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

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Abstract

This research, based on the gravity model, explores the complex relationship between regional integration and intra-regional informal agricultural trade in West Africa over the period 2010–2022. By assessing the major impact of the ECOWAS Common External Tariff (CET) and the gradual implementation of the African Continental Free Trade Area (AfCFTA), it reveals a paradoxical dynamic: despite institutional progress in regional integration, informal agricultural trade - largely driven by small-scale operators - remains insufficiently addressed in regional policies and strategies. The findings highlight a significant correlation between these integration initiatives and a marked decline in informal agricultural trade, thereby raising critical questions about the effective inclusion of these key actors in 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 is one of the cornerstones of Agenda 2063. 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 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 for analyzing trade flows. This intuitive and robust model has proven to be an effective tool for estimating and predicting bilateral trade flows based on the economic and geographical characteristics of trading partners.

Theoretical model

The gravity model is a generic term referring to a family of quantitative models. It is based on the fundamental law of physics developed by Isaac Newton in 1687 to describe the gravitational force between two bodies with mass. In economics, geography, and other disciplines, it is used as a tool to predict flows between two entities based on their "mass" (such as GDP or population) and the distance between them. For several years, the model lacked a solid theoretical foundation in economics.

The various forms of the model's equation that have succeeded one another and been debated in the empirical literature can be explained by the absence of a consensus theory. These theoretical foundations have gradually developed thanks to the work of Tinbergen (1962); Anderson (1979) (for microeconomic considerations); Bergstrand (1985); Deardorff (1995); and Evenett and Keller (1998) (drawing on international trade theories). Since Tinbergen's work in 1962, the gravity model has become increasingly popular as an instrument for the empirical analysis of international trade. In recent years, the remarkable contributions of Anderson and Wincoop (2003) have enabled significant progress in gravity model development.

After presenting the theoretical gravity model, this research will introduce the empirical model and the estimation method adopted, as well as the data collected and their respective sources.

Empirical model

The gravity model has been widely used by researchers to analyze various phenomena. Some researchers - Carrère (2004), Gbetnkom and Avom (2005), Agbodji (2007); Afesorgbor (2013); Carrère (2013) and Beke and N'Guessan (2021) - have used the model to study the effects of regional integration on trade in West Africa. Other authors, such as Keller and Yeaple (2009) and Kleinert and Toubal (2010), have applied the gravity model to analyze foreign direct investment.

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 ECO-ICBT database, a quadripartite management platform that brings together ECOWAS, CILSS, WAEMU, and WACTAF[1].

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 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.

[1] West African Association for Cross-Border Trade, in Agro-forestry-pastoral, Fisheries products and Food

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 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 *ECOWAS Informal Cross-Border Trade* (ECO-ICBT) database, a quadripartite management platform that brings together ECOWAS, CILSS, WAEMU, and WACTAF.

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 (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 (ECOWAS Informal Cross-Border Trade) platform, established jointly by ECOWAS, CILSS, WAEMU, and WACTAF as part of a regional coordination initiative. 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.

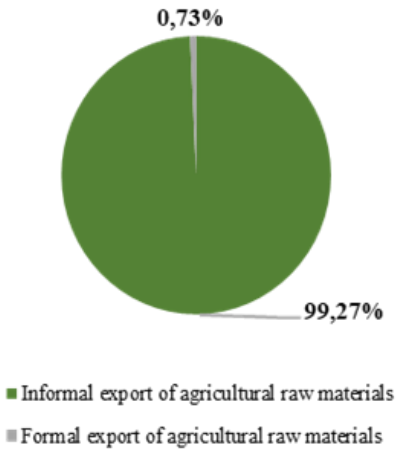


Figure 1: Export of agricultural raw materials

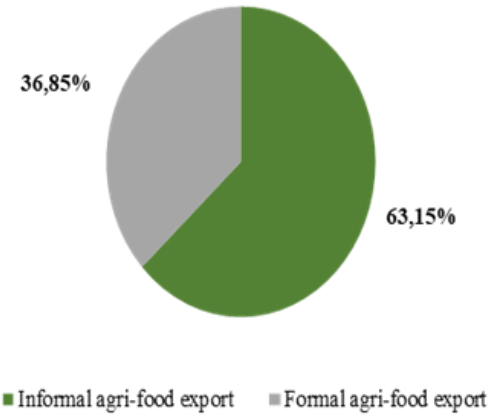


Figure 2: Agri-Food Exports
Source: Author's calculations based on data from ECO-ICBT, UNCTAD, and ITC[2] (2025).

