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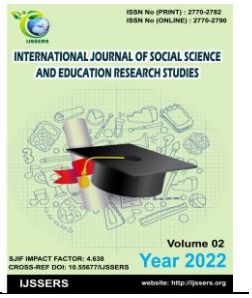

Analysing the Flow of Intra-Industry Trade in the Central African Monetary Community

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ABSTRACT

This paper empirically examines the flow of Central African Economic and Monetary Community (CEMAC) intra-industry trade at different sectors and product categories using the Standard International Trade Classification (SITC). An augmented gravity model of trade was adopted to analyse changes in the different sectors and product categories from 1995 to 2015; this is the time span for which consistent and useable time series data is available for CEMAC. A time fixed effects variable and within estimator were included to control for unpredictable changes in exogenous factors and capture the heterogeneity of the sample over time. The results showed that prior to the formation of the CEMAC customs union, the growth in intra-industry trade had been higher than that of the CEMAC customs union with the exception of very few sectors and that since the establishment of the customs union in 1994, IIT trade has remained low and only Cameroon has witnessed an increase in trade with member states, especially in food and live animals. The results also showed that only mineral fuels exports had been significant and positive for Chad and Equatorial Guinea.

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Keywords:
CEMAC, common currency, gravity model, intra-industry trade, regional integration

1 INTRODUCTION

Intra-industry trade has grown rapidly over the past 3 decades, and it has also become the subject of both theoretical and empirical analysis. It is gaining prominence and accounts for more than half of all trade manufacturing among industrialised countries. As industries grow, the level of similarity in production also increases. Intra-industry trade arises from the fact that products are differentiated. This has attracted the attention of trade experts since the phenomenon forms an important component of the theories of international trade. As trade experts continue to develop and refine theories to explain the nature and determinants of intra-industry trade (IIT), there is insufficient theoretical and empirical literature to explain the development of the effect of a common currency on IIT, especially in developing countries. This may be attributed to a lack of data on the different sectors of the economy and the estimation of disaggregated data not being as straightforward as the aggregation of data (Asian Development Bank, 2018).

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IIT is significantly low in Africa, and many trade blocs in Africa are still struggling to promote IIT among themselves. According to the United Nations Economic Commission for Africa (UNECA; 2015), the low level of IIT is attributed to weak industrialisation, which typically constrains the scope for IIT. The merchandise trade complementarity index from the United Nations Conference on Trade and Development (UNCTAD) statistics database shows that Africa is one of the regions with the lowest indices after Oceania. The index assesses how a country or region's exports to potential trading partners match that of its imports from these trading partners. Central African Economic and Monetary Community (CEMAC) has performed poorly in comparison to other trade blocs, such as the West African Economic and Monetary Union (WAEMU), the East African Community (EAC), and the Southern African Development Community (SADC) in IIT. A lack of export diversification and product concentration is contributing to this poor performance (Ofa et al., 2012). The presence of numerous roadblocks and cumbersome border-crossing procedures along the main transit corridors in the CEMAC region exacerbates the situation. According to Brulhart (2008), IIT in these regions differs substantially over time and institutional depth. The

author further reiterated that in 2006, none of these regions' IIT exceeded 2% of the total trade, and none contributed significantly to regional trade or structural convergence.

The absence of regional value chains, a narrow range of manufacturing bases across the region, a lack of economic diversification, and the absence of large corporations trading in various parts of the continent are some of the reasons for the low level of IIT in the manufacturing sector in Africa (UNCTAD, 2013). This same UNCTAD (2013) report showed that approximately 25% of Africa's total trade involved regional trade with only 1% accounting for product categories in 2011, which was in sharp contrast to the trading in Asia, where approximately 40% of the total trade involved IIT in the nine Standard International Trade Classification (SITC) product categories, and 25% was for the Americas in six of the nine product categories. A mismatch in production versus consumption rates and trends in Africa also contributes to low levels of IIT (Brulhart, 2008).

A closer look at the share of IIT by product category in some of the trade blocs in Africa indicates that the EAC's IIT accounted for more than 25% of the total trade in five out of nine product categories between 2007 and 2011. Regarding the Economic Community of Central African States (ECCAS) and the Economic Community of West African States (ECOWAS), IIT comprised approximately 25% of their total trade in three product categories. In the Common Market for Eastern and Southern Africa (COMESA) and SADC, IIT was significant in only two product categories (UNCTAD, 2013). In Figure 1, the total value of IIT in the CEMAC region is lower relative to its total trade with the rest of the world. CEMAC's total IIT has been relatively low since 1995, whereas its trade with the rest of the world during the same time frame has witnessed an upward trend before declining after 2012. Figure 1 compares CEMAC's total exports to the rest of the world and its IIT.

Figure 1: Comparing CEMAC's total exports to the rest of the world and CEMAC's intra-industry trade (million US Dollars). Source: Author's computations using data from UNCTAD database.

The paper aimed to contribute to the debate on IIT within the context of CEMAC. The analysis used yearly data for CEMAC's member states and its main trading partners from 1995 to 2015 using the gravity equation framework. The discussion and analysis of the flow of IIT were focused on three main sectors – agriculture, fuel, and manufacturing – and the nine product categories according to the SITC in the CEMAC region. Although this approach could be considered an "unsophisticated" way to assess the impact of the CFA Franc on CEMAC IIT, the belief is that it might, nevertheless, provide a useful starting point for future research on IIT in the CEMAC trade bloc.

While the analysis presented in this paper underscores the importance of sectoral trade in the CEMAC region, breaking down total exports into the different product categories will inform policymakers as to which sectors are contributing to the growth of IIT. The effects of monetary union and intra-regional trade flow are usually assessed at the aggregate level, where trade models aggregate all products of a country or trade bloc as a single homogenous good. There is less attention given to the impact of the monetary union on sectoral trade in literature, and this might be due to the fact that such an estimation is less straightforward and bears more complications than an estimation of aggregated trade data. Many developing countries are heavily dependent on primary products as their main source of export income. The question that arises is to what extent has the formation of CEMAC in 1994 contributed to the growth of IIT? In attempting to answer this question, we decomposed the growth in total trade according to sectoral levels and the different product categories according to SITC classifications.

