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Exports Diversification and Trade Performance Among the West African Economic and Monetary Union Members

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Abstract

Diversification is a strategy applied to international trade that can be a lever for increasing trade flows and the welfare of populations. This diversification makes it possible to increase the number of products (horizontal diversification) on the one hand and to improve the quality of the products traded (vertical diversification) on the other. The purpose of this study is to assess the effect of export diversification on the expansion of trade between the West African Economic and Monetary Union (WAEMU) member countries. It considers both horizontal and vertical diversification indexes in a gravity model. The concentration index measures horizontal diversification. The share of Medium and High-Tech Activities in the Manufacturing Export index evaluates the vertical diversification level. Data includes the period 1995 to 2017. We estimate a gravity model in panel. Results show that the level of diversification, both horizontal and vertical, slows down trade between member countries. Thus, intra exports diversification remains a challenge for deep integration in WAEMU.

Keywords: Export diversification, vertical diversification, intra WAEMU exports.
Jel classification: F02, F15, O40

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1. Introduction

From a general point of view, diversification is an economic strategy based on an optimal allocation of the productive resources available in the economy. It concerns both the aggregate and sectoral levels. From a macroeconomic perspective, diversification can involve global strategies regarding the main components of aggregate demand. It affects as well as international trade. As such, diversification could be export- or import-oriented.

Diversification steps reflect the reallocation of resources over a range of activities that is much less coarse than the well-known categorization into three sectors (primary, secondary, tertiary). This reallocation appears to be driven by the interaction of economic growth and openness to trade. Diversification, as presented, goes beyond the well-documented transfer of resources from agricultural sectors to manufacturing and services. Trade diversification refers to a modification in the composition or the structure of the existing product or a spread of tradable production over many sectors (Ridwan and al, (1991), Berthélemy and Chauvin, (2000). It can also refer to the extension of trading partners: geographical[2] diversification (Shepherd, 2010). This study analyses the effects of export diversification on trade flows between WAEMU member countries.

According to the economic theory, differences in technology (Ricardian model) or factor loading (HOS model) explain the specialization and the trade structure and composition between partners at the point of supply. Countries must specialize in following the principle of comparative advantages. The generalization of this principle leads to a kind of diversification of the exportable basket of countries. From this point of view, the more diversified the exportable offer of the partners, the volume of trade between them will increase (Feenstra, 2015; Krugman and al, 2018). Therefore, diversification could be a critical factor in expanding trade between partners in a free trade area.

Similarly, on the supply side, economies of scale, innovation, the international division of the production process are factors that impact the production structure by reducing production costs. Therefore, the dynamic of export-oriented sectors that benefit from these factors can increase the exportable supply. Other factors relying on consumers' preferences could also explain diversification theoretically on the demand side. The demand for differentiated goods and the

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[2] We do not put a look on this geographical diversification anymore as we are into a Regional Economic Community: the West African Economic and Monetary Union.

demand for variety can diversify exported goods and trading partners. Exporting firms can multiply products and customer countries by investing in product differentiation, matching products to customers' tastes and preferences.

The theoretical literature distinguishes at least two types of diversification: product diversification and geographical diversification. Geographical diversification is about diversifying customers or the number of foreign markets or trade partners. It depends on several factors such as direct export costs, transaction costs, tariff barriers, international transport costs (Shepherd, 2010). He shows that reducing one of these costs leads to an increase in the number of markets. As a result, the increase in the number of needs leads to a rise in exports.

In the same perspective, diversification also depends on the quality of the institutions. Indeed, by modelling the effects of institutional reforms in LDCs[3] on export varieties, Sheng and Yang (2016) suggest that institutional reforms in developing countries can effectively expand their product varieties in export. They find that easing restrictions on ownership of foreign direct investment and improving judicial quality may play an essential role in amplifying the introduction of product varieties. Such institutional reforms are also channeling to reach export diversification.

Didier, (2017) examine the diversification of trading partners and, more precisely, to what extent the nature of external trading partner's matters for the geographical diversification of intra Sub-Saharan Africa (SSA) trade. The geographical diversification of partners has a positive impact on intra-SSA trade. The diversification of partners leads to improving the quality of exported products. Brambilla and Porto (2016) have shown that companies that export to high-income partners focus on improving the quality of exported products. According to them, high-income countries require high-quality products.

Nevertheless, diversification of partners can be a source of export volatility and increase the vulnerability of exporting firms (Brainard and Cooper,1968; De Sousa and al, 2020). Gonzague and al (2016) show that selling to a more diverse set of countries has more volatile exports among minor exporters. The relationship between diversification and economic variables is not linear. According to Le and al (2020), an inverse U-shaped relationship exists between overall export diversification and income inequality in an economy. According to Imbs and Wacziarg (2003), diversification is a non-monotonous process. It is a process that evolves. The stage of diversification depends on the level of income. For developing countries, the empirical literature

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[3] Low Developed countries

on diversification shows that developing countries tend to diversify. This situation is not the case until they reach relatively high per capita income levels that incentivize specialization to take over as the dominant economic force (Imbs & Wacziarg, 2003).