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 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. (2020) further

[2] 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.

estimate that informal trade in commodities constitutes about 30% of regional trade in West Africa.

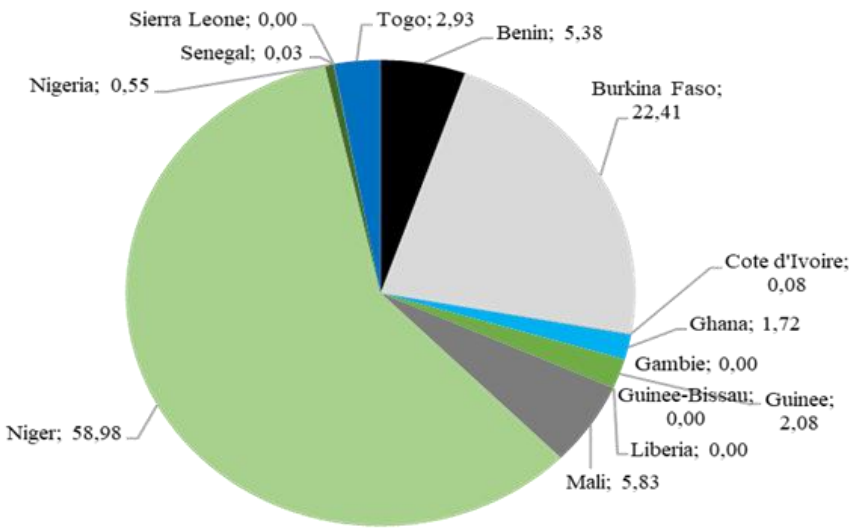
This implies that official agricultural trade data considerably underestimate the value of intra-regional trade between West African countries. The substantial gap indicates that, over the years, agricultural trade in West Africa has been shifting toward the informal sector, especially following the 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

The role of intra-regional informal agricultural trade in West Africa is now widely recognized as essential for the economic development of the sub-region's countries and their resilience to global crises. It contributes to accelerating the process of regional integration 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.

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.

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



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

Estimation of the gravity model

The results of the regression of gravity model (2) are presented in the table below (Table 1). Several columns of results are shown, reflecting the gradual inclusion of variables in the model to test the impact of the ECOWAS Common External Tariff (CET) and the gradual implementation of the AfCFTA on informal agricultural trade (IAT) between West African countries. The use of the log-linear form of the gravity equation allows the coefficients to be interpreted as elasticities and semi-elasticities of intra-regional trade flows with respect to the explanatory variables. The estimate used to assess the impact of the CET is based on the full model, the results of which are presented in column 3 of Table 1. Due to potential multicollinearity between the CET and AfCFTA variables, an additional column (column 4) has been included to better isolate the effect of the AfCFTA implementation on IAT. The analysis shows the significance of several variables, with most coefficients displaying the expected signs in line with the existing literature, though with varying degrees of intensity.

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.

Impact of Economic Factors on the Intensity of Intraregional Informal Agricultural Trade (IAT)

In general, the estimation results show that the classic variables of the gravity model - such as the income levels of the exporting and importing

countries, the distance between them, and the presence of a common border - have coefficients that are largely consistent with theoretical expectations.