The remainder of the paper is organised as follows: Section 2 examines the literature review while Section 3 briefly looks at the theoretical and methodological framework. Section 4 presents the empirical results and their interpretations. Finally, Section 5 concludes the study.

2 LITERATURE REVIEW

Regional trade agreements in Africa differ greatly from one region to another in terms of age, structure, and complexity. Brülhart (2009) showed how IIT is similar across the African continent in terms of negligible trade effects and low levels of growth[1]. He concluded that IIT in Africa had contributed to trade flow but had not been promoting any regional structural convergence. The relevant literature on IIT is mostly on South Africa and its major trading partners. In the CEMAC region, there is a high level of complementarity in the production structure. IIT can allow countries to gain exports over and above that gained through comparative advantages (Krugman & Obstfeld, 2006).

In terms of the similarity in the levels of demand and how aggregate expenditure can affect IIT, Shahbaz and Leitão (2011) tested the determinants of IIT between Pakistan and its main trading partners using an unbalanced panel for the period from 1980 to 2006. The results from the study showed that the sizes of the markets were an important determinant of IIT and that countries with similar levels of demand tended to promote IIT more than those without similar demand patterns. In analysing the patterns of IIT in the EAC, Rutaihwa and Rutatina (2012) studied the effects of EAC regional integration on IIT. The study concluded that the patterns of IIT flows in the period between 1990 and 2000 were very low compared to those in the period between 2004 and 2010. Regional macroeconomic policies and the establishment of the EAC in January 2005 played an important role in the improvement in IIT among the EAC member states.

Gebreselasie and Jordaan's (2009) analysis on IIT showed how IIT in manufacturing was sufficiently great between South Africa and countries similar to South Africa in terms of economic size. IIT occurred less between South Africa and its trading partners that were not proportional in size. The authors concluded that IIT plays an important role in promoting South Africa's bilateral trade. The fact that South Africa's (SA) manufacturing sector responded positively between 1994 and 2004 to the similarity of trading-partner-factor endowments implies that SA's manufacturing sector shares characteristics similar to those of the developed world. Damoense and Jordaan (2007) analysed the determinant of SA IIT in the automobile industry using Harmonized System (HS) six-digit disaggregated data and tested whether SA's IIT with its main trading partners was vertical or horizontal. Their results showed that SA IIT in the automobile industry was mostly horizontal while IIT in automotive parts was highly vertical.

Faruqee (2004) argued that countries with more flexibility in shifting their resources to sectoral levels tended to enjoy a comparative advantage and could realise larger trade gains. Most of the studies on IIT in Africa have been carried out by authors studying different sectors of SA's trade with its trading partners (Dias, 1998; Isemonger, 2000; Matthee & Naudé, 2007; Sichei, Harmse & Kanfer, 2007). These studies have shown that SA IIT occurs mostly with countries that are proportional in size, and only a limited amount of trade is conducted with countries within Africa. Although these studies have greatly contributed to existing knowledge on IIT, none have been carried out in the CEMAC region.

3 THEORETICAL AND METHODOLOGICAL FRAMEWORK

3.1 Theoretical model

The theoretical work on IIT started to gain recognition after Grubel and Lloyd published a book on IIT in 1975. Grubel and Lloyd (1975) analysed the trade pattern of member states of the Organisation for Economic Cooperation and Development (OECD) and realised that there was a steady increase in IIT. This was somehow contrary to existing trade theories at that time, such as the Heckscher–Ohlin–Samuelson comparative advantage and specialisation theories. Grubel and Lloyd (1975) developed an index to measure IIT, which is given in Equation 1 as follows:

$$IIT_{ij} = \left[1 - \frac{\left|X_{ij} - M_{ij}\right|}{\left(X_{ij} + M_{ij}\right)}\right](100), \quad (1)$$

where X_{ij} = exports from industry i to country j, M_{ij} = imports of industry i from country j, and i = 1, … , n. The values of IIT_{ij} normally lie between 0 and 100. The level and intensity of IIT between trading partners are greatest when the computed value of IIT_{ij} is closer to 100 (Sharma, 2004). In order to measure the IIT in all product categories, Equation 1 can be modified as a weighted measure of the IIT_{ij}. According to Ekayanake, Veeramacheneni and Moslares (2009), this can be written as follows:

[1] Brülhart's (2009) analysis of IIT shows that African IIT barely exceeded 2% of total trade compared to that of the European Union (EU), which was 46% in 2006.

$$IIT_{ij} = \sum_{i=1}^{n} w_{ij}\left[1 - \frac{\left|X_{ij} - M_{ij}\right|}{\left(X_{ij} + M_{ij}\right)}\right], \quad \text{where}$$

$$w_{ij} = \left[\frac{\left(X_{ij} + M_{ij}\right)}{\sum_{i=1}^{n}\left(X_{ij} + M_{ij}\right)}\right]$$

Therefore, $$IIT_j = \frac{\sum_{i=1}^{n}\left(X_{ij} + M_{ij}\right) - \sum_{i=1}^{n}\left|X_{IJ} - M_{ij}\right|}{\sum\left(X_{ij} + M_{ij}\right)} \quad (2)$$

In Equation 2, n represents the number of industries at a given level of aggregation.

