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RESEARCH ARTICLE

Institutional Quality and Intra-Regional Trade Flows: Evidence from ECOWAS

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Abstract
Since institutional quality can either create or destroy incentives for individuals to engage in trade, it has become a source of worry to policymakers, as it can limit both intra- and extra-regional trade. Based on this, we empirically analyzed the extent to which national institutional quality affects bilateral trade flows in ECOWAS based on a gravity model for the period from 2000 to 2018. Specifically, the study employs the negative binomial pseudo-maximum likelihood estimator (NBPML). The results reveal that institutional variables with both aggregated and disaggregated measures of the quality of institutions have a significant and positive impact on trade flows in ECOWAS and on its sub-samples, WAEMU and WAMZ. The results further indicate that for both importing and exporting countries, reduced corruption, effective rule of law, and effective government coincide with more trade among member countries. The degree of regional integration is an important determinant of intra-ECOWAS trade, as are GDP, GDP per capita, common language, and landlockedness.

Keywords Institutions · Bilateral trade · Gravity model · NBPML · ECOWAS

Abbreviations

ARII	Africa Regional Integration Index
ASEAN	Association of South East Asian Nations
AUC	African Union Commission
AfDB	African Development Bank
CEMAC	Central African Economic and Monetary Community
CEN-SAD	Community of Sahel-Saharan States
CEPII	Centre d'Etudes Prospectives et d'Informations Internationales
COMESA	Common Market for Eastern and Southern Africa
Dist	Distance
DOT	Direction of trade
EAC	East African Community

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ECA	Economic Commission for Africa
ECCAS	Economic Community of Central African States
ECOWAS	Economic Community of West African States
ETLS	ECOWAS Trade Liberalization Scheme
EU	European Union
FEM	Fixed-effects model
FE-NBPML	Fixed-effects negative binomial pseudo-maximum likelihood
GDP	Gross domestic product
GDPPC	Gross domestic product per capita
H–O	Heckscher–Ohlin
HT	Hausman–Taylor
IMF	International Monetary Fund
INST	Institutional quality
IRS	Increasing returns to scale
Lang	Language
MFN	Most favored nations
NB	Negative binomial
NBPML	Negative binomial pseudo-maximum likelihood
PPML	Poisson pseudo-maximum likelihood
REC	Regional economic community
REM	Random effect model
ROT	Road networks to total population
RTI	Intra-region trade integration index
SADC	Southern African Development Community
TIVs	Time-invariant variables
UNCTAD	United Nations Conference on Trade and Development
UNECA	United Nations Economic Commission for Africa
WAEMU	West African Economic and Monetary Union
WAMZ	West Africa Monetary Zone
WDI	World Development Indicators
WGI	World Governance Indicators
WITS	World Integrated Trade Solution
WTO	World Trade Organization
ZIPML	Zero-inflated pseudo-maximum likelihood

1 Introduction and Research Issues

The role of institutions in international trade and how they affect economic prosperity are well recognized in the literature (see Kuncic, 2013; Araujo et al., 2016; Bilgin et al., 2018; Álvarez et al., 2018). Attaining high levels of trade and economic transactions requires an effective legal and economic environment (UNECA, 2009). The quality of governance and the extent of familiarity with the resulting framework of rules and norms affect the cost of doing business between any two countries (de Groot et al., 2004). The uncertainties associated with the decisions to export or import depend to a large extent on unobservable trade costs arising from negotiating and enforcing contracts, and invariably affect the volume of trade flows (Deardorff, *Local Comparative Advantage: Trade Costs and the Pattern of Trade*, 2001, unpublished). As a result, the quality of institutions can influence the course

of international trade. According to a World Trade Organization report (2004), institutional quality can incentivize or disincentivize engagement in trade. High institutional quality, such as the efficient rule of law and good endowment of informal institutions, is expected to promote trade (Yu et al., 2015). Conversely, inefficient institutions that are subject to corruption, time-consuming bureaucratic procedures, or an ineffective legal system represent a cost factor for domestic exporters. As such, poor institutional quality lowers international competitiveness, with negative repercussions on trade (Bigsten et al., 2000; Karam & Zaki, 2016).

The quest to improve trade outcomes among countries in West Africa and foster cooperation and integration among its member states led to the formation of the Economic Community of West African States (ECOWAS) in 1975, ratified by the Treaty of Lagos. A revised ECOWAS treaty of 1993 and the broad-based ECOWAS Trade Liberalization Scheme (ETLS) (Diop et al., 2008; Shuaibu, 2015) have since followed. At the heart of ECOWAS is trade and market integration through the formation of a customs union designed to bring about rapid growth and development for member states. The creation of an economic union, however, requires that the domestic economic institutions and the process of regional integration reinforce each other (Ojeaga et al., 2014). Consequently, ECOWAS trade policy had been geared towards increasing intra-regional commerce, raising trade volume, and galvanizing economic activities within the region in a way that makes it impactful on the economic well-being of ECOWAS citizens (ECOWAS, 2016). Anecdotal evidence shows that additional efforts to reduce trade barriers, specifically tariffs, in the twenty-first century may have brought further improvements among ECOWAS countries (Arbache et al., 2008). According to Oyejide et al. (1999), joining a regional integration framework was a significant stimulus for trade liberalization in many countries in sub-Saharan Africa that are members of ECOWAS. This arrangement is likely to foster intra-regional trade. Nigeria (followed closely by Côte d'Ivoire) accounts for about 20–30% of ECOWAS intra-regional exports, and Côte d'Ivoire's intra-regional imports are the highest in the ECOWAS region. However, intra-ECOWAS trade flows have remained relatively low, albeit with fluctuations, despite the deployment of several policy prescriptions (Shuaibu, 2015). One of the reasons advanced for the weak trade performance in Africa (including ECOWAS member states) is that the continent has concentrated more on the removal of trade barriers but less on the development of the productive capacities necessary for trade (UNCTAD, 2013). While the removal of trade barriers is undoubtedly important, it can only have the desired effect on trade flows if it is complemented by the infrastructure and institutional quality required to boost trade.

Even though ECOWAS members have made a big push towards reforming their regulatory frameworks to take advantage of trade liberalization, most West African countries still share common challenges related to facilitating trade. Many member countries are still characterized by poor institutional frameworks that cannot adequately allow implementation of policies that will ease the movement of persons and products within the sub-region (Olayiwola et al., 2011). The prevalence of institutional barriers such as inefficient trade-related regulations and corruption has hampered trade in the sub-region. According to the WTO (2004), the major bane of Africa's development (particularly the continent's poor trade) is poor governance. Most ECOWAS countries are characterized by poor institutional quality, weak rule of law, the absence of accountability, tight controls over information, and high levels of corruption (Osman et al., 2011). For example, according to World Governance Indicators (WGI) average measures from 2000 to 2018, Cape Verde was the best performer in ECOWAS in terms of controlling corruption perception, while Guinea-Bissau was the worst. In terms of government effectiveness, Cape Verde, Ghana, and Senegal maintained their lead with average values of

0.2, − 0.09, and − 0.31, respectively, whereas Liberia, Togo, and Guinea-Bissau were the three weakest performers in the region, with average values of − 1.41, − 1.29, and − 1.26, respectively. Cape Verde (0.56) had the highest perception of the rule of law, followed by Ghana (− 0.01) and Senegal (− 0.17) in that order, with Guinea-Bissau, Guinea, and Liberia trailing at − 1.37, − 1.35, and − 1.24, respectively.

Against this background, pertinent questions arise. Does institutional quality affect the volume of trade? If so, what institutional factors facilitate or hinder the effectiveness of intra-regional trade in ECOWAS? And to what extent has intra-regional trade integration promoted trade in ECOWAS? Our study seeks answers to these questions and contributes to the existing literature on intra-regional trade in the following ways:

First, although research has shown that more trade coincides with better institutions, the debate in Africa about the quality of institutions as determinant factors for intra-regional trade is still in its infancy. So far, this debate has been limited to advanced and emerging countries or regions where institutional quality is regarded as strong. Our study is aimed at providing more empirical evidence on the impact of institutional quality on trade, with a focus on intra-regional trade in ECOWAS at both aggregated and disaggregated levels, using a gravity model. Second, while some notable studies, such as Olaifa and Jimoh (2020) and Gammadigbe (2021) have recently attempted to show why institutional quality matters for explaining intra-regional trade in West Africa, these studies use dummy variables to capture the various aspects of regional integration in West Africa. Our study is unique in that we calculate a measure of regional integration to capture the degree of regional cooperation and integration in ECOWAS, based on the methodology for calculating the Africa Regional Integration Index (ARII) jointly developed by the AUC, AfDB, and ECA (2016). Finally, we employ a negative binomial pseudo-maximum likelihood estimator (NBPML). This is in contrast to many previous empirical studies that have used the fixed-effects (FE) model, which fails to account for time-invariant variables, or the Hausman–Taylor method, which only works well if the instruments are uncorrelated with the errors. Santos-Silva and Tenreyro (2006) suggested the application of the Poisson pseudo-maximum likelihood (PPML) estimator to estimating gravity models because it gives consistent parameters, is robust to different forms of heteroskedasticity, and can technically deal with zero trade flow data. However, the method's major drawback is that, in the case of many zeros, the number of observed zero flows tends to exceed the number of zero flows predicted by the model. Our method is superior because it produces consistent parameters that are resistant to both heteroskedasticity and zero flows.

The paper unfolds as follows: Section 2 presents stylized facts about the economic background of ECOWAS. Section 3 reviews the literature on institutions and trade. Section 4 describes the theoretical framework and methodology of the study. Section 5 discusses the variables and data used in the empirical analysis, as well as their sources. Section 6 discusses the empirical results, and Sect. 7 summarizes the findings and concludes the study.

