the sea hinders trade, landlocked countries show a potential for informal agricultural exports that is more than 80[8] times higher than that of coastal countries. Without direct access to international markets, these countries rely more heavily on their land borders with neighboring states.

The frequency of bribes and informal payments in importing countries has a negative and statistically significant effect on informal agricultural trade in the sub-region. Specifically, a 1% increase in such illicit practices leads to a 0.22% decrease in the demand for agricultural products purchased through informal channels.

The effect of private investment on informal agricultural trade (IAT) varies depending on the country's trade role. In exporting countries, such investment tends to reduce informal exports, whereas in partner countries it encourages imports. Specifically, a 1% increase in private investment leads to a 0.12% decrease in informal agricultural exports within ECOWAS countries. Conversely, an equivalent increase in investment in the importing country is associated with a 0.05% rise in informal agricultural imports.

The estimates indicate that the agricultural programs and policies implemented have no significant effect on the trade of agricultural products between West African countries. This suggests limited effectiveness, or even a mismatch of these measures with the dynamics of regional informal trade.

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[7] $e^{(3,001)} = 20,11$
[8] $e^{(4,393)} = 80,88$

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The results related to the effective implementation of the Common External Tariff (CET) reveal a negative and statistically significant effect on informal agricultural trade. Specifically, its enforcement leads to a reduction in informal agricultural trade flows by approximately 0.38 times compared to situations where the CET is not in effect. Regarding the West African Economic and Monetary Union (WAEMU), although the use of a common currency such as the CFA franc is generally perceived as a trade-facilitating factor among member states, the estimates here indicate the opposite. Membership in WAEMU reduces the intensity of informal agricultural trade between its members by 0.28 times compared to other countries in the region. However, the effect is reversed in the case of exports to non-member countries: an exporting country that is a WAEMU member shows an informal export potential approximately four times greater than that of a non-member country. This finding aligns with the data presented in Figure 2, which shows that WAEMU countries account for nearly 95.65% of intra-regional informal agricultural exports. Finally, the estimates related to the African Continental Free Trade Area (AfCFTA) also indicate a negative and highly significant impact on intra-regional informal agricultural trade. The progressive implementation of this agreement is associated with a decrease of more than 0.14 times in informal flows, suggesting a possible shift toward more formalized trade as continental integration progresses.

Robustness tests

The objective of these tests is to assess the robustness of the results obtained through the estimation technique by employing the Poisson Pseudo Maximum Likelihood (PPML) approach. Alternative estimation methods used for comparison include the Ordinary Least Squares (OLS) estimator and the Tobit model.

The Ordinary Least Squares (OLS) method is used to estimate model parameters under assumptions such as homoscedasticity and strictly positive trade flows. However, it struggles with zero trade values and heteroscedasticity, leading to inefficiencies. To address this, the Tobit model, introduced by Tobin (1958), offers a nonlinear approach suitable for censored data like trade flows truncated at zero. It combines the probability of trade occurrence with the estimation of trade volume, capturing both the likelihood and intensity of trade. Still, its reliability depends on strong assumptions, including normality and constant variance of errors, which may not hold in practice.

The table below presents the estimation results obtained from the different methods for selected variables of interest.

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Table 2: Robustness test results

Variables	PPML	OLS	Tobit
CET_ECOWAS	-0.971	0.744	0.077
	(0.560) *	**(0.179) *****	**(0.013) *****
WAEMU	-1.257	1.583	0.111
	(0.667) *	**(0.231) *****	**(0.017) *****
ExportWAEMU	1.324	1.095	0.063
	(0.546) **	**(0.424) *****	**(0.017) *****
AfCFTA	-1.936	-0.346	0.023
	(0.624) ***	**(0.196) ***	**(0.014) *****

Notes: Standard deviations in parentheses, *significant at 10%; **significant at 5%; ***significant at 1%.

Source: Author's estimate

Overall, the signs of the coefficients estimated using the PPML estimator are consistent with those obtained through the OLS and Tobit methods, except for the ECOWAS CET and AfCFTA variables, where discrepancies in sign are observed across the different estimation techniques. This divergence underscores the robustness of the PPML estimator, which effectively accounts for zero trade flows and corrects for heteroscedasticity, thereby producing more reliable estimates. In contrast, methods such as Ordinary Least Squares (OLS) and the Tobit model do not adequately address these issues.