3.2 Model specifications

In analysing the patterns of IIT, the Kandogan (2004) method of estimation was used to derive the dependent variable. This model is derived directly from the definition of IIT. The values of exports and imports play an important role in the estimation technique. Export and import values are aggregated at two different levels. The higher level of aggregation signifies industries while the lower level of aggregation signifies the products produced in each industry. The values of exports and imports are given as follows:

$$X_i = \sum_p X_{ip} \text{ and } M_i = \sum_p M_{ip}, \quad (3)$$

where X_{ip} and M_{ip} are the values of the export and import of goods p in industry i, respectively. Accordingly, for goods p in industry i, the total trade (TT) and IIT are given as in Equations 4 and 5:

$$TT_i = \sum_p X_{ip} + M_{ip} = X_i + M_i \quad (4)$$

$$IIT_i = TT_i - \left|X_i - M_i\right| \quad (5)$$

The expression $\left|X_i - M_i\right|$ is the absolute value of the trade balance, where M_i = imports of the i^{th} industry and X_i = exports of the i^{th} industry. CEMAC's IIT was estimated at the one-digit industry level, applying different equations for each sector. This gave an indication of how the flow of IIT in the CEMAC customs union had been affected since its formation in 1994. In estimating the gravity equation for IIT, Anderson and van Wincoop (2004) derived Equation 6:

$$X_{ij}^{k} = \sum_i \left(\frac{t_{ij}^{k}}{P_j^{k}\prod_i^{k}}\right)^{1-\sigma^k} \frac{E_j^{k} Y_i^{k}}{Y^{k}} \quad (6)$$

Equation 6 is divided by $E_j^{k} Y_i^{k}$ and logarithms are used to derive Equation 7:

$$\ln\left(\frac{X_{ij}^{k}}{E_j^{k} Y_j^{k}}\right) = -\ln Y^{k} + \ln N_{ij} + (1-\sigma^{k})\ln t_{ij}^{k} - (1-\sigma^{k})\ln P_j^{k} - (1-\sigma^{k})\ln\prod_i^{k}, \quad (7)$$

where X_{ij}^{k} = value of sector $k(k = 0,1,2,...,n)$ exports from country i to country j, and $(1-\sigma^{k})$ = the elasticity of substitution between all goods traded in sector k.

According to Anderson and van Wincoop (2004), trade barriers determine the level of bilateral trade. The two indices P_j^{k} and $\prod_i^{k}$ indicate the outward and inward multilateral resistance and can be solved as a function of trade costs with t_{ij}^{k} and $E_j^{k} Y_i^{k}$.

$\ln\left(\frac{X_{ij}^{k}}{E_j^{k} Y_j^{k}}\right)$ in Equation 7 is then normalised to $\ln(X_{ij})$ and Equation 7 is then transformed into Equation 8:

$$\ln(\ln X_{ij}) = -\ln Y^{k} + \ln N_{ij} + (1-\sigma^{k})\ln t_{ij}^{k} - (1-\sigma^{k})\ln P_j^{k} - (1-\sigma^{k})\ln\prod_i^{k} \quad (8)$$

where N_{ij} represents the supply and demand capacity and is often proxied by both the exporter and importer gross domestic product (GDP). The regression uses a fixed effects panel data model. In this model, a time fixed effects variable is included to control for any sudden increase in trade due to increase in oil prices (Rose & van Wincoop, 2001). According to Alturki (2007), a panel data estimator should include a within estimator in order to capture the heterogeneity of the sample over time. When one includes t_{ij}^{k} (trade costs for sector k between countries i and j), the different fixed effects, and other controlled variables in the regression, Equation 8 then becomes:

$$\ln X_{ijt}^{k} = \alpha_0^{k} + \alpha_1^{k}\ln GDP_{it} + \alpha_2^{k}\ln GDP_{jt} + \alpha_3^{k}\ln D_{ij} + \alpha_4^{k} Pop_{ij} + \alpha_5^{k} CMAC_{ijt} + \alpha_6^{k} Border_{ij} + \alpha_7^{k} Lang_{ij} + \alpha_8^{k} Locked_{ij} + \gamma_i + \varphi_j + \varepsilon_{ijt} \quad (9)$$

The explanatory variables were regressed against each trade sector of the SITC 1 classification. The regression analysis indicated how each trade sector in the CEMAC region was affected by the explanatory variables.

3.3 Data Sources

The IIT of CEMAC with selected trade blocs was examined based on SITC data. The data was obtained from the UNCTAD statistics database. This was supplemented with data from the World Bank, the World Trade Organisation (WTO), the *Centre d'Études Prospectives et d'Informations*

Internationales (CEPII), and the Penn World Table. Panel data was used for the six member states of the CEMAC customs union (Cameroon, Chad, Central African Republic, Republic of the Congo, Equatorial Guinea, and Gabon) and the region's main trading partners over the period from 1995 to 2013. The variables used in this paper include the following:

- Exports per sector (X_{ij}): This involves annual data from 1995 to 2013 and represents the value of exports for the six member states in the CEMAC region. The value of exports is expressed in nominal dollar prices. We considered exports in 10 trade sectors at the first-digit level of aggregation of the SITC. The sectors were food and live animals (sector 0); beverages and tobacco (sector 1); crude material, except fuels (sector 2); mineral fuels, lubricants, and related materials (sector 3); animal and vegetable oils and fats (sector 4); chemicals (sector 5); manufactured goods (sector 6); machinery and transport equipment (sector 7); miscellaneous manufactured articles (sector 8); and commodities and transactions (sector 9). The main source of export values was derived from the UNCTAD and WTO statistics databases.
- Gross Domestic Products (Yi) : The GDPs of both the exporter and importer were used as a proxy to determine the level of growth. The datasets were derived from the World Bank statistics database.
- Size of a country (Pop_i): The coefficient for the population tends to be negative, assuming that small countries tend to trade more with other countries since they find it difficult to enjoy economies of scale as compared to countries with large populations. Although these large countries trade more with trading partners in absolute terms, they tend to find more markets within the borders of their countries. As a result, the total cross-border trade forms a lower percentage of the total GDP. The data on the populations was derived from the Penn World Table (PWT) version 7.1.
- Distance ($Dist_{ij}$): The distance between trading partners is frequently used as a proxy for transaction costs. The data on distance was derived from the CEPII geo-distance database.
- Dummy variable ($CEMAC_{ij}$): This takes the value of 1 if trading partners are members of the customs union and 0 otherwise.
- Dummy variable (*contiguity*) for common border: The variable takes the value of 1 if the two countries included in the model share a common border and 0 otherwise.
- Common language ($Lang_{ij}$): Five out of six countries in the CEMAC regions had been colonised by France, and only one country in the region, that is, Equatorial Guinea, had been colonised by Spain. There is a need to incorporate countries that speak more than one official language. This was the case with Cameroon that had been colonised by both the French and British and, therefore, has a linguistic connection with both France and England. The variable takes the value of 1 if country i and country j share a common official language and 0 otherwise.
- Landlocked countries ($LLock_{ij}$): Two of the countries in question, Chad and the Central African Republic, are landlocked while the other four countries share a marine coastline. The variable takes the value of 1 if either or both countries in the equation are landlocked and 0 for countries with a marine coastline.
- γ_i is the multilateral resistance variable and takes the value of 1 if country i is the exporter and 0 otherwise.
- φ_j is the multilateral resistance and takes the value of 1 if country j is the importer and 0 otherwise.