2 ECOWAS's Intra-Regional Trade Performance and Institutional Quality

2.1 Intra-Regional Trade Performance of ECOWAS

This section examines the extent of ECOWAS intra-trade performance vis-à-vis other regional economic communities (RECs) in sub-Saharan Africa. As shown in Fig. 1, the value of intra-ECOWAS exports has increased since 2000, but progress in this regard

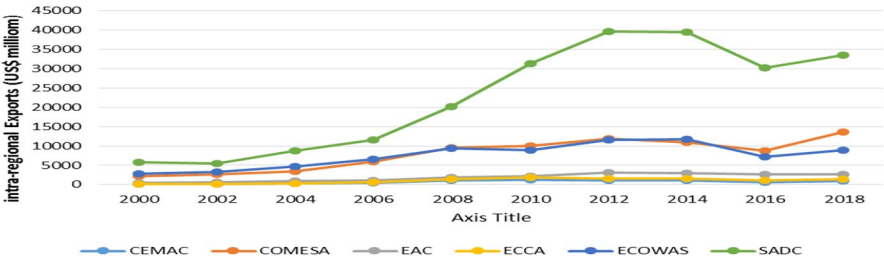

Fig. 1 ECOWAS intra-regional exports: 2000–2018 Source: Data obtained from UNCTADstat (2019)

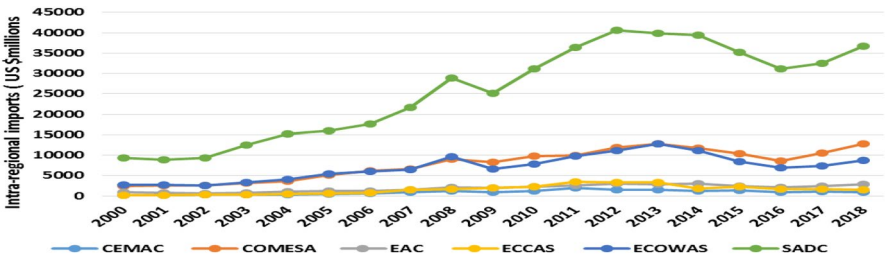

Fig. 2 ECOWAS intra-regional imports: 2000–2018 Source: Data obtained from UNCTADstat (2019)

slowed down from the end of 2014 to 2016, after which it picked up again. Except for SADC, intra-regional exports in ECOWAS grew faster than those of other RECs, though marginally with respect to COMESA.

A similar observation is made about intra-regional imports (Figure 2). Thus, Figures 1 and 2 show that intra-regional imports and exports in ECOWAS are far below those in SADC, though they are comparable to those in COMESA, while being both larger and growing faster than in the other RECs.

Intra-regional trade can be more pronounced and more revealing when presented as a share of trade volume, in terms of the proportion of exports and imports in total exports and total imports, respectively, and in overall trade, as shown in Table 1. Since 2000, intra-ECOWAS trade shares (exports and imports) generally lagged behind those of SADC and EAC, but outperformed CEMAC, COMESA, and ECCAS.

The trends in intra-regional trade flows within the ECOWAS region across all member states are highlighted in Table 2. Intra-regional trade was uneven across the countries in ECOWAS from 2000 to 2018. For instance, Nigeria (followed closely by Côte d'Ivoire) accounted for most intra-regional trade in terms of exports since 2000, but Nigeria was overtaken by Côte d'Ivoire in 2016. This might be the offshoot of the crash in the international price of crude oil that occurred from mid-2014 through 2016, as the country relies heavily on this single commodity for the bulk of its revenue and as a source of foreign exchange. Most countries in ECOWAS generally improved their intra-regional exports, although with a low share. In terms of intra-regional imports, Côte d'Ivoire generally had the highest shares during the 2000-2018 period. Cabo Verde clearly came in with the lowest shares, likely due to the country's high dependence on tourism.

Table 1 Intra-Regional Trade in ECOWAS and SSA REC: 2000–2018

	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018
(a) Intra-regional exports as a proportion of total exports										
CEMAC	1.23	1.98	1.68	1.61	2.63	3.40	2.27	2.71	3.57	2.91
COMESA	6.20	7.23	5.82	6.51	6.47	7.44	7.86	9.74	9.99	11.92
EAC	17.82	18.40	19.36	16.83	18.93	18.62	21.02	21.19	19.76	18.74
ECCAS	0.83	1.15	0.98	1.04	1.27	2.02	1.23	1.45	1.92	1.76
ECOWAS	9.32	10.84	8.90	8.38	8.86	7.63	7.45	8.02	10.42	8.15
SADC	12.20	12.51	11.92	10.38	11.82	17.96	18.28	19.29	20.91	17.89
(b) Intra-regional imports as a proportion of total imports										
CEMAC	3.31	4.73	5.05	5.63	6.83	6.01	5.91	3.98	5.64	5.15
COMESA	5.59	5.76	5.58	6.71	6.03	6.22	5.93	5.70	5.21	6.51
EAC	13.87	10.08	11.34	8.01	8.29	8.29	8.16	7.38	6.95	7.71
ECCAS	2.19	2.79	2.55	3.65	3.76	4.97	5.60	2.58	4.42	3.54
ECOWAS	13.46	12.73	12.21	11.67	10.81	9.39	10.63	9.84	8.35	8.83
SADC	20.48	20.32	19.23	16.25	18.17	20.24	20.36	19.33	21.30	20.91
(c) Intra-regional exports as a proportion of total trade										
CEMAC	0.85	1.19	1.18	1.17	1.88	2.15	1.43	1.57	1.86	1.83
COMESA	2.80	3.19	2.79	3.24	3.21	3.43	3.40	3.45	3.46	4.41
EAC	5.33	6.55	6.72	5.03	5.44	5.52	5.91	5.34	6.02	5.23
ECCAS	0.57	0.70	0.66	0.77	0.91	1.36	0.83	0.89	1.11	1.17
ECOWAS	5.54	6.50	5.49	5.03	4.82	4.44	4.44	4.51	4.73	4.27
SADC	6.19	6.12	5.74	5.24	6.13	9.54	9.52	9.66	10.41	9.24
(d) Intra-regional imports as a proportion of total trade										
CEMAC	1.89	1.49	1.53	1.95	2.20	2.19	1.67	2.71	1.92	1.03
COMESA	3.22	2.91	3.37	3.04	3.35	3.37	3.69	3.41	4.10	3.07
EAC	6.49	7.41	5.62	5.90	5.83	5.86	5.52	4.84	5.56	9.72
ECCAS	1.08	0.83	0.96	1.07	1.62	1.83	1.00	1.87	1.20	0.69
ECOWAS	5.09	4.68	4.66	4.93	3.93	4.30	4.31	4.56	4.21	5.47
SADC	10.38	9.97	8.05	8.75	9.49	9.75	9.65	10.69	10.11	10.10

Source: Data obtained from UNCTADstat (2019)

2.2 Institutional Quality/Governance Indicators of Countries within ECOWAS

This section presents and reports some indicators of institutional quality in ECOWAS. Table 3 shows the average score index of perceptions on corruption, government effectiveness, the rule of law, and regulatory quality for the period from 2000 to 2018 on a scale from − 2.5 (worst) to 2.5 (best) based on World Governance Indicators (WGI) criteria.

Table 3 shows that Cape Verde is the best performer in terms of corruption control, with a positive index of 0.79, distantly followed by Ghana (− 0.15) and Senegal (− 0.21). By contrast, the three worst performers are Guinea Bissau (− 1.02), Nigeria (− 1.17), and Guinea (− 1.23) in that order. Similarly, with respect to government effectiveness, Cape Verde, Ghana, and Senegal maintained the lead with average values of 0.2, − 0.09, and − 0.31, respectively, while Liberia (− 1.41), Togo (− 1.29), and Guinea-Bissau (− 1.26) were the three weakest performers in the region. Perception of the

Table 2 Intra-ECOWAS Members' Exports and Imports as a proportion of Total Trade

	Exports							Imports						
	2000	2005	2010	2012	2014	2016	2018	2000	2005	2010	2012	2014	2016	2018
Benin	0.64	1.15	3.70	1.16	1.86	1.03	1.55	4.20	4.31	4.69	4.51	4.40	4.78	4.9
Burkina Faso	0.85	1.07	1.29	1.39	3.57	1.99	2.24	5.79	6.05	7.87	7.95	18.45	9.62	8.56
Cabo Verde	0.00	0.00	0.00	0.01	0.01	0.00	0.02	0.11	0.16	0.15	0.09	0.05	0.20	0.15
Côte d'Ivoire	30.43	31.92	31.57	24.29	25.91	24.88	29.87	27.80	29.39	31.53	26.48	26.92	21.79	26.02
Gambia	0.29	0.06	0.46	0.88	0.84	1.38	0.44	1.08	0.77	0.95	1.22	1.02	1.27	0.85
Ghana	4.79	7.90	5.91	15.80	9.97	15.15	9.47	20.90	12.88	2.97	8.10	3.28	4.91	10.77
Guinea	0.07	0.97	0.12	0.02	4.37	6.33	1.19	4.21	5.08	0.40	0.31	0.72	2.54	2.19
Guinea-Bissau	0.12	0.25	0.13	0.05	0.22	0.37	0.28	0.61	0.94	0.53	0.49	0.65	0.77	0.59
Liberia	0.18	0.21	0.21	0.19	0.46	0.64	0.39	2.40	1.83	1.04	1.25	1.40	0.78	1.51
Mali	6.37	2.00	2.37	2.65	0.90	4.53	2.48	12.14	13.21	24.04	15.67	13.14	22.31	15.42
Niger	3.14	1.73	0.91	3.28	3.12	2.05	2.19	3.93	4.09	3.62	3.11	3.77	4.74	3.96
Nigeria	45.85	39.67	41.33	37.45	34.92	23.29	36.60	3.08	9.67	3.52	5.03	8.79	11.86	8.89
Senegal	5.04	8.66	10.32	7.39	9.13	11.19	8.56	9.99	9.34	8.22	9.15	7.04	9.98	9.38
SierraLeone	0.07	0.05	0.05	0.14	0.21	1.88	0.18	1.48	0.87	8.64	14.95	8.37	1.51	4.73
Togo	2.16	4.36	1.63	5.30	4.49	5.29	4.53	2.28	1.39	1.83	1.70	2.00	2.93	2.03

Source: Computed using data from IMF Direction of Trade Statistics (2019)