In the context of this research, the negative coefficients of the CET and AfCFTA variables obtained through the PPML estimation can be considered more robust and reflective of the actual dynamics of informal agricultural trade among West African countries.

Discussion

The analysis of the results reveals a dampening effect of regional integration on informal trade in agricultural products in West Africa. This finding diverges from certain studies that highlight the potentially distortionary effects of regional trade agreements (RTAs), particularly those by Salazar-Xirinachs (2002) and Carrère (2013). According to Lee, Mulabdic, and Ruta (2023), the impact of such agreements on external firms largely depends on their specific provisions. Conversely, other research (Beke & N'Guessan, 2021; Coulibaly et al., 2015) shows that regional integration can, under certain conditions, foster intra-regional trade. Furthermore, studies by Foroutan and Pritchett (1993), Ogunkola (1998), Longo and Sekkat (2004), and Agbodji (2007), which focus on informal trade, suggest that integration agreements in Africa have had, overall, a limited or even negligible effect on intra-African trade.

In this context, our results highlight three major implications associated with the implementation of the Common External Tariff (CET).

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

First, the CET encourages some informal traders to shift toward formal channels, thereby reducing informal trade flows. Second, it offers insufficient protection for local agricultural products, which struggle to compete with external imports. Third, to offset fiscal losses from the exemption of agricultural goods, some states introduce technical and quantitative barriers that hinder intra-regional trade - barriers that disproportionately affect small informal operators. These obstacles, compounded by burdensome customs procedures and technical requirements, significantly hamper informal agricultural trade in West Africa.

Regarding the AfCFTA, our findings, which indicate a negative impact, contrast with those of Geda and Yimer (2023), who suggest that the agreement could boost intra-African exports. The limited effect observed on informal agricultural trade in our study is largely due to the sector's weak integration into the implementation policies of the agreement. Informal traders - often unregistered due to high registration costs - lack access to information and the digital tools required to benefit from the AfCFTA. Furthermore, the alignment of the AfCFTA with pre-existing regulatory frameworks such as those of WAEMU and ECOWAS is not always seamless, posing additional challenges for small operators who are frequently ill-informed or ill-equipped to navigate these overlapping systems. This complicates procedures and creates further barriers - such as duplication, contradictions, or administrative burdens - ultimately limiting their participation in regional trade.

The positive result associated with the landlocked country variable runs counter to theoretical expectations. The literature (Beke and N'Guessan, 2021; Mackellar et al., 2002) generally highlights landlockedness as a natural barrier to trade, due to higher transportation costs and the lack of direct access to seaports. This structural disadvantage is particularly evident in formal trade channels, where it undermines the competitiveness of countries without a coastline. This apparent paradox can be explained by the increased reliance of landlocked countries on cross-border trade with neighboring states, often through informal routes that are more accessible. Deprived of direct access to international markets, these countries depend more heavily on informal intra-regional trade, particularly as a means of distributing their agricultural output.

Consistent with the findings of Beke (2022) and Portugal-Perez and Wilson (2008), our results confirm that corruption undermines regional trade by increasing transaction costs. Although some authors (De Jong & Bogmans, 2011) suggest that bribes may facilitate trade by speeding up border-crossing procedures, in the West African context, such practices impose an additional financial burden on traders - particularly along cross-border corridors. They weaken the competitiveness of informal agricultural trade by discouraging small operators and disrupting market dynamics.

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Private investment, meanwhile, has a dual effect. On one hand, it promotes the formalization of agricultural value chains, effectively excluding many informal traders who are unable to meet new compliance standards. On the other hand, it boosts demand for agricultural inputs for processing units, prompting some businesses to turn to flexible and responsive informal cross-border channels for rapid sourcing. As such, informal trade continues to play a crucial role in maintaining the balance of regional food systems.