4 EMPIRICAL RESULTS

Applying the fixed effects model, the regression results of the total intra-industry CEMAC exports at the aggregate level are presented in Table 1. The fixed effects models are sometimes considered the gold standard in empirical research as they have the capability to identify a causal effect and allow for the correlation of traditionally unobserved factors (Schurer & Yong, 2012). Three dummies were introduced to represent the different fixed effects. The first two are the countries' fixed effects dummies, one for the exporter and the other for the importer. The third is the time dummy, which represents the year fixed effects. Country dummies remove cross-section bias between the unobservable term and the included variables (Cipollina & Salvatici, 2012).

In Table 1, all the coefficients have the expected signs, except for the common language (comlang) one, which is negative. The reason for the negative result is perhaps due to the differences in the official languages spoken in the region. The official language in Equatorial Guinea is Spanish, and English is also widely spoken in Cameroon. Moreover, each country in the CEMAC region has many native languages that are unique and different from each other, and these are the main languages used in the marketplace and sometimes in cross-border trade. In columns 3, 4, and 5 of Table 1, the CEMAC dummy coefficients equal 0 when we included country and year fixed effects (columns 3, 4, and 5). This

shows that some pairs of countries do not trade with each other. According to Silva and Tenreyro (2006), the 0 observations pose no problem in the equation, especially in their multiplicative form. The variable of concern (CEMAC) is negative in both the fixed and non-fixed effects, indicating a negative relationship with IIT. This implies that since the establishment of the CEMAC customs union in 1994, the policy change has not contributed favourably to IIT in the CEMAC region.

Table 1: Estimation results (total IIT exports, 1995–2013)

Dependent variable: Log of Export value	**Non-Fixed Effects (1)**	**Fixed Effects (2)**	**Fixed Effects (3)**	**Fixed Effects (4)**	**Fixed Effects (5)**
lgdp_exp	1.17***	0.76***	0.94***	0.25	0.37
	(0.16)	(0.17)	(0.33)	(0.45)	(0.42)
lgdp_imp	0.46***	0.25***	1.46***	0.92***	0.88***
	(0.09)	(0.09)	(0.26)	(0.32)	(0.28)
Ldist	-0.59***	-0.62***	-3.89***	-3.89***	-0.48
	(0.23)	(0.24)	(0.80)	(0.77)	(0.90)
Border	2.66***	2.84***	0.22	0.26	1.48***
	(0.24)	(0.22)	(0.58)	(0.55)	(0.56)
Comlang	-0.58***	-0.62***	-0.95	-1.04	-4.77***
	(0.19)	(0.18)	(0.58)	(0.64)	(0.79)
CEMAC	-4.46***	-6.85***	0.00	0.00	0.00
	(0.92)	(0.95)	(.)	(.)	(.)
Constant	0.91	8.53**	17.99**	33.80***	1.15
	(3.63)	(3.70)	(8.79)	(10.36)	(4.82)
Country-Specific Dummy	No	No	Yes	Yes	No
Year Dummy	No	Yes	No	Yes	Yes
Country Pair Dummy	No	No	No	No	Yes

Robust standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

* Significant at 10%; ** significant at 5%; *** significant at 1%

Note: The table reports t-statistic in parentheses. Regression results of total intra-industry CEMAC exports at the aggregate level. It include the fixed effects model to solve the problem of omitting the multilateral resistance term
Regressions include country specific dummy, and time dummy

Table 2 shows the fixed effects results of CEMAC aggregate exports and the value of exports from the three major sectors in the region. The GDP coefficients (lgdp_exp) of the CEMAC member states are insignificant in the agricultural and fuel sectors (A02 and A04). Instead, the GDPs (lgdp_imp) of the importers are significant at 1% for total products and fuels and 5% for manufacture. As the GDPs of importers increase, so too do the exports of fuels and manufactured goods. There is a positive relationship between the GDPs of importers and the exports of fuels and manufactured goods. The coefficients for agricultural products are mostly insignificant except for the landlocked one, which is significant and negative. The common border (contig)[2] is significant and positive, and the distance coefficients are negative and statistically significant for total products, fuel, and manufactured foods and insignificant for agriculture. This suggests that the greater the distance between trading partners, the lesser the degree of trade between these countries. Surprisingly, the landlocked coefficients are positive except for agriculture, which is a probable indication that landlocked countries in the CEMAC region tend to trade less in agriculture.
The common border coefficients are positive and significant at 5%, implying that countries sharing common borders do not have to go through many border posts, which reduces trade costs. Despite having French as the official language in five out of six states, the coefficients are all negative and those of agricultural raw materials and fuels are insignificant. As mentioned earlier, the market language (medium of communication) in the CEMAC region differs from one country to another. The fact that member states mostly use the local languages and, in some cases, local dialects to

[2] The variable "contig" appears in the regression table representing the common border.

communicate in the marketplace makes communication less successful between the trading partners.