Table 3 Quality of Institutions in ECOWAS: Averages, 2000–2018

Country	COC	GOE	RUL	REQ
Benin	−0.59	−0.49	−0.51	−0.43
Burkina Faso	−0.24	−0.60	−0.46	−0.25
Côte d'Ivoire	−0.86	−0.99	−1.11	−0.68
Cape Verde	0.77	0.10	0.51	−0.14
Ghana	−0.14	−0.08	0.04	−0.09
Guinea	−1.02	−1.05	−1.32	−0.98
Gambia, The	−0.60	−0.64	−0.45	−0.42
Guinea-Bissau	−1.26	−1.28	−1.32	−1.13
Liberia	−0.88	−1.37	−1.18	−1.27
Mali	−0.66	−0.82	−0.45	−0.45
Niger	−0.74	−0.73	−0.61	−0.58
Nigeria	−1.16	−1.03	−1.14	−0.88
Senegal	−0.19	−0.32	−0.16	−0.20
Sierra Leone	−0.86	−1.23	−0.99	−0.97
Togo	−0.89	−1.32	−0.85	−0.80
ECOWAS (average)	**−0.62**	**−11.86**	**−0.67**	**−0.62**

Source: computed by the author from World Bank World Governance Indicators (2019)

Note: *COC* represents corruption control; *GOE* symbolizes government effectiveness, *RUL* denotes rule of law while *REQ* represents regulatory quality

rule of law was highest in Cape Verde (0.56), followed by Ghana (−0.01) and Senegal (−0.17) in that order. At the same time, Guinea-Bissau, Guinea, and Liberia faltered most on average in terms of the rule of law, recording −1.37, −1.35, and −1.24 respectively. Ghana recorded the highest regulatory quality, followed by Cape Verde and Senegal, whereas Liberia, Guinea-Bissau, and Sierra Leone were the worst performers.

3 Literature Review

3.1 Theoretical Literature

A few studies have documented the importance of institutional quality for trade, offering both empirical and theoretical explanations for the link. Some have emphasized the impact of institutions on transaction costs in bilateral international trade within the context of a theoretically derived gravity model based on new trade theories of product differentiation and the classical Heckscher–Ohlin (H–O) theory of comparative advantage. H–O theory and, in particular, theories that focused on contract incompleteness and institutions can reveal how transaction and production costs affect comparative advantage. Hence, they uphold institutions as important factors that influence the patterns of comparative advantage among countries, just as traditional sources such as factor endowments or technology (Levchenko, 2004, 2007; Cowan & Neut, 2007; Nunn, 2007; Anderson & Young, 2006; Acemoglu et al., 2005; Iwanow, 2008; Ferguson & Formai, 2013; Nunn & Trefler, 2014).

Despite the above theoretical contributions, which are rooted in traditional trade theories, the association between institutions and trade has benefitted from different theoretical models linking institutional factors and trade. Araujo et al. (2016) provide a theoretical model to show how the dynamics of exporting firms are affected by the institutional differences in the importing country. They maintain that the stronger the institutions in the importing country, the greater the rate at which firms enter into a new export market with higher sales. Further, a firm's export growth in a foreign market is higher with less effective institutions in the foreign destination. Li and Samsell (2009) and Wu et al. (2012) asserted that the direction of the effect of governance on trade depends on the effectiveness of governance systems. Li and Samsell (2009) showed that a highly rule-based governance environment is relatively easy to trade with compared to countries with highly relation-based governance environments, while Wu et al. (2012) showed that apart from the rule-based and relation-based modes of impact on trade, family-based governance (or trade networks) also tends to be important for trade. Likewise, Segura-Cayuela (2006) and Stefanadis (2010) demonstrated that trade opening can deteriorate in countries with weak economic institutions and policies. In another line of argument, Creane and Jeitschko (2016) developed a model of how weak governance facilitates exports by raising the cost of production in the domestic country, and as such, reducing the marginal value of the product quality and consumer welfare. Consequently, barring trade policy barriers, domestic producers will look for market access in countries where institutions are stronger. This implies that while weak governance can penalize welfare, it also has the potential to increase trade (exports).

The above theoretical issues suggest that the institutional setup is an essential element in explaining the pattern of trade. Hence, a further extension of a trade model such as the gravity model, as used in this study to link institutional factors and trade, would be in order.

3.2 Empirical and Methodological Review

Anderson and Marcouillier's (2002) early work on bilateral trade volumes and institutional quality revealed a positive relationship between the two in a 48-country study. When all other factors are held constant, their findings show that a 10% increase in a country's transparency and impartiality index leads to a 5% increase in its volume. They came to the conclusion that low inter-country trade was due to institutional inefficiencies. De Groot et al. (2004) extended the gravity equation to examine the effect of institutions on trade flows by including proxies for institutional quality and institutional homogeneity among trade partners. They found that higher-quality formal institutions tend to correlate with more trade, and that having a similar institutional framework promotes bilateral trade. According to Anderson and Young (2006), a lack of contract enforcement may act as a tariff on risk-neutral traders, reducing trade.Koukhartchouk and Maurel (2003) examined the effects on trade patterns of joining international institutions such as the World Trade Organization (WTO) and the European Union (EU) by incorporating variables reflecting institutional quality into the analysis of potential trade effects for Central and Eastern European countries. Their findings demonstrate the importance of institutions for achieving European trade integration. According to Levchenko (2004), institutional differences can be a source of comparative advantage. He examined trade data from 177 countries and 389 industries and found that institutional quality influences cross-national trade. The study also revealed

that even when cross-interaction terms are included, the institutional content of trade remains unchanged. For 1990 to 2000, Meon and Sekkat (2008) investigated how different dimensions of the institutional framework affect total exports, manufactured goods exports, and non-manufactured goods exports in a panel of countries. They found that improving institutional quality increases a country's capacity to export manufactured goods.

In addition to the earlier work in the field of institutions and trade, the effects of institutional quality on international trade have been highlighted in recent trade literature, supporting the idea that better institutions and governments increase international trade flow. Álvarez et al. (2018) showed that institutional quality increases bilateral trade and that this effect increases over time. Francois and Manchin (2013) investigated the influence of institutional quality and infrastructure on bilateral trade patterns in a panel of 97 developed and developing countries using Poisson estimators over a number of years. According to their study, low institutional quality impedes market access for exports, with the negative impact being more pronounced in developing countries.

To determine the effects of institutional quality on bilateral trade, some authors have based their evaluations on country-specific institutional differences. De Mendonça et al. (2014) used a gravity model to investigate the effect of institutional differences between countries on agricultural product trade flows in a study that spanned 59 countries from 2005 to 2010. They found that country-specific institutional differences have a significant and negative impact on agricultural trade. Huyen et al. (2017) used fixed and random effects panel estimation methods from 115 economies to examine the effects of institutional quality on export patterns in six ASEAN countries from 2000 to 2012. Their findings indicate that higher institutional quality in ASEAN's trading partners significantly impacts the bloc's export performance. The legal structure of importers, the protection of property rights, and the freedom to trade internationally were also found to be important determinants in attracting more exports from ASEAN countries.

In another development, Soeng-Cuyvers (2006) used the Hausman–Taylor method to investigate the importance of domestic institutions in Cambodian export performance using an augmented gravity model and a panel dataset from 1996 to 2015. According to the findings, the rule of law has a significantly positive relationship with Cambodian exports. Furthermore, Murata (2018) examined the relationships between trade aid, institutional quality, and trade using an instrumental variable approach and a large country sample. The study found that trade aid has a significantly higher positive effect on trade when combined with a measure of institutional quality.

With respect to the methodology used in examining the link between institutional quality and bilateral trade flows, different approaches have been adopted, ranging from time series to panel and cross-sectional regression and gravity models. Others have adopted the use of econometrics to make projections and *ex ante* forecasts based strictly on past and actual data rather than endogenously derived figures. However, the gravity model stands out as an essential tool in empirical literature on international trade, insofar as other methods cannot account for time effects, country effects, and bilateral trade effects. The robustness of the gravity model in dealing with the these problems explains its extensive usage in the literature (including in this paper) in examining the impact of institutional quality on bilateral trade. Even though the gravity model was initially criticized as not having a theoretical foundation in economics, a myriad of studies have adopted this methodology, as evident in the over 75 reviewed papers on the gravity model by Kepaptsoglou et al. (2010) from 2000 to 2010. Anderson and van Wincoop (2002) showed that the gravity equation can be derived from a number of different international trade models, including

the Ricardian model, the Hecksher–Ohlin model, and new trade theories of economies of scale, monopolistic competition, and intra-industry trade.

In more recent trade discussions in Africa, some authors have specifically investigated the role of institutional variables on ECOWAS trade flows. Abban (2020) for instance employed the Poisson pseudo-maximum estimator to evaluate the impact of institutions on trade in ECOWAS using six institutional quality datasets in a related study. The study also looked into the impact of transportation infrastructure on trade in order to estimate an augmented gravity model of trade. According to the findings, two of the six indicators of institutional quality had positive and significant impacts on trade. Abban (2020)'s findings were consistent with those of Yu et al., (2015) and Álvarez et al. (2018), identifying substantial influences of the rule of law and regulatory quality variables on the promotion of international trade. Similarly, Olaifa and Jimoh (2020) used a modified Poisson model to investigate intra-regional trade determinants in ECOWAS and the Community of Sahel-Saharan States (CEN-SAD) for 1995 to 2018. The study revealed that various governance-related variables in either importing or partner countries influence imports within ECOWAS. Gammadigbe (2021) also examines how institutional variables contributed to the explanation of trade flows in West Africa between 1996 and 2018. The results, based on an augmented gravity model suggested that institutional quality in West Africa has a positive, significant, and long-term impact on trade.

Despite the fact that the above empirical findings largely support the notion that more trade coincides with a better institution, most of these findings are are on advanced and other emerging countries or regions where institutional quality is perceived to be strong. The discussion around the quality of institutions as determinant factors for intra-regional trade is still in its infancy for Africa in general and ECOWAS in particular. Hence, there is a need for further investigation, particularly concerning intra-regional trade in ECOWAS, where institutions are perceived to be weak. The present study advances the few on ECOWAS in particular, by using both aggregated and disaggregated data, as well as presenting results for the WAEMU and WAMZ areas.