In the case of the Association of Southeast Asian Nations (ASEAN), Vogiatzoglou (2019) displays that there has been a substantial expansion of exports between member countries. However, the composition of exports differs from one member country to another. The author suggests that policies encouraging diversification away from traditional export sectors should lead to higher long-term export growth effects. Thus, export restructuring in manufacturing industries is associated with a more significant long-run growth effect for a country's exports. In the same vein, an analysis with ECOWAS[4] countries ten years earlier confirmed this result (Odularu, 2009). Indeed, this analysis has shown that the diversification of exported products is a challenge for member countries whose economies heavily depend on exports and, therefore, vulnerable to external shocks. Odularu (2009) shows that adopting a diversification strategy, including manufacturing and processing primary goods, would be appropriate to stabilize export earnings and increase per capita income.

Product diversification concerns the structure or the composition of the basket. There are two ways in the process of product diversification: either an increase in the number of products in the exportable basket (horizontal diversification) or an increase in the value of the products contained in the basket (vertical diversification) (Ridwan and al, 1991). Some authors argue that in analyzing the effects of international trade on growth, exported products diversification is an explanatory channel (Melitz, 2003; Feenstra and Kee, 2008). They have highlighted product diversification (or sectors) as a source of trade and economic growth expansion. Eicher and Kuenzel (2016) examine the diversity of sectoral exports and the development of broad-based comparative advantage as a potential growth determinant. They find that export diversity serves as a crucial growth determinant for low-income countries.

This literature shows that diversification has a positive effect on exports. It is, therefore, a source of trade expansion and economic growth. Several factors contribute as a catalyst in this time-related process, which leads to a new allocation of productive resources. There are direct export costs, transaction costs, tariff barriers, international transport costs, institutional reforms.

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[4] Economic Community of West African States

This study contributes to the existing literature by investigating the relationship between the exported products diversification and trade flows in the West African Economic and Monetary Union (WAEMU). To what extend exported goods on the WAEMU home market are vertically diversified? Does exported goods diversification lead to an increase in trade flows between members? Does vertical diversification influence trade flow between countries? These questions are essential to improve trade integration in WAEMU. The paper will help with two issues: first, local demand for exported products and the potential value chains in this Regional Economic Community to boost trade between members.

The rest of the paper is organized as follows. Section 2 describes the methodology. Section 3 presents the estimation results. Section 4 discusses and give some policy implication to strengthen economic integration in WAEMU.

2. Methodology
2.1. Empirical approach and estimation strategy

The following structural gravity equation is estimated to assess the effect of export diversification on intra WAEMU trade (Santos-Silva and Tenreyro, 2006):

$$EX_{ij,t} = exp\big[\delta_{it} + \vartheta_{jt} + \beta_{GDPit}\ln(GDP_{it}) + \beta_{GDPjt}\ln(GDP_{jt}) + \beta_{DIST}\ln(DIST_{ij}) +$$
$$\beta_{CNTG}CNTG_{ij} + \beta_{sea}SEA_i + \beta_{div(ijt)}\ln(MHXshI_{ijt}) + \beta_{REMi}\ln(REM_{it})\big] \times \varepsilon_{ijt} \ (1)$$

Where $EX_{ij,t}$ corresponds to the bilateral export flows from exporter i to importer j at time t. $\ln(GDP_{it})$ $(\ln(GDP_{jt}))$ is the logarithm of GDP of country i (j) at time t. $\ln(DIST_{ij})$ measures the logarithm of the distance between partners i and j. $CNTG_{ij}$ is an indicator variable capturing the presence of contiguous borders between trading partners i and j. SEA_i denotes a dummy variable for the existence of a sea border in country i . REM_{it} is the remoteness index, to control for the multilateral resistance terms in the estimation, $\ln(MHXshI_{it})$. The logarithm of the Manufactured Export Share Index, the proxy of vertical diversification.

The model uses bilateral export flows between WAEMU countries. Equation (1) is estimated using the Pseudo Poisson Maximum Likelihood (PPML) method to address the problems associated with zero trade flows and heteroscedasticity (Santos-Silva and Tenreyro, 2006). Practically, two arguments justify using the PPML estimator on various grounds (Yotov and al, 2016). First, it solves the heteroscedasticity issues in data (Santos-Silva and Tenreyro, 2006).