Table 2: Fixed effects results for total products and major sectors (1995–2013)

	Total Products	A02 Agriculture	A04 Fuels	A12 Manufacture
lgdp_exp	0.58**	0.22	0.72	0.53**
	(0.23)	(0.26)	(0.47)	(0.23)
lgdp_imp	1.44***	0.57	1.23***	0.77**
	(0.31)	(0.37)	(0.37)	(0.31)
Ldist	-1.61***	0.57	-0.15	-0.76**
	(0.32)	(0.51)	(1.00)	(0.33)
landlocked	2.42***	-2.17*	1.41*	1.01*
	(0.47)	(1.20)	(0.81)	(0.61)
Contig	1.32***	1.63***	2.33***	2.17***
	(0.25)	(0.53)	(0.76)	(0.27)
Comlang	-0.80***	-0.37	-0.72	-1.41***
	(0.20)	(0.26)	(0.49)	(0.22)
Constant	1.23	-7.64	-12.74	-2.87
	(4.38)	(5.45)	(12.32)	(4.17)
Observations	1155	821	638	1092
Adjusted R^2	0.750	0.743	0.655	0.658

Standard errors in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

* Significant at 10%, ** significant at 5%, and *** significant at 1%

Note: The table reports t-statistic in parentheses and the fixed effect regression results of CEMAC exports and the exports from the three major sectors in the region.

Table 3 shows the regression results of the disaggregated data at the one-digit SITC level of the different product categories. The exporter GDP is negative and significant at the 5% and 1% levels for SITC 0 (food and live animals) and SITC 1 (beverages and tobacco), respectively. This suggests that as the GDPs of CEMAC member states increase, the IIT of SITC 0 and SITC 1 does not increase as expected. One reason is that as the GDPs of these states increase, they tend to import more goods from non-member states. For SITC 2 (crude materials, except fuels), SITC 3 (mineral fuels, lubricants, and related materials), and SITC 4 (animal and vegetable oils, fats, and waxes), the coefficients are all insignificant. Importer coefficients of SITC 0, SITC 2, SITC 3, and SITC 8 are positive and significant. This implies that as the GDPs of the CEMAC trading partners increase, their demand for these products is positively affected.

Table 3: Disaggregate trade results (product category, 1995–2013)

	0 Food & Live	1 Beverages & tobacco	2 Crude Materials	3 Mineral fuels	4 Animal & Vegetable
lgdp_exp	-0.75**	-2.15***	0.25	0.72	0.35
	(0.34)	(0.56)	(0.26)	(0.47)	(1.16)
lgdp_imp	1.19***	0.61	0.81**	1.23***	-0.54
	(0.35)	(0.50)	(0.40)	(0.37)	(0.48)
ldist	3.29***	-4.67***	-0.45	-0.15	-4.32***
	(0.63)	(0.93)	(0.42)	(1.00)	(1.65)
landlocked	0.49	-1.10	-0.85*	-1.41*	-4.01*
	(0.86)	(1.26)	(0.50)	(0.81)	(2.40)
contig	2.47***	-1.44**	1.49***	2.33***	-3.07*
	(0.47)	(0.70)	(0.38)	(0.76)	(1.63)
comlang	-1.15**	0.49	-0.41*	-0.72	-1.88
	(0.46)	(0.73)	(0.23)	(0.49)	(1.20)
Constant	-28.30***	52.09***	-4.66	-12.74	56.42***

	(8.56)	(8.93)	(7.15)	(12.32)	(20.49)
Observations	716	476	897	638	287
Adjusted R^2	0.594	0.328	0.755	0.655	0.408

Table 3: Disaggregate trade results (product category, 1995–2013) (continuation)

	5 Chemicals	6 Manu goods	7 Machine & Trans	8 Misc.	9 Commodities
lgdp_exp	2.19***	0.46*	-0.04	0.03	1.18**
	(0.38)	(0.25)	(0.30)	(0.31)	(0.49)
lgdp_imp	-0.19	0.03	0.34	0.89***	-1.08
	(0.29)	(0.27)	(0.24)	(0.30)	(0.95)
ldist	-1.03**	-0.92**	-1.69***	-0.74*	1.75**
	(0.52)	(0.43)	(0.41)	(0.42)	(0.84)
landlocked	-0.92	0.25	-1.78***	0.88	0.43
	(0.77)	(0.56)	(0.67)	(0.65)	(1.37)
contig	3.30***	2.31***	0.83**	1.60***	1.18*
	(0.48)	(0.33)	(0.33)	(0.32)	(0.68)
comlang	-2.26***	-0.86***	-1.15***	0.32	-1.87***
	(0.37)	(0.25)	(0.26)	(0.28)	(0.61)
Constant	2.53	14.79**	10.36**	0.51	1.64
	(7.89)	(6.24)	(4.57)	(5.07)	(16.52)
Observations	729	965	967	877	469
Adjusted R^2	0.528	0.614	0.629	0.570	0.468

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

* Significant at 10%, ** significant at 5%, and *** significant at 1%

Note: The table reports t-statistic in parentheses and the regression results of the disaggregated data at one digit SITC level of the different product categories.

The distance coefficients in Table 3 are negative and significant except for SITC 0 and SITC 9, which are positive but significant. This deviates from what the gravity model stipulates: geographical distance as an indicator of trade costs is inversely proportional between two countries. According to Wu (2015), when trading partners are neighbours, and if they have similar climatic conditions, farmers in these two countries will likely grow similar crops that are suitable to that particular climate, and no country will have a comparative advantage over another at growing and trading that particular crop. For these reasons, incentives to trade with each other are minimal, notwithstanding the fact that these countries share the same border. Food and live animal (SITC 0) and commodity (SITC 9) products fall into this category, and the argument put forward is that the distance coefficient is positive as countries further away from CEMAC will likely buy more of their products, given the fact that the importer GDP is positive.

The dummy coefficients for landlocked countries are insignificant for sectors 0, 1, 5, 6, 8, and 9, while they are significant and negative for sectors 2, 3, 4, and 7 in Table 3. This implies that CEMAC member states that are landlocked tend to trade less in sector 2, 3, 4, and 7 products. For the common border (contig), the coefficients are significant and positive for 9 out of 10 sectors. Only the sector 1 (beverages and tobacco) coefficient is significant and negative at 5%. The common language dummy coefficients are significant and negative for most of the product categories except sectors 1, 3, 4, and 8, which are insignificant. The probable implication is that the common language has no effect on trade in beverages and tobacco (sector 1), mineral fuels (sector 3), animals and vegetables (sector 4), and miscellaneous manufactured articles (sector 8). For sectors 0, 2, 5, 6, 7, and 9, the coefficients for a common language (comlang) are significant and negative, suggesting that a common language has not benefited the trade in these sectors since 1995. The implication is that CEMAC countries export these products to non-member states and that there is a very negligible amount of trade among member states in sector 0, 2, 5, 6, 7, and 9 products. Low industrialisation in the CEMAC regions makes trade in these sectors less attractive.