4 Theoretical Framework and Methodology

4.1 Theoretical Framework

Anderson and van Wincoop (2003) made theoretical refinements to the traditional gravity model (i.e., the theory-based gravity model) by including multilateral trade resistance variables. According to Anderson and van Wincoop (2003), controlling for relative trade costs is required for a well-specified gravity model. Their theoretical findings show that bilateral trade is determined by relative trade costs. That is, the propensity of country *j* to import from country *i* is determined by country *j*'s trade cost towards *i* relative to its overall "resistance" to imports (weighted average trade costs) and the average "resistance" faced by exporters in country *i*—not simply by the absolute trade costs between countries *i* and *j* (Anderson & van Wincoop, 2003).

The "theory-based" gravity model (an improved conditional general equilibrium model) be presented as in different ways from the gravity equation of the following (Anderson and van Wincoop, 2003):

$$x_{ij} = \frac{y_i y_j}{y^w}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}, \tag{1}$$

where

$$t_{ij} = \left(Z_{ij}^m\right)^{\gamma m}, \tag{2}$$

and where x_{ij} is nominal exports from country i to j, y_i and y_j is the nominal income (GDP) of exporter i and importer j, respectively, y^w is nominal world income (total world GDP), t_{ij} is the bilateral trade costs, γ is the elasticity of substitution among goods, Π_i and P_j are outward and inward multilateral resistance variables, respectively. In addition, z_{ij}^m ($m = 1,\ldots, M$) is a set of observables to which bilateral trade frictions/barriers are related.

In its general formulation, the gravity equation has the following multiplicative form:

$$X_{ij} = KY_iY_jD_{ij}, \tag{3}$$

where X_{ij} represents the force of attraction at time t, Y_i and Y_i stand for two entity masses, D_{ij} stands for the distance between these two entities at time t, and K is a gravitational constant depending on the units of measurement for mass and force.

Equation (3) is used to provide a direct link between trade flows and trade barriers, while incorporating the relevant factors affecting trade flows. Susanto et al. (2011) noted that the purpose of using a gravity model for international trade flows is to determine the micro-economic foundations of trading partner countries or regions. In addition, they proposed that one of the characteristics of the model is its general validity, since it is equally applicable to any pair of countries. It is also symmetric because it provides the trade flows in both directions by changing the country i variables for the country j.

5 Methodology

5.1 Empirical Model

Given the multiplicative form of the gravity equation, the model is log-linearized to enable total exports from country i to j, written as follows:

$$\ln X_{ijt} = InK + \beta_1 InY_{it} + \beta_2 InY_{it} + \beta_3 \ln D_{ijt} + \beta_4 \ln \theta_{ijt} + \varepsilon_{ijt}, \tag{4}$$

where the inclusion of ε_{ijt} makes it estimable with regression methods, X_{ijt} is bilateral trade (exports) between countries i and j, Y_i and Y_j are the GDPs and economic size equivalent of countries i and j, respectively, D_{ijt} is the bilateral distance between the two countries, θ_{ijt} is used to allow for the inclusion of institutional quality (*inst*), as well as country-specific characteristics (e.g., landlockedness, *landlock*), country-pair characteristics (e.g., language, *lang*). The degree of trade integration among ECOWAS members is captured by intra-ECOWAS trade index (e.g intra-region trade integration index –*rti*), while the ratio of total roads network to total population (*rot*) is used to capture the state of road infrastructure in the region. Our estimable model for ECOWAS blocks, following the work of Álvarez et al. (2018) and Yushi & Begoro (2019) is given by Equ. 5.

$$\ln \exp_{ijt} = \beta_0 + \beta_1 \ln gdp\_x_{it} + \beta_2 \ln gdp\_m_{jt} + \beta_3 \ln gdppc\_x_{it} + \beta_4 \ln gdppc\_m_{jt} + \beta_5 \ln \text{dist}_{ijt} + \beta_6 \text{inst}\_x_{it} + \beta_7 \text{inst}\_m_{it} + \beta_8 \text{comm\_lang}_{ijt} + \beta_9 \text{landlock}\_x_{it} + \beta_{10} \text{landlock}\_m_{jt} + + \beta_{11} rti\_x_{it} + \beta_{12} rti\_m_{jt} + \beta_{13} rot\_x_{it} + \beta_{14} rot\_m_{jt} + \varepsilon_{ijt}. \quad (5)$$

In line with literature on regional and bilateral trade flows, dummies were used to proxy for common language Border, Lang, and landlock Landlock edness. These variables take a value of one (1) if the two countries have a common language and if the country is landlocked, and otherwise they take the value of zero (0). The measure of intra-regional integration (rti) is calculated using the Africa Regional Integration Index (ARII) jointly developed by the three continental institutions of Africa (AfDB, UNECA, and AUC) in 2016. The ARII focuses on five major regional integration components: trade integration, regional infrastructure, productive integration, the free movement of people, and financial integration and macroeconomic convergence. This study, however, focuses on trade integration in line with the mandate of our study. We estimate the *rti* for each ECOWAS member country, employing different formulae for the first three of the four components in the ARII methodology. The four components are: (1) the level of customs duties on imports index, (2) the share of intra-regional goods exports index, (3) the share of intra-regional goods imports index, and (4) the share of total intra-regional goods trade (percentage of total intra-REC trade) index. Each index is calculated as listed in equations (10–12) of Sect. 5.3.

5.2 Estimation Techniques

In estimating the log transformation of the gravity model, several estimators have been proposed. The choice of the method of estimation is critical for the interpretation of the coefficients of the model and depends on the underlying advantages of each estimator (Egger, 2002; Greenaway and Milner, 2002). The fixed-effects model (FEM) and random-effects model (REM) have been widely used. However, the FEM cannot accommodate time-invariant variables (TIVs) such as distance and common language in the common effects regression. The REM has a possible drawback in that it requires that unobserved heterogeneity obey some probability constraints (Greene, 2003; Wooldridge, 2002) while imposing strict exogeneity of orthogonality between explanatory variables and disturbance terms (Mundalk, 1978). When there is endogeneity among the regressors on the right-hand side, random-effects estimators are substantially biased and may yield to misleading inferences (Baltagi et al., 2003). The proposed solution to the bias of the random-effects model in the presence of correlation between the individual effects and the regressors is the Hausman–Taylor (HT) estimator (Hausman & Taylor, 1981). The HT estimator strategy is based on an instrumental variable estimator which uses both between- and within-variation of the strictly exogenous variables as instruments (Baltagi et al., 2003; Hausman & Taylor, 1981). The drawback is that the HT estimator can only work well if the instruments are uncorrelated with the errors and unit effects, while highly correlated with the endogenous regressors. Although the choice of strictly exogenous variables is a testable hypothesis, it is often not a trivial task.

To overcome the difficulties linked to panel data models with unit effects, this study employs a variant of the Poisson regression model known as negative binomial pseudo-maximum likelihood (NBPML). The advantage of this model is that it can handle situations where there are zero values of the dependent variable, and where the number of

observed zeroes exceeds the number of zeroes predicted by the model (Burger et al., 2009).

$$y_{ijt} = \exp(x_{ijt}\beta)\varepsilon_{ijt}, \tag{6}$$

$E\left[\varepsilon_i|x\right] = 1$; x_{ijt} denotes the explanatory variables of the gravity equation defined in Eq. (3) above; β is the parameters; and ε_{ijt} is a composite error term that contains the importer and exporter fixed effects, time effects, and the remainder of the error term.

The Poisson pseudo-maximum likelihood (PPML) estimates β by solving the following first-order conditions:

$$\sum_{i=1}^{n}\left[y_{ijt} - \exp(x_{ijt}\beta)\right]x_{ijt} = 0. \tag{7}$$

$E\left[y_{ijt}|x\right]$ given as $\exp(x_{ijt}\beta)$ is equal to the conditional variance $V\left[y_{ijt}|x\right]$, which imposes restrictions on the conditional moments of the dependent variable:

$$E\left[y_{ijt}|x\right] = \exp(x_{ijt}\beta) \propto V\left[y_{ijt}|x\right]. \tag{8}$$

However, the equidispersion assumption is unlikely to hold (Santos Sliver & Tenreyro, 2006; Martinez-Zarzaso et al., 2009) as the estimator does not fully account for the presence of heteroscedasticity in the model. In other words, the estimator does not fully take account of the presence of unobserved heterogeneity caused by unobserved trade costs, thus making the conditional variance greater than the conditional mean.

Because the Poisson model's equidispersion assumption does not always hold, the negative binomial (NB) model is used instead to deal with the occurrence of overdispersion in the dependent variables (Burger et al., 2009). The negative binomial probability distribution function for y can be assessed by solving the following conditions, in line with Wineman (2008):

$$\Pr(Y = y_i|\mu_i, \alpha) = \frac{\Gamma(\alpha + y_{ijt})}{\Gamma(\alpha)\Gamma(y_{ijt}+1)}\left(\frac{\alpha}{\alpha + \exp(x_{ijt}\beta)}\right)^{\alpha}\left(\frac{\exp(x_{ijt}\beta)}{\alpha + \exp(x_{ijt}\beta))}\right)^{y_{ijt}}, \tag{9}$$

5.3 Definitions and Measurement of Variables

The fundamental variables used in this study are consistent with those in a number of other related studies. In what follows, we discuss these important variables.

i. **Bilateral trade (*exp*):** Following several studies (Longo & Sekkat, 2004; Musila, 2005; Salisu et al. 2013), this study adopts bilateral exports as the dependent variable, which is obtained from World Integrated Trade Solution (WITS). Opinion remains divided as to whether imports, exports, or both should be used to capture trade flows. Elbadawi (1997) is indifferent to using imports or export and argued that both are influenced by the same factors. Jugurnath et al. (2007) noted that imports more closely proxy the effects of domestic trade.
ii. **Gross domestic product (*gdp*):** The GDPs of trading partners largely represent the productive and consumption capacity that determines the trade flow between them. The economic size of countries is usually measured by GDP, and in a gravity model

it is expected that it significantly influences trade flows between trade partners. Thus, as the GDP of any two or more trading countries increases, trade flows also increase between them, $\beta_1$and β_2 in Eq. (3) are expected to be positive. The data on GDP are obtained from World Governance Indicators (2019).