The impact of the development level variable, measured by GDP per capita, on informal agricultural trade is found to be statistically insignificant for the exporting country, but highly significant and positive at the 1% level for the partner (importing) country. This implies that a 1% increase in the importing country's GDP per capita leads to a 2.48% rise in its demand for agricultural products within West Africa through informal trade channels. This result confirms the findings of Avom and Gbetnkom (2005) and Avom and Njikam (2013), who show that GDP growth has a positive effect on trade. In contrast, Gammadigbe (2017), whose work focused on agricultural product flows within ECOWAS, reports an opposite result and argues that the negative sign may be attributed to the specific characteristics inherent to agricultural goods. He concludes that the direction of the effect of income on agricultural trade is unstable. Our findings can be explained by the fact that an increase in GDP per capita is generally accompanied by improved purchasing power. This rise in income stimulates demand for food, particularly for locally produced agricultural goods. In developing countries, it is often the informal sector that responds most rapidly and effectively to this growing demand, due to its flexibility, lower costs, and proximity to consumers. Meanwhile, higher-income countries tend to undergo a process of trade formalization. This process typically involves the implementation of regulatory frameworks, compliance with quality standards, and the acquisition of export certifications for agricultural products. These requirements often entail high costs that small-scale traders are unable to bear. As a result, many are forced to operate within the informal sector to avoid such expenses - ultimately increasing the informal agricultural trade of both the country and its trading partners.

The expected results regarding distance are consistent with the gravity model and previous empirical studies. A 1% reduction in commuting time and associated costs leads to a 0.6% increase in informal agricultural trade. Distance acts as a barrier to trade, confirming the inverse relationship between distance and bilateral trade flows, as highlighted by Agbodji (2007). An increase in geographical distance between partner countries reduces trade intensity (El Bekri 2023). Similarly, Freund and Rocha (2011) find that a one-day reduction in travel time leads to a 7% increase in intra-African exports. Fouquin and Hugo (2006), in their analysis of the relationship between bilateral trade and geographical proximity, demonstrate that trade costs tend to decline between geographically closer countries. In a context such as West Africa - where transport infrastructure is often inadequate - the greater the distance between trading countries, the higher the transport costs, which in turn reduces trade intensity. It is important to note that West Africa

remains one of the regions with the highest number of road checkpoints (Bouët et al., 2018). For informal traders - often small-scale operators - crossing multiple regions or covering long distances means passing through numerous checkpoints, where unofficial payments are frequently demanded. These payments, although illegal and contrary to ECOWAS policies on trade liberalization, represent additional costs that significantly raise the overall cost of transportation. Beyond the checkpoints, logistical challenges also persist - such as inadequate packaging, lack of refrigeration infrastructure, and limited access to cold chains - particularly for perishable agricultural products. These constraints limit the capacity of small informal traders to engage in long-distance agricultural trade, thereby weakening the potential of informal trade across the region.

The coefficient of the variable related to geographical proximity is positive and statistically significant at the 1% level. The intensity of trade is significantly higher between two countries that share a common border. Specifically, agricultural trade between neighboring countries is approximately 20[3] times greater than between countries that do not share a land border. This result is consistent with Kpemoua (2023), who finds that trade is more intensive between countries with shared borders than between those without. Geographical proximity enhances informal agricultural trade through several mechanisms. First, it reduces the physical distance between markets, which are often located near or across borders, thereby lowering transport costs. Second, these markets are frequently managed by communities with strong cultural, ethnic, or institutional ties on both sides of the border, which fosters trust and cooperation among trading partners. Additionally, such borders tend to be porous, allowing for the free movement of goods and people, and facilitating informal trade flows. This type of trade is often conducted on a small scale and remains largely unrecorded by border control authorities. Fustier (2015) emphasizes that geographical proximity plays a decisive role in shaping trade affinities, primarily due to its effect on reducing transaction costs.

The positive coefficient obtained for the landlocked variable is contrary to the expected sign. Several empirical studies report an inverse relationship between the absence of maritime access and trade flows between countries (Beke and N'Guessan, 2021). According to these authors, who examined agricultural flows through formal trade channels, being landlocked constitutes a natural barrier that limits the marketing potential of such countries compared to those with direct access to the sea. Mackellar et al. (2002) find that for most landlocked African countries, transport costs represent between 15% and 20% of import costs - three to four times higher

[3] $e^{(3,001)} = 20,11$

than in most developed countries. In this sense, landlocked status is often seen as a structural economic disadvantage in the context of international trade. However, our results reveal the opposite effect. The estimation findings indicate that informal agricultural trade is 80[4] times more intense in landlocked countries than in coastal countries, with a statistical significance at the 1% level. This result can be explained by the particular position and constraints of landlocked countries, which stimulate their participation in informal intra-regional trade, especially in the agricultural sector. Due to their lack of direct access to international markets, landlocked countries are more reliant on land borders with neighboring states. These borders - often located in rural areas - frequently allow for informal crossings, enabling traders to bypass the high transaction costs and delays associated with official checkpoints. Consequently, landlocked countries are more active in informal intra-regional agricultural trade than coastal countries, which tend to focus more on producing export-oriented crops destined for markets outside the ECOWAS region.