The absence of a significant link between the share of the national budget allocated to agriculture and informal agricultural trade (IAT) reflects the low level of funding granted to the sector - insufficient to drive a genuine agricultural transformation in Africa, as envisioned in the Maputo commitments of 2003. With limited agricultural budgets, regional and national policies and programs tend to prioritize formal actors and specific major value chains. Moreover, the lack of reliable data on the informal sector, combined with a negative perception often associated with its unregulated nature, hinders its inclusion in public policy frameworks.

Conclusion

This research has empirically examined the relationship between regional integration and informal agricultural trade in West Africa. To this end, an augmented gravity model was applied to a panel of fourteen ECOWAS member countries over the period 2010–2022. The results indicate that unrecorded intra-regional agri-food exports represent approximately 63.15% of the region's total agri-food trade, underscoring the significant role of these flows in shaping regional trade dynamics. Econometric estimates reveal that the ECOWAS Common External Tariff (CET), joint membership in an integrated economic and monetary area (WAEMU), and the progressive implementation of the African Continental Free Trade Area (AfCFTA) all exert negative and statistically significant effects on informal agricultural trade among West African countries. These findings suggest that, in their current form, regional integration mechanisms - such as the ECOWAS CET, WAEMU policy instruments, and the AfCFTA - do not support, and may in fact hinder, the development of informal intra-regional agricultural trade within the ECOWAS area. This raises important questions about the strategic orientation of regional agreements as effective levers for fostering intra-regional trade, particularly in a context where informal trade is largely driven by small-scale actors, including women and youth. Furthermore, the role of other structural and institutional factors is far from negligible. The engagement of the private sector plays an ambivalent role: while it tends to reduce informal exports from countries of origin, it modestly stimulates informal imports in partner countries.

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In light of these findings, it is essential that regional bodies such as ECOWAS and the AfCFTA more systematically integrate small traders and informal sector actors - who are predominantly women and youth - into regional policies through tailored mechanisms. These may include simplified declaration systems, the issuance of cross-border trader permits, access to trade information via multilingual digital platforms, targeted microfinance, and flexible legal recognition. Their active inclusion in regional value chains represents a key lever for achieving more equitable economic integration. Furthermore, incorporating data from informal trade into national statistics is crucial for accurately assessing the true weight of intra-regional trade on the continent.

Acknowledgements

The authors express their sincere gratitude to the West African Association for Cross-Border Trade in Agro-Forestry-Pastoral, Fisheries Products and Food (WACTAF/AOCTAH), and in particular to its Permanent Secretary, Mr. Motchosso Justin MATITOMA, for providing access to the ECO-ICBT databases and related documentation. These resources were instrumental in the execution of this research and significantly contributed to enhancing its scientific rigor.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The authors did not obtain any funding for this research.

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 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

Appendices

Table A1: Description and Source of Gravity Model Variables

Variables	Description	Unit	Sources
$Export_{ijt}$	Flows of agricultural exports from country j from country i (in current dollars)	USD million	**ECO-ICBT** (Ecowas Informal Cross-Border Trade)
$LnPotVin_{it}$, $LnPotVin_{jt}$	Bribe payments to control officers	USD	
$LnGDPhab_{it}$,, $LnGDPhab_{jt}$	GDP per capita of country i and country j at current prices	USD	**WDI** (World Development Indicators)
$QInfra_{it,}$ $QInfra_{jt}$	Quality of trade and transport infrastructure	1 = low to 5 = high	
$InvesPriv_{it,}$ $InvesPriv_{jt}$	Private sector investment in the economy	Percent	
$LnDist_{ij}$	Weighted distance between country capitals	Km	CEPII (Centre for Prospective Studies and International Information)
$FronCom_{ij}$	Sharing a common border	1 if the two partner countries border and 0 otherwise	
$Enclav1_{ij}$	Lack of maritime opening of one of the 2 co-trade countries i and j	1 if at least one of the countries is landlocked and 0 otherwise	
$WAEMU_{ij}$	Membership of the 2 co-trade countries in the WAEMU Economic and Monetary Integration Agreement	1 if both partner countries belong to WAEMU and 0 if not	
$ExportWAEMU_{ij,}$	Exporter's membership of WAEMU and importer's non-membership of WAEMU	1 if the exporter belongs to the WAEMU and 0 otherwise	
$LnPop_{it,}$ $LnPop_{ij}$	Population size of exporting i and importing country j	In thousands	UNCTAD-NTM (United Nations Conference on Trade and Development)
$ParbugAgro_{it,}$ $ParbugAgro_{jt}$	The share of the national budget devoted to the agricultural sector.	Public agricultural expenditure (% of total expenditure)	ReSAKSS (Regional Strategic Analysis and Knowledge Support System)
CET_ECOWAS_{ijt}	Implementation of the CET in ECOWAS from 2015	0 for the period before 2015 and 1 from 2015 onwards	Authors
AfCFTA	Progressive implementation of the AfCFTA since 2018	0 for the period before 2018 and 1 from 2018 onwards	Authors