iii. **GDP per capita (*gdppc*):** This is used to indicate the stage of development of countries and allows us to compare the prosperity of ECOWAS countries with different population sizes. Frankel (2010) points out that rich countries tend to trade more than poor ones simply because they also tend to be more open to trade. However, in our case, GDP per capita is included to test the effect of the proclaimed similarity of factor endowment on trade in ECOWAS. As the GDP per capita of any two or more trading countries increases, bilateral trade flows are expected to increase between them, such that β_3 and β_4 in Eq. (3) are anticipated to be positive. The GDP per capita data are obtained from World Governance Indicators (2019).

iv. **Distance (*dist*):** This is used to capture the proxy for the trade cost, and it is commonly used for transportation costs between countries. Distance as a trading resistance factor represents trade barriers such as transportation costs, delivery time, cultural unfamiliarity, and market access barriers (Masron, et al., 2014). Shorter distance between countries encourages them to trade more than those who are farther apart, because of reduced transaction costs (Feenstra, 2016). Consequently, longer distance is expected to increase transportation costs, which in effect reduces bilateral trade, so $\beta_5 \beta_3$ is expected to be negative. The bilateral distance data are from CEPII.

v. **Institutional quality (*inst*):** For the purpose of this study and based on international trade flows literature, four variants of institutional qualities are discussed, as noted above: control of corruption (*corr*), government effectiveness (*govf*), rule of law (*rul*), and regulatory quality (*reg*). Although the Worldwide Governance Indicators (WGI) produced by the World Bank, following the work of Kaufmann et al. (2010), identified six dimensions for measuring good governance and institutions, there are four institutional qualities related to trade, as enunciated in the literature. According to the World Trade Organization (WTO, 2004), these variables are appropriate to be employed as institutional quality indicators in the context of trade. They can be expected to significantly affect the degree of uncertainty involved in trade and, therefore, transactions costs. According to Kaufmann et al. (2009), virtually all measures of governance are subjective, but perceptions matter because agents act based on these perceptions, impressions, and views, which form the basis for estimating the WGI. This obvious advantage and others are the key reason for the adoption of WGI over other institutional measures. It also makes the accompanying margins of error explicit, whereas in most other cases, they are ignored. Finally, the WGI is sufficiently informative in many cross-country comparisons to produce statistically significant differences in estimated governance. This demonstrates that governance can and does change over relatively short periods. Their extensive coverage and application allow for comparisons with existing literature. Zulkhibri and Ghazal (2017), Alter and Yontcheva (2015), and others have used WGI.

- Control of corruption: This measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as elite "capture" of the state. It measures, among other things, the level of irregular payments, the degree of corruption in administrations and companies, and the frequency of corruption in public institutions. It is assumed that corruption increases transaction costs and introduces a component of uncertainty

in economic transactions that hampers bilateral trade (World Governance Indicators, 2019).

- Government effectiveness: This captures the perception of the quality of public services, the quality of civil service and degree of independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies (World Governance Indicators, 2019). Competent and efficient bureaucracy can promote quick growth in trade and investment (World Governance Indicators, 2019).
- Rule of law: This captures the extent to which citizens have confidence in and abide by the rules of the society, in particular the quality of contract enforcement mechanisms, property rights, law enforcement against violent and organized crime, and judicial independence. It is a proxy for the overall quality of the legal system (World Governance Indicators, 2019).
- Regulatory quality: This captures the perception of a state's ability to formulate policies and implement sound policies and regulations that permit and promote private sector development (World Governance Indicators, 2019). It also refers to the extent to which government policies impede or promote market activities.

vi. **Language (*lang*):** There is common consensus in the literature that countries in former colonies were shaped, at least partially, by their colonization experience. Countries with a common language are expected to trade more with one another based on this level of affinity. So, we expect β_8 to be positive (i.e., $\beta_8 > 1$). The data on common language are from CEPII.

vii. **Landlockedness (*landlock*):** Countries that do not readily have access to the sea are regarded as landlocked countries. Trade is often debarred and transaction costs are relatively greater for most of these countries. Hence, β_9 and β_{10} are anticipated to be negative for both importers and exporters. The data on country's landlockedness are from CEPII.

viii. **Road networks to total population (*rot*):** This is used to capture the quality of road infrastructure. It is needed to ensure that the competitiveness in regional markets will not be compromised by the lack of good road infrastructure. In the current economic environment, overcoming geographic and road infrastructural obstacles that increase trade margins is more important for regional trade expansion. Improvements in road infrastructure reduce trade costs and widen trading opportunities. Hence, $\beta_{13}\,\beta_4$ and β_{14} are expected to be positively related to bilateral trade (i.e., β_{13}, $\beta_{14} > 1$).

ix. **Intra-regional trade index (*rti*):** *rti* is used to capture the impact of the degree of trade integration within the ECOWAS member countries with a view to tracking the progress of member countries toward shared regional integration goals. The more integrated the countries of a trading block are, the higher their trade volume. As such, the coefficients β_{11} and β_{12} of the exporters and importers are expected to be positive. The components that form the calculation of *rti* are as follows.

(1) **Index: level of customs duties on imports** where Country Results is a country's simple average of the tariff rate applied to the most favored nations (MFN), while Min and Max are respectively the minimum and maximum simple average of the tariff rate applied by ECOWAS countries to the MFN for each year.

The index is calculated from simple averages on the basis of imports from the REC. The higher the result for a country, the less the duty is liberalized.

Therefore, we deduct the result of the division from the value 1. The formula in calculating this index is:

$$\text{Index} = 1 - \frac{\text{Country Results} - \text{MinResult}}{\text{MaxResult} - \text{MinResult}}, \tag{10}$$

where Country Results is a country's simple average of the tariff rate applied to the most favored nations (MFN), while Min and Max are respectively the minimum and maximum simple average of the tariff rate applied by ECOWAS countries to the MFN for each year.

(2) **Index: share of intra-regional goods exports** where $\text{Country Results}_{\text{exp}\,orts}$ is a member country's share of intra-regional goods exports, while Min and Max respectively denote the minimum and maximum share of intra-regional goods exports in ECOWAS for each year.

This represent the value of intra-regional goods exports expressed as a percentage of the country's gross domestic product. The formula is given as:

$$\text{Index} = \left(\frac{\text{Country Results}_{\text{exp orts}} - \text{MinResult}_{\text{exp orts}}}{\text{MaxResult}_{\text{exp orts}} - \text{MinResult}_{\text{exp orts}}}\right), \tag{11}$$

where $\text{Country Results}_{\text{exp}\,orts}$ is a member country's share of intra-regional goods exports, while Min and Max respectively denote the minimum and maximum share of intra-regional goods exports in ECOWAS for each year.

(3) **Index: Share of intra-regional goods imports**

This is the value of intra-regional goods imports expressed as a percentage of the country's gross domestic product. The formula used to calculate this is given as:

$$\text{Index} = \left(\frac{\text{Country Results}_{\text{imports}} - \text{MinResult}_{\text{imports}}}{\text{MaxResult}_{\text{imports}} - \text{MinResult}_{\text{imports}}}\right), \tag{12}$$

where $\text{Country Results}_{\text{imports}}$ is the country's share of intra-regional goods imports, while Min and Max respectively denote the minimum and maximum share of intra-regional goods imports in ECOWAS for each year.

In the final part of the calculation of *rti*, each country's intra-regional goods trade index is calculated as an average of the indices obtained from Eqs. (10–12). The *rti* is estimated using data from the International Monetary Fund (IMF) Direction of Trade (DOT) statistics. The exception is the data for estimating the level of customs duties on imports, i.e., the tariff rate applied to the MFN, which is obtained from the World Development Indicators (WDI). The range of the index is between 0 and 1, and values closer to 1 indicate that an economy is highly integrated to its trade bloc.

A summary of the variables and their sources is presented in Table 8 in the appendix. The list of the 15 members of ECOWAS covered is presented in Table 9 in the appendix. The period used for the econometric analysis ranges from 2000 to 2018. The choice of this period is due to the availability of data and also to bring the bilateral export trade data closer to the year in which the index of World Governance Indicators was constructed (i.e., 1996).

6 Empirical Results

6.1 Descriptive Statistics

We first examine the characteristics of the variables used. Table 10 of the appendix reports summary statistics of the mean value, the standard deviation, and the minimum and maximum value associated with the actual value of the different variables used in the study, for both the panel of all countries in ECOWAS and the two sub-ECOWAS divisions (WAEMU and WAMZ).

6.2 Analysis of Intra-regional Exports using Aggregate Institutional Quality

The results in Table 4 present the aggregate estimates for the ECOWAS, WAEMU, and WAMZ country groups using the aggregate average value of the four measures of institutional quality. The rationale for the sub-sample analysis is that aggregating all ECOWAS countries together in an analysis may result in biased estimates, as institutional setups differ across these countries and may affect trade volume. To avoid this, the ECOWAS region was grouped into two sub-regions (i.e., the West African economic and integration organizations known as WAEMU) and the West Africa Monetary Zone (WAMZ). The former is made up of French-speaking countries, while the latter is made up of English-speaking countries. WAEMU has a very strong monetary union, which may help its trading activities, whereas WAMZ does not. As a result, a disaggregated approach is used to examine the differential impact of institutional setup in each of WAEMU and WAMZ on their trade separately.

To control for unobserved heterogeneity between country pairs and to account for importer-specific fixed effects, the fixed-effect NBPML in columns 2, 4, and 6 are interpreted in each of the models. Most of the explanatory variables are statistically significant at the 1% confidence level. Economic size and the level of development in terms of the GDP and per capita GDP of exporters and importers, in addition to bilateral distance, institutional quality, common official language, landlockedness, and intra-regional trade integration, were found to be significant determinants of bilateral trade in ECOWAS. However, in the case of WAEMU and WAMZ, the ratio of total road networks to total population appears as an important determinant of trade within the country groups. In the full sample estimates, only the GDP per capita of importers fails to conform to the theory. In the sub-samples estimates, the GDP per capita of both exporters and importers for WAEMU and the GDP of exporters and per capita GDP of importers are inconsistent with the expected signs in the case of WAMZ.