Impact of incentive factors for informal trade on intra-regional agricultural flows

The prevalence of bribes and unofficial payments in importing countries has a significant negative impact on informal intra-regional agricultural trade within the subregion. A 1% increase in such illicit payments is associated with a 0.22% decline in informal demand for agricultural products. This finding is consistent with the work of Beke (2022), who examined formal agricultural trade, and with Portugal-Perez and Wilson (2008), who argue that corruption hampers regional trade flows by increasing transaction costs and reducing efficiency. Conversely, De Jong & Bogmans, (2011) suggest that bribes paid at customs checkpoints may, in some contexts, paradoxically facilitate trade by accelerating border clearance procedures. However, in the African context, such informal payments - often perceived as a form of unofficial taxation - constitute an additional financial burden for traders. This is particularly the case along cross-border trade corridors, where multiple checkpoints and non-tariff barriers persist. These payments undermine the efficiency and competitiveness of informal intra-regional agricultural trade by increasing costs, discouraging small-scale operators, and distorting market dynamics.

[4] $e^{(4,393)} = 80,88$

Impact of the private sector on the intensity of informal agricultural trade (IAT)

The sign and significance of the impact of private sector investment on informal agricultural trade (IAT) differ between exporting and importing countries. Private investment appears to reduce export intensity while simultaneously increasing the volume of informal intra-regional agricultural imports. The estimation results indicate that a 1% increase in private investment leads to a 0.12% decline in informal agricultural exports within ECOWAS countries. This effect can be explained by the fact that rising private investment is often associated with the formalization of agricultural value chains. This formalization entails stricter requirements, such as adherence to quality standards, improved packaging, and the acquisition of certifications. These requirements, which often incur high compliance costs, tend to exclude informal traders who typically lack the resources or capacity to meet such standards. Consequently, informal actors face increasing barriers to accessing intra-regional markets. Furthermore, the structuring and modernization of certain agricultural sectors may lead to a reorientation of trade flows toward international markets, to the detriment of regional markets. This shift can reduce the availability of agricultural products for informal intra-regional trade, thereby diminishing export flows within the subregion.

With regard to imports by the partner country, the results indicate that a 1% increase in private investment is associated with a 0.05% rise in informal agricultural imports. Private investment fosters the development of agro-industrial processing units, wholesale markets, and related infrastructure, which in turn stimulates demand for agricultural raw materials. When the domestic market is unable to fully satisfy this growing demand, businesses often resort to sourcing from neighboring countries, where informal supply channels are more accessible, flexible, and responsive. This dynamic reinforces the role of informal trade as a mechanism for meeting supply shortages and supporting regional food systems.

Impact of countries' agricultural programmes and policies on the intensity of IAT

The results of our estimation reveal that agricultural programs and policies have no significant impact on the trade flows of food products, particularly agricultural goods, among West African member countries. These findings suggest that public funding for agricultural programs and policies is primarily directed toward the formal sector and more structured value chains, thereby excluding actors operating within informal circuits. Consequently, small-scale agricultural players, who constitute the majority in

the informal sector, do not sufficiently benefit from such financing. This outcome underscores the limited budgetary allocations that national governments dedicate to the agricultural sector, which remain inadequate and fall short of the commitments made by states during the 2003 Maputo Summit. At this summit, African countries pledged to allocate at least 10% of national public expenditure to agriculture and to achieve annual agricultural growth rates of at least 6%. However, the majority of African nations continue to fall significantly below the target allocation of 10%, hindering genuine agricultural transformation across the continent.