4.1 Sensitivity analysis

The following analysis showcases the extent to which individual member states of the CEMAC customs union have contributed to CEMAC IIT. The results are shown in Tables 4 and 5. Table 4 shows the individual countries' sensitivity to

total products and the three main sectors in the CEMAC region (agricultural raw materials, fuels, and manufactured goods). The exporters' coefficients for total products are all positive and significant except for Chad (TCD), where the coefficient is insignificant. Chad's exports of these products to member states were mostly zero during the time frame. This is also true for the agriculture sector and manufactured goods. The fuels coefficient for Chad is positive and significant at 1%, indicating the boom in fuel exports that started in the late 1990s due to the discovery of oil in the country and also the political stability that Chad had started to enjoy. The exporters' coefficients for fuels and manufactured goods are positive and significant except for the agricultural materials coefficient, which is negative and significant. This demonstrates that exports of agricultural material from the CEMAC region are negligible. The negative effect is highly significant for Equatorial Guinea (GNQ) and the least significant for Cameroon (CRM).

The second half of Table 4 shows the importers' effects. The importers are CEMAC member states and trade blocs in Africa and their main trading partners. For the total products, the coefficients for CEMAC member states as importers are all negative and highly significant at 1%. This indicates that CEMAC IIT for total products has been negative on average. Non-CEMAC countries and regions, such as China (CHN), India, and the European Union (EU), are the main importers of products from the CEMAC region, and their imports from the region are statistically significant.

Table 4: Country sensitivity (total and main sectors, 1995–2013)

	-1	-2	-3	-4
VARIABLES	Total_products	_Agric	_Fuels	_Manu
Exporters				
CAR	7.469***	-1.990**	7.733***	5.771***
	(0.559)	(0.958)	(0.899)	(0.561)
COG	5.734***	-1.605*	6.787***	3.728***
	(0.494)	(0.887)	(0.847)	(0.497)
CRM	5.915***	-0.153	6.613***	4.661***
	(0.532)	(0.907)	(0.914)	(0.534)
GAB	5.493***	-1.031	6.648***	3.190***
	(0.522)	(0.901)	(0.897)	(0.525)
GNQ	3.113***	-2.134**	7.591***	1.182***
	(0.450)	(0.848)	(0.794)	(0.449)
TCD	0.266	0.388	3.185***	0.0326
	(0.248)	(0.317)	(0.600)	(0.255)
Importers				
CAR	-3.176***	0.702	-6.697***	-1.291
	(0.967)	(1.385)	(1.915)	(0.968)
CHN	5.759***	7.189***	2.668***	0.294
	(0.290)	(0.371)	(0.652)	(0.299)
CRM	-2.558***	0.0366	-4.864***	-1.320
	(0.958)	(1.342)	(1.864)	(0.960)
COG	-2.480***	0.0450	-5.274***	0.325
	(0.897)	(1.316)	(1.817)	(0.901)
COMESA	0.0877	3.758***	-2.054	1.363**
	(0.692)	(0.903)	(1.366)	(0.694)
EAC	-3.493***	0.241	-9.685***	-0.840
	(0.750)	(0.975)	(1.509)	(0.752)
ECOWAS	-0.471	3.407***	-1.642	1.244
	(0.932)	(1.227)	(1.807)	(0.930)
EU	6.766***	8.812***	2.788***	6.076***
	(0.479)	(0.612)	(0.956)	(0.482)
GAB	-3.544***	0.555	-6.264***	-0.416
	(1.026)	(1.513)	(2.093)	(1.030)
GNQ	-4.415***	-0.510	-5.809**	-0.941
	(1.209)	(1.704)	(2.378)	(1.206)
IND	2.778***	5.147***	0.280	0.735*

	(0.363)	(0.464)	(0.781)	(0.379)
TCD	-3.339***	2.496*	-4.315**	-1.955**
	(0.934)	(1.392)	(1.933)	(0.931)
Ldist	-1.603***	0.539	-0.513	-0.717*
	(0.378)	(0.486)	(0.713)	(0.377)
Landlocked	2.557***	-2.150**	1.112	1.174**
	(0.480)	(0.867)	(0.776)	(0.482)
Border	1.188***	1.525***	1.920***	2.041***
	(0.294)	(0.455)	(0.611)	(0.295)
comlang	-0.810***	-0.373	-0.620	-1.421***
	(0.230)	(0.295)	(0.442)	(0.232)
Constant	16.35***	-0.499	7.738	8.482**
	(3.841)	(4.924)	(7.205)	(3.826)
Observations	1,155	821	638	1,092
R-squared	0.680	0.741	0.634	0.585

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

* Significant at 10%, ** significant at 5%, and *** significant at 1%

Note: The table reports t-statistic in parentheses. Regressions shows individual member states of the CEMAC customs union contribution to CEMAC IIT. It also shows the individual countries' sensitivity to total products and the three major sectors in the CEMAC region (agricultural raw materials, fuels, and manufactured goods).