The FE-NBPML estimates in columns 2 and 4 show significant positive impact of the GDP of exporters and importers on bilateral exports among ECOWAS and WAEMU. For ECOWAS, the GDP of importers has a greater impact than that of the exporters, thus predicting the differing impact on bilateral exports. Specifically, the elasticity coefficient of the GDP of importers is 0.31%, indicating that holding other factors constant, a 1% increase in the economic size of importers stimulates bilateral exports in the ECOWAS region by 0.3%, while a 1% increase in the economic size of exporters only raises bilateral exports by 0.25%. The implication of this result is that members strictly depend on primary products at the ECOWAS level and cannot turn these products into semi-finished or finished goods. This therefore limits their exports capacity both intensively and extensively. Rather, they tend to import these products from members with comparative advantage using advanced

Table 4 Analysis of intra-regional exports using aggregate institutional quality;

	Full sample (ECOWAS)		Sub-sample (WAEMU)		Sub-sample (WAMZ)	
	NBPML	FE-NBPML	NBPML	FE-NBPML	NBPML	FE-NBPML
	(1)	(2)	(3)	(4)	(5)	(6)
	Exp	Exp	Exp	Exp	Exp	Exp
lngdp_x	1.292*** (0.081)	0.249*** (0.035)	4.190*** (0.163)	1.557*** (0.123)	0.811*** (0.281)	−0.281** (0.117)
lngdp_m	0.744*** (0.073)	0.311*** (0.030)	0.714*** (0.083)	0.356*** (0.036)	0.576*** (0.173)	0.247*** (0.053)
lngdppc_x	0.502** (0.229)	0.107 (0.094)	−4.497*** (0.388)	− 1.517*** (0.242)	2.083** (0.926)	1.870*** (0.370)
lngdppc_m	−0.046 (0.189)	−0.311*** (0.076)	0.121 (0.199)	−0.536*** (0.093)	1.290*** (0.482)	−0.563*** (0.143)
lndist	−1.759*** (0.089)	−0.481*** (0.031)	−2.039*** (0.122)	−0.446*** (0.040)	−2.604*** (0.190)	−0.262*** (0.058)
inst_x	1.635*** (0.248)	1.041*** (0.081)	1.568*** (0.294)	0.370*** (0.134)	1.664*** (0.390)	0.606*** (0.148)
inst_m	−0.162 (0.176)	0.530*** (0.070)	0.889*** (0.176)	0.599*** (0.082)	−0.190 (0.420)	0.644*** (0.137)
comm_lang	0.651*** (0.148)	0.658*** (0.047)	0.954*** (0.154)	0.413*** (0.067)	0.823*** (0.267)	0.203** (0.099)
landlock_x	0.671*** (0.230)	−0.219*** (0.076)	−2.665*** (0.271)	−1.658*** (0.134)	–	–
landlock_m	0.519*** (0.180)	−0.086 (0.070)	0.576*** (0.196)	0.103 (0.083)	0.000 (0.392)	−0.673*** (0.148)
rti	3.496*** (0.399)	1.606*** (0.144)	4.421*** (0.564)	3.604*** (0.297)	−1.384 (0.952)	0.217 (0.262)
rot_x^2	−0.932** (0.408)	0.247 (0.156)	1.478*** (0.457)	0.731*** (0.198)	−3.156*** (0.882)	0.891* (0.467)
rot_m^2	−0.822* (0.421)	0.035 (0.146)	−1.822*** (0.421)	0.138 (0.170)	−2.004** (0.885)	0.061 (0.301)
_cons	−31.286*** (2.332)	− 10.674*** (0.974)	−61.933*** (3.566)	−29.879*** (1.987)	−28.417*** (4.180)	−8.453*** (1.550)
lnalpha:_cons	2.410*** (0.025)		1.809*** (0.032)		2.787*** (0.045)	
Obs	3989	3723	2128	2128	1595	1329
Pseudo R^2	0.038	.z	0.044	.z	0.048	.z

Source: authors computation from Stata 15 package

Standard errors are in parenthesis. ***$p<0.01$, **$p<0.05$, *$p<0.1$

technology. For WAEMU, the elasticity coefficient shows that a 1% increase in the economic size of exporters raises bilateral exports by 1.6% while increasing the economic size of importers only raises bilateral imports by 0.4%. These results are very close to that of Salisu and Ademuyiwa (2013), who found that an increase of about 1.7% in WAEMU intra-regional trade is accounted for by a 1% increase in the economic size of exporters. In the case of the WAMZ, however, the estimates reveal a significant negative coefficient of GDP of exporters, whereas this is positive for that of the importers on bilateral exports. This also indicates that country groups in the WAMZ export fewer of those commodities, that they have a comparative disadvantage, and that the smaller the economic size of exporting countries in WAMZ, the less they turn out.

GDP per capita measures a country's level of development, and its estimates for exporters and importers with respect to trade among WAEMU members were found to be negative and statistically significant in explaining their bilateral exports, with exporters' per capita GDP having a greater impact than that of the importers. This is unlike the case of the WAMZ, with exporters' per capita GDP having a positive impact and importers having a significant negative coefficient. Overall, this indicates that majority of countries under the WAEMU—with exception of Côte d'Ivoire and Senegal—are classified as low-income countries (LICs). By implication, the low level of development of these countries (either as exporters or importers) hinders the export volume of the WAEMU. Comparatively, this is low relative to exporting countries under the WAMZ. Across the specifications, the development level of all the importing countries is low, implying that about 73%, 75%, and 67% of ECOWAS, WAEMU, and WAMZ country groups, respectively, are classified as low-income countries.

The estimates in Table 4 also show the role of geographical distance as a determinant of bilateral exports. Bilateral distance across the specifications is found to be negative and statistically significant in explaining bilateral exports in the ECOWAS, WAEMU, and WAMZ country groups. As shown in columns 2, 4, and 6, it is clear that the issue of bilateral distance is more pronounced for trade within ECOWAS (elasticity of 0.481) relative to that of WAEMU (elasticity of 0.446) and WAMZ (elasticity of 0.262). Regarding the aggregate measure of the institutional variable, the quality of institutions shows a significantly positive impact on the export flows of the exporters in ECOWAS and its sub-samples. Better institutions tend to coincide with more trade between members. The fixed-effect NBPML results also confirm the significant positive effect of institutions on intra-regional trade in the ECOWAS region. These results also imply that similar levels of institutional quality between the importing and exporting countries of ECOWAS members play a significant role in their intra-regional trade.

With common language, the estimated bilateral exports rise in ECOWAS and in the sub-samples, confirming the noticeable patterns in the literature that countries with a common language tend to trade more with one another based on their colonial ties. The positive coefficients of the variables in the full sample and sub-samples conform to the apriori expectation. In both the full sample and sub-samples, exporting countries that are naturally landlocked found it difficult and more costly to engage in either regional or international trade. They trade less because they do not have access to the ocean and lack market accessibility. From the estimates in columns 2 and 4, the coefficients of landlockedness for exporting countries are negative and statistically significant for ECOWAS (−0.219) and WAEMU (−1.658). The results specifically indicate that a greater number of these landlocked countries belong to the WAEMU, thereby significantly reducing its exports volume more than others. Generally, the landlocked nature of some of ECOWAS members imposes higher costs of trading and thus inhibits trade relations with other regions. Also,

there is tendency for bilateral imports reduction among WAMZ members that are landlocked. This is shown in column 6, with a significant negative coefficient of landlockedness of importers.

With regard to the regional integration between member countries in ECOWAS, WAEMU, and WAMZ, the results show that during the period of study, strengthening intra-regional trade integration within the ECOWAS and WAEMU regions resulted in an increase in the volume of bilateral trade among the member countries in the region. This positive effect suggests that the degree of intra-regional trade cooperation in the WAEMU is higher and more vibrant than that of the WAMZ. This also suggests that the WAEMU is a strong force in intra-ECOWAS trade integration.

Additional increase in the available ratio of the total road networks to the total population is associated with lower costs of trading, as this leads to lower transportation cost and improved trading activities among the WAEMU and WAMZ country groups. From the estimates, the coefficient of the ratio of total road networks to the total population of exporters was found to be significantly positive for both the WAEMU and WAMZ. Conversely, the ratio total road networks to total population of importers under the WAEMU is negative and statistically significant. By implication, total exports of both WAEMU and WAMZ members could be improved if the ratio of their total road networks to total population is increased. It could also be hindered if importers, particularly, fail to make similar improvements.

6.3 Robustness Analysis

In order to check the robustness of the analysis above, the aggregate institutional quality was disaggregated. This allowed us to examine the individual effects of each dimension of the institutional quality measures on intra-regional trade in ECOWAS, WAEMU, and WAMZ. This is essential because of the differing institutional setups of the country groups.

6.3.1 Analysis of Intra-regional Trade in ECOWAS Using disaggregated Institutional Quality

The analysis of intra-regional exports with consideration to institutional quality at disaggregated levels among ECOWAS country groups is shown in Table 5. The results with respect to all indicators of institutions show that they are positive and have a significant impact on intra-ECOWAS trade. Low levels of corruption, compliance to the rule of law, regulatory quality, and government efficiency in both exporting and importing countries account for more than 30% of the trade within the region. Hence, institutional quality is an important determinant of intra-ECOWAS trade.