Source : Authors

Table A2: Statistical Summary of Model Variables

Variable	Mean	Std. Dev.	Min	Max
$Export_{ijt}$	5 484 628	1.09E+08	0	5.09E+09
$LnGDPhab_{it,}$	6.895393	0.457682	6.162105	8.035512
$LnGDPhab_{jt}$	6.895393	0.457682	6.162105	8.035512

 ISSN: 1857-7881 (Print) e - ISSN 1857-7431

LnPotVin i	0.593092	2.042075	0	13.04495
LnPotVin j	0.4699251	1.893379	0	16.57286
$InvesPriv_{it,}$	7.907215	8.805133	0	29.86267
$InvesPriv_{jt}$	7.907215	8.805133	0	29.86267
$LnDist_{ij}$	7.183372	0.732111	4.784988	8.077416
$FronCom_{ij}$	0.2743026	0.4462565	0	1
$Enclav1_{ij}$	0.3956044	0.4890835	0	1
$WAEMU_{ij}$	0.3076923	0.461636	0	1
$ExportWAEMU_{ij,}$	0.2637363	0.4407511	0	1
$LnPop_{it,}$	9 432 924	1.113514	7.356918	12.29 473
$LnPop_{ij}$	9.432924	1.113514	7.356918	12.29473
$ParbugAgro_{it,}$	6.052143	4.015941	0.62	23.11
$ParbugAgro_{jt}$	6.052143	4.015941	0.62	23.11
CET_ECOWAS_{ijt}	0.6153846	4866071	0	1
AfCFTA	0.3846154	0.4866071	0	1

Source : Authors

Table A3: Multicollinearity test

Test with all variables		Test without the variable Zlecaf		Test without the variable Tec_cedeao	
Variable	VIF	Variable	VIF	Variable	VIF
Log_Pib_Ha~i	3.07	Log_Pib_Ha~i	2.97	Log_Pib_Ha~i	3.06
Log_Pib_Ha~j	3.05	Log_Pib_Ha~j	2.96	Log_Pib_Ha~j	3.04
Log_Pop_i	2.77	Log_Pop_i	2.72	Log_Pop_i	2.76
enclav1	2.77	Log_Pop_j	2.70	enclav1	2.74
Log_Pop_j	2.76	enclav1	2.69	Log_Pop_j	2.74
zlecaf	2.04	uemoa	1.74	uemoa	1.75
uemoa	1.75	froncom	1.66	Log_PotVin_i	1.68
tec_cedeao	1.72	Log_PotVin_i	1.62	froncom	1.66
Log_PotVin_i	1.68	Log_dist	1.60	Log_PotVin_j	1.61
froncom	1.66	Log_PotVin_j	1.60	Log_dist	1.60
Log_PotVin_j	1.61	exportuemoa	1.52	exportuemoa	1.52
Log_dist	1.60	invespriv_i	1.39	partbugagr~i	1.41
exportuemoa	1.52	partbugagr~i	1.39	invespriv_i	1.41
partbugagr~i	1.42	partbugagr~j	1.39	partbugagr~j	1.40
invespriv_i	1.42	invespriv_j	1.32	zlecaf	1.38
partbugagr~j	1.41	tec_cedeao	1.17	invespriv_j	1.33
invespriv_j	1.34				
Mean VIF	1.98	Mean VIF	1.90	Mean VIF	1.94

Source : Authors

Table A4: Correlation test

	tec_ce~o	zlecaf
tec_cedeao	1.0000	
zlecaf	0.6250	1.0000

Source : Authors