Table 5: Country sensitivity (product categories, 1995–2013)

VARIABLES	Food_live (0)	Bevtoba (1)	Crude_mat (2)	Minfuels (3)	Aniveg (4)
Exporters					
CAR	4.312***	2.144*	0.879	7.733***	-1.262
	(0.889)	(1.258)	(0.617)	(0.899)	(2.208)
COG	1.096	1.533	0.193	6.787***	-6.473***
	(0.823)	(1.202)	(0.551)	(0.847)	(2.159)
CRM	3.523***	1.530	1.495**	6.613***	-3.409
	(0.927)	(1.390)	(0.586)	(0.914)	(2.382)
GAB	1.083	0.555	0.928	6.648***	-4.144*
	(0.883)	(1.323)	(0.571)	(0.897)	(2.231)
GNQ	-1.344*	-2.538***	-0.882*	7.591***	-8.625***
	(0.724)	(0.950)	(0.506)	(0.794)	(1.504)
TCD	-2.083***	0.876	0.535**	3.185***	0.0181
	(0.436)	(0.824)	(0.268)	(0.600)	(1.204)
Importers					
CAR	9.322***	-8.596***	-0.946	-6.697***	
	(1.577)	(2.442)	(1.142)	(1.915)	
CHN	1.199**	-0.169	7.254***	2.668***	
	(0.557)	(1.492)	(0.318)	(0.652)	
CRM	9.796***	-10.91***	-1.126	-4.864***	0.0354
	(1.556)	(2.412)	(1.111)	(1.864)	(0.790)
COG	7.717***	-8.002***	-1.663	-5.274***	-0.772
	(1.482)	(2.358)	(1.067)	(1.817)	(0.811)
COMESA	6.399***	-6.806***	2.416***	-2.054	0.0429
	(1.098)	(1.905)	(0.760)	(1.366)	(1.932)
EAC	4.339***	-8.270***	-1.306	-9.685***	-0.943
	(1.195)	(2.066)	(0.813)	(1.509)	(1.867)
ECOWAS	8.494***	-9.679***	1.365	-1.642	-1.506

	(1.434)	(2.281)	(1.023)	(1.807)	(1.015)
EU	9.439***	-2.431	8.140***	2.788***	6.433**
	(0.794)	(1.596)	(0.515)	(0.956)	(2.674)
GAB	9.401***	-12.33***	-1.126	-6.264***	1.483*
	(1.743)	(2.639)	(1.253)	(2.093)	(0.773)
GNQ	10.19***	-11.30***	-2.096	-5.809**	-4.602***
	(1.996)	(2.968)	(1.417)	(2.378)	(1.311)
IND	1.713***		4.913***	0.280	10.19**
	(0.649)		(0.392)	(0.781)	(4.467)
TCD	8.760***	-7.581***	-0.707	-4.315**	-1.120
	(1.474)	(2.315)	(1.162)	(1.933)	(1.278)
ldist	3.291***	-4.831***	-0.485	-0.513	-3.901**
	(0.577)	(0.848)	(0.406)	(0.713)	(1.548)
landlocked	0.164	-0.785	-0.627	1.112	-4.442**
	(0.816)	(1.178)	(0.531)	(0.776)	(2.155)
border	2.504***	-1.654**	1.336***	1.920***	-2.782*
	(0.433)	(0.707)	(0.362)	(0.611)	(1.413)
comlang	-1.083***	0.751	-0.404*	-0.620	-1.730*
	(0.377)	(0.676)	(0.241)	(0.442)	(1.045)
Constant	-28.74***	47.30***	7.474*	7.738	37.83***
	(5.906)	(8.671)	(4.104)	(7.205)	(11.77)
Observations	716	476	897	638	287
R-squared	0.600	0.346	0.751	0.634	0.444

Table 5: Country sensitivity (product categories, 1995–2013) (continuation)

VARIABLES	Chem (5)	Man_goods (6)	Machine trans (7)	Misc manu (8)	Commo (9)
Exporters					
CAR	5.143***	5.107***	6.272***	5.104***	1.591
	(0.787)	(0.632)	(0.694)	(0.621)	(1.393)
COG	1.809**	2.294***	4.009***	3.559***	0.783
	(0.707)	(0.567)	(0.626)	(0.550)	(1.173)
CRM	2.662***	3.215***	4.475***	3.054***	4.062***
	(0.766)	(0.608)	(0.673)	(0.582)	(1.336)
GAB	1.634**	1.757***	3.860***	2.760***	0.828
	(0.742)	(0.599)	(0.661)	(0.576)	(1.236)
GNQ	-0.0122	0.111	1.504***	1.083**	-0.199
	(0.624)	(0.509)	(0.559)	(0.486)	(1.077)
TCD	-2.043***	-0.635**	-0.153	0.770***	-1.416**
	(0.428)	(0.310)	(0.321)	(0.295)	(0.676)
Importers					
CAR	-3.561**	-2.620**	-2.594**	-2.295**	6.168**
	(1.388)	(1.125)	(1.205)	(1.031)	(2.455)
CHN	0.146	0.747**	-0.193	-1.193***	2.460***
	(0.581)	(0.349)	(0.392)	(0.375)	(0.947)
CRM	-3.249**	-3.806***	-1.884	-2.706***	7.582***
	(1.349)	(1.119)	(1.189)	(1.018)	(2.324)
COG	-1.916	-2.693**	0.0978	-1.785*	7.262***
	(1.306)	(1.061)	(1.119)	(0.966)	(2.261)
COMESA	0.840	-0.291	0.818	0.550	5.214***
	(1.011)	(0.803)	(0.865)	(0.750)	(1.509)
EAC	-0.679	-3.077***	-0.958	-0.943	2.544
	(1.071)	(0.865)	(0.931)	(0.810)	(1.696)

ECOWAS	-0.0311	-0.693	0.522	0.0253	7.818***
	(1.294)	(1.069)	(1.142)	(0.985)	(2.032)
EU	4.484***	5.693***	5.740***	3.944***	9.538***
	(0.708)	(0.555)	(0.597)	(0.517)	(1.061)
GAB	-2.228	-2.793**	-1.053	-1.754	7.840***
	(1.489)	(1.229)	(1.287)	(1.100)	(2.461)
GNQ	-3.149*	-3.201**	-1.155	-2.717**	7.741***
	(1.687)	(1.410)	(1.504)	(1.277)	(2.918)
IND	1.494**	0.668	0.672	-0.302	1.111
	(0.586)	(0.433)	(0.487)	(0.448)	(0.833)
TCD	-4.617***	-3.514***	-2.448**	-1.741*	7.717***
	(1.378)	(1.094)	(1.159)	(1.004)	(2.326)
Ldist	-0.999*	-0.961**	-1.546***	-0.749*	1.798**
	(0.517)	(0.434)	(0.467)	(0.401)	(0.804)
landlocked	0.0612	0.434	2.029***	0.942*	0.473
	(0.669)	(0.543)	(0.607)	(0.520)	(1.178)
Border	2.928***	2.059***	0.539	1.535***	1.225*
	(0.431)	(0.341)	(0.365)	(0.319)	(0.637)
comlang	-2.312***	-0.896***	-1.273***	0.260	-1.822***
	(0.346)	(0.266)	(0.289)	(0.253)	(0.564)
Constant	11.28**	11.82***	13.87***	7.082*	-17.39**
	(5.190)	(4.390)	(4.730)	(4.042)	(8.160)
Observations	729	965	967	877	469
R-squared	0.474	0.580	0.514	0.542	0.494

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

* Significant at 10%, ** significant at 5%, *** significant at 1%

Note: The table reports t-statistic in parentheses. Regressions shows individual member states of the CEMAC customs union contribution to CEMAC IIT. It also shows the individual countries' sensitivity to the different product categories (sectors 0-9).