Impact of Regional Agreements on the Intensity of IAT

Estimates of the variable capturing the actual implementation of the Common External Tariff (CET) indicate a negative and statistically significant impact. The CET reduces intra-regional informal agricultural trade by 0.38 times compared to situations without the CET. This result aligns with several empirical studies that have demonstrated the distortive effects of regional trade agreements (RTAs) on trade flows among member countries (Salazar-Xirinachs, 2002; Carrère, 2013). According to Lee, Mulabdic, and Ruta (2023), the impact of RTAs on third-country firms partially depends on the specific provisions contained in these agreements. Conversely, other research - including studies by Beke and N'Guessan (2021), Coulibaly et al. (2015), Bangaké and Eggoh (2009), Diop (2007), and Avom and Gbetnkom (2005) - highlight a positive effect of regional integration on intra-regional trade, demonstrating that integration mechanisms can, in certain contexts, effectively stimulate trade flows among member countries. Additionally, the findings of Foroutan and Pritchett (1993), Ogunkola (1998), Longo and Sekkat (2004), and Agbodji (2007) - who specifically studied informal trade - underline that regional integration agreements in Africa have had little or no significant effect on intra-regional trade. Our results reveal three notable effects related to the CET. First, some informal traders, attracted by the benefits associated with the CET, choose to formalize their activities by shifting into official trade channels, thereby reducing informal trade volumes. Second, the CET appears insufficiently protective of local agricultural products, which struggle to compete with imports, raising questions about its effectiveness in enhancing the competitiveness of Community-produced goods. Third, to compensate for the loss of tax revenue resulting from ECOWAS's exemption of agricultural products, certain member countries have implemented technical and quantitative measures that impede intra-regional trade. Although ECOWAS member states share common agricultural trade policy guidelines, each country retains the freedom to develop its own agricultural and food policies, including market protection and regulation mechanisms. These measures

often take the form of quotas, import or export licenses, or similar instruments. They constitute significant barriers, particularly for small-scale traders in the informal sector, due to their restrictive nature and associated costs. According to UNCTAD (2024), technical requirements, inefficient customs procedures, and other non-tariff barriers limit intra-African trade three times more than tariffs. Collectively, these obstacles contribute to reducing the intensity of informal agricultural trade within the region.

The variable indicating membership in a single WAEMU monetary zone is expected to have a significant and positive effect on agricultural trade between member countries. Indeed, WAEMU countries sharing the CFA franc are anticipated to trade more extensively with one another compared to countries outside this monetary union. However, in this study, WAEMU membership is found to reduce trade intensity between member countries by 0.28 times relative to other West African nations. This finding corroborates Agbodji (2007), who demonstrated that belonging to a common monetary zone and undertaking economic reforms have led to notable trade diversion effects on imports and exports, particularly in contexts marked by significant unrecorded cross-border trade. Conversely, other studies - including those by Avom and Gbetnkom (2005), Bangake and Eggoh (2009), Beke and N'Guessan (2021), and Kpémoua (2023) - report a positive relationship between WAEMU membership and intra-regional trade among member countries. Nitsch (2002) further observes that countries within a monetary union tend to trade more with each other than countries of comparable development levels operating their own currencies. From a theoretical standpoint, Clark (1973) and Hooper and Kohlhagen (1978) argue that a monetary union can stimulate bilateral trade by reducing exchange rate uncertainty. Additionally, according to Krugman (1993) and Eichengreen (1990), the increased trade intensity within monetary unions is largely due to member countries exploiting their comparative advantages.

The WAEMU zone, characterized by territorial contiguity among its member countries, has established a regional agricultural policy (PAU) aimed at promoting the integration of agricultural markets. However, efforts to harmonize standards, customs procedures, and tariff policies within the zone appear to exert a slightly negative impact on intra-WAEMU trade. This outcome persists despite initiatives such as the PAU's "Cross-Border Trader's Booklet," which is designed to facilitate the movement of small-scale traders, the majority of whom operate in the informal sector.

Regarding the variable indicating whether the exporter is a WAEMU member, a positive and significant effect is observed on exports from WAEMU countries to non-WAEMU countries. Specifically, when the exporting country belongs to WAEMU, its potential for informal intra-regional agricultural exports is approximately four times higher than that of a

non-WAEMU exporter. This finding corroborates the results presented in Chart 2, which show that WAEMU countries account for the majority of intra-regional exports, contributing 95.65% of the total.