Based on the estimates presented in Table 5, the GDPs of exporters and importers play an important role in promoting trade relations between and among ECOWAS member countries. Across the specifications, however, the elasticity coefficient of importer GDP had a higher impact than that of the exporters. The results further indicate that ceteris paribus, a 1% increase in the economic size of importers stimulates bilateral exports in the ECOWAS region more than a 1% increase in the economic size of exporters in the region. From the estimates, it is also clear that the coefficient of importer GDP per capita across the specifications is shown to be negatively significant but positive for that of exporters. The fact remains that ECOWAS is dominated by French-speaking countries, constituting

Table 5 Analysis of intra-regional trade in ECOWAS using disaggregated institutional quality;

	FE-NBPML (1)	FE-NBPML (2)	FE-NBPML (3)	FE-NBPML (4)
	Exp	Exp	Exp	Exp
lngdp_x	0.284*** (0.037)	0.230*** (0.035)	0.154*** (0.034)	0.226*** (0.035)
lngdp_m	0.306*** (0.030)	0.304*** (0.029)	0.251*** (0.029)	0.313*** (0.029)
lngdppc_x	0.020 (0.099)	0.187** (0.093)	0.353*** (0.089)	0.289*** (0.089)
lngdppc_m	−0.237*** (0.080)	−0.212*** (0.074)	−0.125* (0.066)	−0.233*** (0.073)
Lndist	−0.508*** (0.031)	−0.489*** (0.031)	−0.446*** (0.032)	−0.504*** (0.031)
comm_lang	0.653*** (0.047)	0.661*** (0.047)	0.578*** (0.047)	0.617*** (0.047)
landlock_x	−0.252*** (0.079)	−0.168** (0.076)	−0.185** (0.075)	−0.063 (0.073)
landlock_m	−0.026 (0.072)	−0.035 (0.070)	0.017 (0.066)	−0.041 (0.068)
rti	1.554*** (0.145)	1.592*** (0.142)	1.427*** (0.145)	1.877*** (0.144)
rot_x^2	0.053 (0.158)	0.533*** (0.159)	0.116 (0.159)	0.277* (0.156)
rot_m^2	−0.037 (0.150)	0.133 (0.148)	0.081 (0.148)	−0.030 (0.147)
corr_x	0.891*** (0.080)			
corr_m	0.315*** (0.061)			
rul_x		0.702*** (0.064)		
rul_m		0.321*** (0.054)		
reg_x			1.146*** (0.085)	
reg_m			0.418*** (0.068)	
govf_x				0.764*** (0.073)
govf_m				0.437***
_cons	−11.288***	−11.740***	−10.226***	−12.043***
	(0.974)	(0.952)	(0.960)	(0.961)
Obs	3723	3723	3723	3723
Pseudo R^2	.z	.z	.z	.z

Source: Authors computation from Stata 15 package

Standard errors are in parenthesis. ***$p<0.01$, **$p<0.05$, *$p<0.1$

about 53% of ECOWAS members. The majority of the countries are low-income countries, thereby negatively affecting their bilateral trade relations.

From the estimates in Table 5, the bilateral distance across the specifications is shown to be negative and statistically significant for explaining bilateral exports in ECOWAS. This strictly follows the literature on the fact that only neighboring countries can easily trade with each other at relatively low transport costs, while trade between countries that are far from each other is hindered due to the associated high costs of trade. These findings are in consonance with other studies (Martinez-Zarzoso et al., 2009; Salisu & Ademuyiwa, 2013). The extent of intra-region trade integration appears to be significant for bilateral trade in ECOWAS, as reflected by its significant positive coefficient. With respect to landlockedness, the results also show that the coefficient for exporters is negatively significant across the specifications. This implies that landlocked countries' exports are greatly hampered because they do not have access to the ocean and other markets.

Table 6 Analysis of intra-regional exports in WAEMU using disaggregated institutional quality;

	FE-NBPML (1)	FE-NBPML (2)	FE-NBPML (3)	FE-NBPML (4)
	Exp	Exp	Exp	Exp
lngdp_x	1.482*** (0.122)	1.552*** (0.121)	1.550*** (0.120)	1.573*** (0.121)
lngdp_m	0.364*** (0.037)	0.359*** (0.036)	0.303*** (0.036)	0.357*** (0.036)
lngdppc_x	− 1.506*** (0.236)	− 1.463*** (0.240)	− 1.400*** (0.240)	− 1.517*** (0.236)
lngdppc_m	− 0.435*** (0.094)	− 0.509*** (0.092)	− 0.322*** (0.083)	− 0.442*** (0.089)
Lndist	− 0.462*** (0.041)	− 0.430*** (0.041)	− 0.441*** (0.041)	− 0.461*** (0.040)
comm_lang	0.408*** (0.067)	0.462*** (0.069)	0.344*** (0.066)	0.373*** (0.066)
landlock_x	− 1.651*** (0.132)	− 1.633*** (0.133)	− 1.612*** (0.134)	− 1.658*** (0.132)
landlock_m	0.162*	0.067	0.219***	0.158*
rti_x	3.563*** (0.294)	3.505*** (0.295)	3.575*** (0.297)	3.674*** (0.302)
rot_x2	0.560*** (0.206)	0.802*** (0.200)	0.766*** (0.203)	0.743*** (0.198)
rot_m2	0.070 (0.174)	0.264 (0.169)	0.171 (0.174)	0.088 (0.171)
corr_x	0.420*** (0.118)			
corr_m	0.331*** (0.068)			
rul_x		0.254** (0.113)		
rul_m		0.431*** (0.065)		
reg_x			0.175 (0.148)	
reg_m			0.498*** (0.081)	
govf_x				0.302*** (0.106)
govf_m				0.453***
_cons	− 29.111*** (2.020)	− 30.660*** (1.964)	− 30.919*** (1.932)	− 30.882*** (1.915)
Obs	2128	2128	2128	2128
Pseudo R^2	.z	.z	.z	.z

Source: Authors' computation from Stata 15 package

Standard errors are in parenthesis. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

6.3.2 Analysis of Intra-regional Exports in WAEMU Using Disaggregated Institutional Quality

The analysis of intra-regional exports with consideration to institutional quality at the disaggregated level among countries in the WAEMU is shown in Table 6. The respective specifications include each of the indicators that reflect the perceived quality of institutions in the WAEMU region. In general, differing between indicators and according to whether the country is an exporter or importer, the impact of all indicators of institutions on bilateral trade in the WAEMU is positive and statistically significant, except for the regulatory quality of importers. The results indicate that good institutional quality increases the level of trade among WAEMU member countries. Less corruption, compliance to the rule of law, and government efficiency in both exporting and importing countries account for over 25% of the intra-regional trade in the WAEMU. The WAEMU results also reveal that having a regulatory framework significantly promotes bilateral trade in importing countries. Thus, it appears that the effect of institutional quality on intra-WAEMU trade outcomes is large and highly significant. Further,

it appears that control of corruption has the largest effect with respect to exporting countries, while improvement in government effectiveness has the largest effect with regard to importing countries.

The estimates in columns 1–4 indicate that the GDP of both the exporters and the importers has a significant positive impact on the bilateral exports of WAEMU members, with the GDP of exporters having a greater impact than that of importers, thereby predicting a differing impact on bilateral exports. This result agrees with the findings of Salisu and Ademuyiwa (2013). Unlike GDP, the FE-NBPML estimates of GDP per capita for exporters and importers with respect to bilateral exports among WAEMU members were found to have a significant negative impact. From the estimates, it is clear across the specifications that exporter GDP per capita has a greater impact than that of importers, thus predicting a differing impact on bilateral exports.

In the literature, bilateral distance has mostly been used to proxy transport costs. According to Samuelson's (1952) concept of *iceberg* transport costs, long distance attracts higher costs of transporting goods, and vice versa, and neighboring countries can easily trade with each other, even with much lower transportation costs. This is obvious from the estimates: the majority of WAEMU members are far from one another and therefore incur higher costs of trading and a lower volume of trade between and among them. These findings are consistent with most gravity models estimated in the literature, showing that economic size and transport costs (measured by bilateral distance) are the main determinants of bilateral trade (Martinez-Zarzoso et al., 2009).

Common language due to the colonial heritage of the WAEMU members has a positive and significant influence on the bilateral exports of the member countries. This agrees with what was previously observed in the literature—that countries with a common language trade more with one another and that a common language is an impetus to intra-regional trade in regions. The estimates in Table 6 also show that, across the specifications, the coefficients of landlockedness for exporting countries are negative and statistically significant. This of course hinders bilateral exports among them, as some WAEMU members are landlocked. However, the estimates further show a significant positive impact of landlockedness for importing countries within the WAEMU. This indicates that even though these countries have no access to the ocean and lack market accessibility, the volume of bilateral exports between and among them could still be improved. This does not conform to the theory. This is because the degree to which landlocked countries engage in either regional or international trade is low.

The positive coefficient of the intra-WAEMU trade index emphasizes the extent of trade integration in the WAEMU. There is a considerable increase in WAEMU trade flows, with more integration in the area of bilateral trade. Intra-regional trade integration can have a significant impact on bilateral trade flows in the WAEMU. Similarly, across all specifications, columns 1–4 in Table 6 indicate that bilateral exports among WAEMU members increase as exporters improve their ratio of total road networks to total population.

6.3.3 Analysis of Intra-regional Exports in WAMZ using Disaggregated Institutional Quality

Following the same approach, the respective specifications of each indicator of the quality of institutions in the WAMZ region are reported in Table 7. The results are not too different from those for the WAEMU. In general, all institutional measures show a

Table 7 Analysis of intra-regional exports in WAMZ using disaggregated institutional quality;

	FE-NBPML (1)	FE-NBPML (2)	FE-NBPML (3)	FE-NBPML (4)
	Exp	Exp	Exp	Exp
lngdp_x	−0.335*** (0.109)	−0.357*** (0.118)	−0.202* (0.121)	−0.290** (0.115)
lngdp_m	0.231*** (0.054)	0.217*** (0.053)	0.178*** (0.052)	0.235*** (0.053)
lngdppc_x	2.001*** (0.341)	2.082*** (0.371)	1.450*** (0.398)	1.973*** (0.353)
lgdppc_m	−0.344** (0.143)	−0.298** (0.132)	−0.264** (0.116)	−0.423*** (0.129)
Lndist	−0.270*** (0.058)	−0.275*** (0.058)	−0.263*** (0.058)	−0.283*** (0.058)
comm_lang	0.223** (0.099)	0.204** (0.099)	0.208** (0.099)	0.213** (0.098)
landlock_x	–	–	–	–
landlock_m	−0.496*** (0.148)	−0.477*** (0.144)	−0.507*** (0.137)	−0.562*** (0.141)
rti	0.201 (0.265)	0.302 (0.258)	0.064 (0.263)	0.372 (0.262)
rot_x^2	0.890* (0.474)	1.317*** (0.452)	1.043** (0.458)	0.564 (0.491)
rot_m^2	−0.033 (0.309)	0.106 (0.308)	−0.002 (0.303)	−0.023 (0.301)
corr_x	0.578*** (0.150)			
corr_m	0.260** (0.115)			
rul_x		0.309*** (0.109)		
rul_m		0.208** (0.101)		
reg_x			0.813*** (0.172)	
reg_m			0.579*** (0.129)	
govf_x				0.600*** (0.146)
govf_m				0.519***
_cons	−9.467*** (1.537)	−9.863*** (1.513)	−7.876*** (1.526)	−9.449*** (1.532)
Obs	1329	1329	1329	1329
Pseudo R^2	.z	.z	.z	.z

Source: Authors computation from Stata 15 package

Standard errors are in parenthesis. ***$p<0.01$, **$p<0.05$, *$p<0.1$

significant positive impact on bilateral trade in the WAMZ. The results indicate that for both importing and exporting countries, reduced corruption, effective rule of law, high regulatory quality, and effective government coincide with more trade among WAMZ members. A one-unit increase in the coefficients of the four institutional indicators on average leads to an increase of over 30% in intra-regional trade in the WAMZ. This indicates that the region has a similar institutional framework that promotes their intra-regional trade.