A closer look at agricultural materials, fuels, and manufactured goods indicates a similar pattern. China, the EU, and India are still the main importers of goods from these sectors. In Africa, the coefficients for COMESA and ECOWAS are positive for agricultural products. It is also significant at 10% for Chad. This implies that Chad's imports of agricultural produce from other CEMAC member states are statistically significant. For trade in fuels, none of the CEMAC member states or trade blocs in Africa are boosting the region's fuel exports. For manufactured goods (man goods), only ECOWAS and EU imports from CEMAC are significant and positive, with the EU accounting for the highest increase. The Economic Partnership Agreements (EPA) between the CEMAC countries and the EU may be producing significant positive effects. The goods exported to the EU are mostly light manufacturing goods that relate to wood and cotton products. There is limited diversification, especially in manufacturing in the region. Only Cameroon has a significant industrial base in the CEMAC region.

Table 5 shows how the individual CEMAC member states respond to the different product categories (sectors 0–9). For the exporters' effects in the different sectors, the coefficients for sector 0 products are positive and significant for the Central African Republic (CAR) and Cameroon (CRM). For Equatorial Guinea (GNQ) and Chad (TCD), the coefficients are negative and statistically significant. The coefficient for Gabon is insignificant and positive. This suggests that CAR and CRM's exports of sector 0 products are significant within the region while GNQ and TCD's exports of sector 0 products after 1994 are negligible. Trade in sector 4 products (animal and vegetable oils, fats, and waxes) is statistically significant and negative for the Congo (COG), Gabon (GAB), and GNQ and statistically insignificant for CAR, CRM, and TCD. The coefficients are positive and significant for most of the sectors for CAR except for sectors 2, 4, and 9, which are insignificant. These findings indicate that since 1995, exports from CAR have been significant in some of the sectors, while a few have been insignificant.

The second half of Table 5 shows the results of the importers' effects. The coefficients for most CEMAC member states are negative. This is an indication that CEMAC countries' imports from fellow member states are negligible, and this phenomenon explains why IIT in the region is exceptionally low as compared to CEMAC's counterparts. The few exceptions are sector 0 (food and live animals) and sector 9

(commodities and transactions), where imports by member states in the CEMAC region have been statistically significant and positive. From Table 5, the main importers of goods from the different sectors are China, India, and the EU. The sector 0, 2, and 9 coefficients are significant and positive for COMESA and negative for sector 1. This is an indication that countries in COMESA tend to import sector 0, 2, and 9 products from the CEMAC region, but their contribution to sector 1 products is negligible.

5 CONCLUSIONS

This paper provides empirical evidence and insights into how the CEMAC customs union has performed in terms of IIT since 1994. The objective of this study was threefold: (i) to analyse IIT flow in the CEMAC region between 1995 and 2015, (ii) to examine how each sector responded to IIT flows, and (iii) to evaluate how individual member states have contributed to the region's growth in IIT. Different applications of the augmented gravity model by Anderson and van Wincoop (2004) were used to analyse CEMAC IIT at the first-digit level of aggregation of the SITC revision 1 classification system. A fixed effects panel model was adopted to analyse the bilateral trade of the six member states of the CEMAC customs union and its main trading partners for the period from 1995 to 2013. The results revealed how the GDPs of both exporters and importers are important in determining the flow of IIT in most sectors. The model sought to explain why the distance coefficient was positive in some instances. Similar climatic conditions in the production of food and live animals do not give most countries in the CEMAC region the comparative advantage needed to trade with partners.

Another notable finding was that the common language coefficients were negative. The gravity model essentially assumed that trading partners that shared a common language tended to trade more with each other. However, this has not always been the case for CEMAC member states, as the results have shown. Despite the fact that five out of six countries in the CEMAC region use French as their official language, the analysis points out that a common language has not benefited the flow of the region's IIT. Though language is an important tool in IIT as it can act as a vehicle to transmit cultural values, the CEMAC case is different as there are hundreds of languages spoken in the region that differ from one country to another.

CEMAC IIT in most of the sectors has been negative with very few exceptions. On average, the CEMAC region has not performed well in promoting IIT. The sensitivity analysis showed how member states' imports from the region had been negative in most sectors and negligible in others. Cameroon was the only country in the region that had witnessed an increase in trade with member states, especially in sector 0. The results also showed that only sector 3 (mineral fuels) exports had been significant and positive for Chad and Equatorial Guinea. These two countries depend mainly on the exports of fuel and petroleum products (UNECA, 2015).

The gains in IIT from the specific sectors would mean that the CEMAC customs union could be enhanced by adding value to the extractive industry. By doing so, member states can demand the finished products. This will further reduce their economic dissimilarities with respect to the existing common currency. However, the literature in IIT has shown that a higher range of IIT should ultimately raise the benefits and reduce the costs of economies in the monetary union. The analysis also showed that despite similarities in the trade structures of the CEMAC economies, IIT trade has remained low. Experience elsewhere shows that growth in IIT cannot be sustained without a structural transformation to uplift the industrial base of the countries involved. This includes policies geared at uplifting workers from low-productivity agriculture and the informal sector to higher-productivity activities. This is important in the CEMAC region since a large proportion of cross-border trade also takes place in the informal sectors.

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