The estimates of the AfCFTA variable, presented in column 4, reveal a negative and highly significant impact on intra-regional informal agricultural trade (IAT) in West Africa. The gradual implementation of the AfCFTA is associated with a reduction in informal agricultural trade by more than 0.14 times. This outcome can be explained by the fact that informal trade - which constitutes a substantial portion of African agriculture - is insufficiently accounted for in the AfCFTA's awareness and development strategies. Informal traders, who are typically unregistered in official records, lack access to the tools and information necessary to benefit from AfCFTA's instruments and measures. Furthermore, the overlap and coexistence of AfCFTA regulations with those of WAEMU and ECOWAS complicate procedures, thereby creating additional barriers for informal traders seeking to integrate into AfCFTA programs. Consequently, informal traders face significant challenges in accessing markets under the AfCFTA framework.

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 employed to estimate the model parameters under the assumptions of homoscedasticity (i.e., constant variance of errors), no correlation between errors and explanatory variables, and strictly positive trade flows. However, OLS has notable limitations, particularly when zero trade flows are present, since the logarithm of zero is undefined. Additionally, heteroscedasticity can result in inefficient estimates and biased standard errors. The Tobit estimator, introduced by Tobin (1958), is a nonlinear method designed to handle zero or censored trade flows. It is particularly suitable when the dependent variable - in this case, trade flows - is continuous but truncated at a lower bound (typically zero). The Tobit model combines a probability component, which predicts the likelihood of trade occurring, with a linear regression component, which estimates trade volume conditional on positive trade flows. Thus, it captures both the intensity and the probability of trade. However, the Tobit model depends on strong assumptions, including normality and homoscedasticity of the error terms, which may not always hold in empirical applications and can affect the reliability of the estimates.

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

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 within West Africa. This finding contrasts with those of several previous studies, such as Camara (2013), Coulibaly et al. (2015), Avom and Gbetnkom (2005), and Carrère (2004), which generally underscore the positive influence of regional integration on international trade flows. Likewise, the present study's conclusions diverge from those of Beke (2021) and Gammandigbé (2017), whose research - focusing on formal regional trade in agricultural products - found that integration agreements had contributed to the intensification of intra-regional trade flows.

Moreover, this research highlights a significant shortcoming in regional trade policies, particularly regarding the implementation of the ECOWAS Common External Tariff (CET) and the gradual

operationalization of the African Continental Free Trade Area (AfCFTA). Notably, informal agricultural trade - largely conducted by small-scale economic actors, especially women and youth - remains insufficiently integrated into existing institutional and policy frameworks. This omission is particularly concerning given that informal trade accounts for a substantial share of intra-regional agricultural exports, estimated at approximately 63.15%.

The study also reveals that private investment in exporting countries tends to have a negative impact on informal agricultural trade, whereas such trade modestly contributes to increasing agricultural imports in partner countries. Moreover, informal trade flows remain particularly vulnerable to illicit practices, notably unofficial payments at border checkpoints, which significantly affect importing countries. These practices constitute a major barrier to the fluidity of cross-border trade within the region.

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.

In light of these findings, it is recommended that African governments place greater emphasis on small-scale traders and informal sector actors - particularly women and youth - within national and regional

development policy frameworks. Their effective inclusion in regional value chains constitutes a strategic lever for fostering more equitable and sustainable economic integration. Furthermore, integrating data on informal agricultural trade (IAT) into national statistical systems is essential for more accurately assessing the true magnitude and contribution of intra-regional trade on the continent.

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Appendix

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
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

Variable	VIF	1/VIF
Log_Pib_Ha~i	2.97	0.336568
Log_Pib_Ha~j	2.96	0.338407
Log_Pop_i	2.72	0.367825
Log_Pop_j	2.70	0.370530
enclav1	2.69	0.372369
uemoa	1.74	0.575117
froncom	1.66	0.601803
Log_PotVin_i	1.62	0.615746
Log_dist	1.60	0.624523
Log_PotVin_j	1.60	0.624885
exportuemoa	1.52	0.659380
invespriv_i	1.39	0.718818
partbugagr~i	1.39	0.718957
partbugagr~j	1.39	0.720895
invespriv_j	1.32	0.757566
tec_cedeao	1.17	0.858011
Mean VIF	1.90	

Source: Authors