Contrary to the estimates obtained for the WAEMU, the estimated results for the WAMZ in columns 1–4 in Table 7 indicate that the GDP of exporters across the specifications has a significant negative impact, while that of importers has a significant positive impact on bilateral exports among country groups in the WAMZ. This indicates that bilateral exports among exporting WAMZ members significantly reduce due to their comparative disadvantage in virtually all products, while importing members significantly increase their imports because they have a comparative disadvantage. The coefficient of the GDP per capita of exporters, as shown in Table 6, is negative but it is positive for that of importers and statistically significant across the specifications. Bilateral distance across the specifications is

found to be negatively significant in explaining bilateral exports among WAMZ country groups. Comparatively, the coefficients of bilateral distance under the WAMZ are relatively lower than those of the WAEMU. This reflects the fact that countries in the WAMZ are very close to each other and that the cost of trading is lower relative to those under the WAEMU.

Across the specifications, the coefficient of common language is positive and significant. The implication of this is that a common language facilitates communication, increases mutual trust, and thus reduces the perceived risk of transactions, thereby promoting intra-regional trade in the region. The landlockedness of importers is negative and statistically significant. This generally shows that landlocked countries are less able to participate in regional or international trade (either as exporters or importers).

Although bilateral exports among WAMZ members could be increased if exporters improve their ratio of total road networks to total population, the degree of intra-WAMZ trade integration is insignificant to their bilateral trade.

7 Summary of Findings and Conclusion

This paper focused on how institutional quality affects intra-regional trade in the ECOWAS zone. We presented empirical results at both the ECOWAS level and the level of WAEMU and WAMZ. The estimation was carried out using the NBPML, due to the presence of some zeros or unreported trade flows among the trading partners. Gravity analysis revealed the following findings. By analyzing the impact of institutional variables, we found that aggregate average measures of institutional quality, as well as individual measures of institutions, have a significant and positive impact on trade flows in ECOWAS. Specifically, the results indicated that for both importing and exporting countries, reduced corruption, effective rule of law, and effective government coincide with more trade among WAEMU and WAMZ members. High regulatory quality is important for intra-regional trade in the WAEMU's importing countries and facilitates trade in both importing and exporting WAMZ countries.

Using disaggregated institutional quality measures, the estimates of intra-regional analysis in the WAEMU indicated that the GDP of both the exporters and the importers had a significant positive impact on bilateral exports. Exporter GDP had a greater impact than importer GDP across all specifications. Contrary results were obtained for trade relations among ECOWAS members, as importer GDP had higher impact than that of exporters. In the WAMZ, however, only importer GDP had a significant positive impact; exporter GDP had a significant negative impact on bilateral exports across the specifications. For GDP per capita, the results indicated that majority of countries under the WAEMU (with exception of Côte d'Ivoire and Senegal) are low-income countries and, by implication, their export volume is hindered compared to exporting countries under the WAMZ. Also, in the analysis of intra-regional exports in ECOWAS, the estimates revealed the significant negative impact of importer GDP per capita across the specifications and the positive impact of exporter GDP per capita. Across the specifications, bilateral distance had a significant negative impact on bilateral exports in the ECOWAS, WAEMU, and WAMZ country groups, although this was more pronounced for trade within ECOWAS than for WAEMU and WAMZ. Furthermore, more landlocked countries belong to WAEMU and this significantly reduces their export volume more than others. Generally, landlocked ECOWAS members incur higher trading costs

and this inhibits trade relations with other regions. A common language seems to promote bilateral trade within the ECOWAS and its sub-regions. The degree of regional trade integration, as measured by a trade integration index, revealed that intensifying intra-ECOWAS trade integration within the region will lead to an increase in the volume of bilateral trade among ECOWAS countries. This benefit is more pronounced and significant for WAEMU countries.

Finally, from the estimates, it was evident that increasing the available stock of road networks is associated with a lower cost of trading, as this leads to lower transportation costs and improved trading activities among WAEMU, WAMZ, and ECOWAS country groups. Across the specifications, the ratio of road networks to the total population of exporter countries was found to be significantly positive for ECOWAS, WAEMU, and WAMZ.

Based on the results, policymakers in ECOWAS should improve their institutional frameworks (especially in the WAMZ) to combat corruption, promote the rule of law, and enhance government effectiveness through measures such as relaxed licensing requirements, reduced import taxes, and other bureaucratic bottlenecks. This will in turn help to increase the volume of trade. For better trade integration, ECOWAS member countries should embark on aggressive development of their infrastructure, such as increasing the network of roads that connect the countries within the region. Also, relevant law-enforcement agencies in ECOWAS should be strengthened, with an emphasis on detecting, prosecuting, and punishing corruption and criminal acts within the limits of the law on exporting activities in the region. Finally, it is critical that ECOWAS as a body creates a new institutional framework that can promote transparency, security, and growth in the region in order to address the community's ills.

Appendix

See Tables 8, 9 and 10.

Table 8 Data description and sources; Sources: Authors compilations from the literature

Variables	Measurement	Source	Expected sign
Bilateral exports (exp)	Trade value of export in 1000 USD	World Integrated Trade Solution (WITS)UNCTAD TRAINS 2019	Nil
GDP (gdp)	GDP at market prices (constant 2010 US$)	World Development Indicators (WDI) database 2019	+
GDPPC (gdppc)	GDP per capita (constant 2010 US$)	World Development Indicators (WDI) database 2019	+
Bilateral distances	kilometre	Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)	–
Institution Quality (*inst*)	Average value of the four elements (control of corruption (*corr*), regulatory quality (*reg*), government effectiveness(*govf*) and rule of law (*rul*)	Worldwide Governance Indicators (WGI). 2019	±
Common (official) language (*lang*)		Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)	+
Landlockedness (*landlocked*)		Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)	–
Intra-regional trade (*rti*)	Intra-regional Trade index	Calculated by the author	+
Road network (rot)	Ratio of total roads network to total population	Computed from WDI; National Planning Commission and Road Statistics Yearbook; https://www.cia.gov/library/publications/the-world-factbook/fields/2085.html	±

Table 9 List of ECOWAS member state in the study

ECOWAS	WAMZ	WAEMU
Benin	Gambia	Benin
Burkina Faso	Ghana	Burkina Faso
Cape Verde	Guinea	Cote D'Ivoire
Cote'd'Ivoire	Liberia	Guinea-Bissau
Gambia, The	Nigeria	Mali
Ghana	Sierra Leone	Niger
Guinea		Senegal
Guinea-Bissau		Togo
Liberia		
Mali		
Niger		
Nigeria		
Senegal		
SieraLeone		
Togo		

Table 10 Descriptive analysis; Source: Authors computation from Stata 15 package

Variable	Exp	lngdp_x	lngdp_m	lngdppc_x	lngdppc_m	lndist	rti_x	rti_m	comm_lang	landlock_x	landlock_m	rot_x2	rot_m2	inst_x	inst_m
Full sample															
Obs	3989	3990	3990	3990	3990	3990	3990	3990	3990	3990	3990	3990	3990	3990	3990
Mean	21,555	22.60	22.60	6.68	6.68	7.12	0.47	0.47	0.44	0.20	0.21	0.24	0.24	− 0.68	− 0.68
Std.Dev	123,000	1.53	1.53	0.61	0.61	0.85	0.18	0.18	0.50	0.40	0.40	0.14	0.14	0.44	0.44
Sub-sample (WAEMU)															
Obs	2128	2128	2128	2128	2128	2128	2128	2128	2128	2128	2128	2128	2128	2128	2128
Mean	18,513.51	22.62	22.60	6.54	6.69	6.99	0.54	0.47	0.57	0.38	0.20	0.22	0.24	− 0.69	− 0.68
Std.Dev	59,885.19	1.01	1.56	0.43	0.62	0.67	0.13	0.19	0.50	0.48	0.40	0.16	0.14	0.34	0.44
Min	0	20.31	20.30	5.78	5.61	5.07	0.28	0.02	0.00	0.00	0.00	0.02	0.02	− 1.49	− 1.75
Max	800,000	24.47	26.88	7.43	8.24	9.00	0.85	1.30	1.00	1.00	1.00	0.80	0.80	0.02	0.34
Sub-sample (WAMZ)															
Obs	1595	1596	1596	1596	1596	1596	1596	1596	1596	1596	1596	1596	1596	1596	1596
Mean	29,206.28	22.82	22.58	6.64	6.68	7.01	0.40	0.48	0.33	0.00	0.21	0.27	0.24	− 0.82	− 0.67
Std.Dev	182,000	2.01	1.48	0.60	0.61	0.79	0.21	0.18	0.47	0.00	0.41	0.12	0.15	0.42	0.44
Min	0	20.30	20.30	5.61	5.61	4.84	0.02	0.02	0.00	0.00	0.00	0.10	0.02	− 1.75	− 1.75
Max	2,590,000	26.88	26.88	7.85	8.24	8.97	1.30	1.30	1.00	1.00	1.00	0.00	1.00	0.54	0.80
Min	0	20.30	20.30	5.61	5.61	4.84	0.02	0.02	0.00	0.00	0.00	0.02	0.02	− 1.75	− 1.75
Max	2,590,000	26.88	26.88	8.24	8.24	9.11	1.30	1.30	1.00	1.00	1.00	0.80	0.80	0.34	0.34

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