Second, the PPML estimator can take advantage of the information contained in the zero trade flows for the same reason. Third, the additive property of the PPML estimator guarantees that the gravity fixed effects are identical to their equivalent structural terms (Arvis and Shepherd, 2013; Fally, 2015).

2.2. Data sources and definition of variables

Only seven members of WAEMU have covered: Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo because of data availability. The period used for the analysis ranges from 1996 to 2017. Table 1 describes variables and their sources.

We consider the share of Medium and High-Tech Activities in Manufacturing Export Index as a proxy of vertical diversification. We assume that having Medium and High-Tech Activities in Manufacturing Exports requires a value in exported products. The index measures the greater or lesser degree of the content of exports of manufactured goods. The larger the index, we will conclude that exports are more vertically diversified. This variable covers only three countries due to data availability: Côte d'Ivoire, Niger and Senegal (UNIDO stat, 2017). Values range from 0 to 1. When the value tends to 0, it indicates that the share of medium and high-tech activities in manufacturing export products is meagre. So does the vertical diversification level of exported products. If the value tends to 1, this indicates that the vertical diversification level of exported products is high.

As we set in the introduction, we also consider the horizontal diversification index for controlling this aspect of product diversification. The exported product concentration index measures the horizontal diversification variable. The export concentration index for a country measures the degree of concentration of export products (without services). This indicator indicates whether a significant proportion of the country's exports come from a limited number of products. It is the standardized Herfindahl-Hirschmann index of concentration of export products at the country level. Values range from 0 to 1. A value of the index close to 1 indicates a high concentration of exports. This value means that the country's exports come from a small number of products. Exports are not diversified. A value close to 0 indicates a low concentration. This value means that the country's exports have spread evenly between several products. Exports are diversified horizontally. In this analysis, we consider the overall concentration index of exports and

not specific to the sub-regional market. We assume WAEMU countries meet the same situation as partners in the rest of the world.

Table 1: Variables description and data source

Variables label	Variables definition	Measurement	Sources	Periods
$EX_{ij,t}$	Bilateral total exports from a WAEMU member country to another one at year t USD (units)	Goods, Value of Exports, Free on board (FOB), US Dollars	The direction of Trade Statistics (DOTS) from the IMF	1996-2017
GDP_{it}	Gross Domestic Product	Millions of USD, current price, current exchange rate	UNCTAD data set	1996-2017
GDP_{jt}	Gross Domestic Product	Millions of USD, current price, current exchange rate	UNCTAD data set	1996-2017
$DIST_{ij}$	Distance	The distance between the main city of each country pairs in km. This variable is a proxy of transaction costs	CEPII data set	
DIV_{it}	Diversification index for the exporter	Diversification index (0-1)	UNCTADstat	1996-2017
$CONC_{it}$	Export product concentration index for the exporter	Concentration index (0-1)	UNCTADstat	1996-2017
REM_{it}	Remoteness index	Multilateral resistance terms	Author calculation	
$MHXshI_{it}$	Medium- and High-tech manufactured Exports share in total manufactured exports index	Only for Côte d'Ivoire, Niger and Senegal	UNIDO Statistcs (Competitive Industrial Performance report and dataset)	1996-2016

Source: Author

3. Results and discussions

3.1. Trade structure and trade between WAEMU members: some facts.

This analysis focuses on the changes that occurred in the intra WAEMU export structure between 1995 to 2017[5]. As much as imports from the WAEMU area are diversified, raw material dominates its exports. The share of raw material in the WAEMU's overall trade increased during 2010-2015, while the share of manufactured goods declined (**Error! Reference source not found.** in appendix 1). The WAEMU trade remains highly concentrated, especially in exports. More than three-quarters of the products traded (in value) relates to about 15 products: mineral products, fuels; Cement; agricultural products, fats, vegetable, oils, Fertilizers, Food Preparations, Fishing Products, Livestock, Cigarettes, Soap, iron and iron products. WAEMU's most extensive exported product is cocoa and its preparations (agricultural products). It represents 25% of total exports in 2015. The second group of products shipped is gold (mineral products).

Since 2010, the intra-WAEMU[6] Trade has increased for most member states, especially in Togo, where almost half of the total exports go to the WAEMU home market in 2015 vs 17% in 2010. This share declines for Guinea Bissau and Senegal in the same period (Table 2). Analyzing imports flows, we notice that Mali and Guinea Bissau depend strongly on other members exports. The share of their imports coming from WAEMU is higher than the rest of the members. It varies between 20% and 25% for Guinea Bissau, 29% and 33% for Mali from 2010 to 2015.

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[5] This period is after the WAEMU establishment in 1994.
[6] Intra -WAEMU is the trade between WAEMU member countries.

Table 2: Intra WAEMU trade from 2010 to 2015

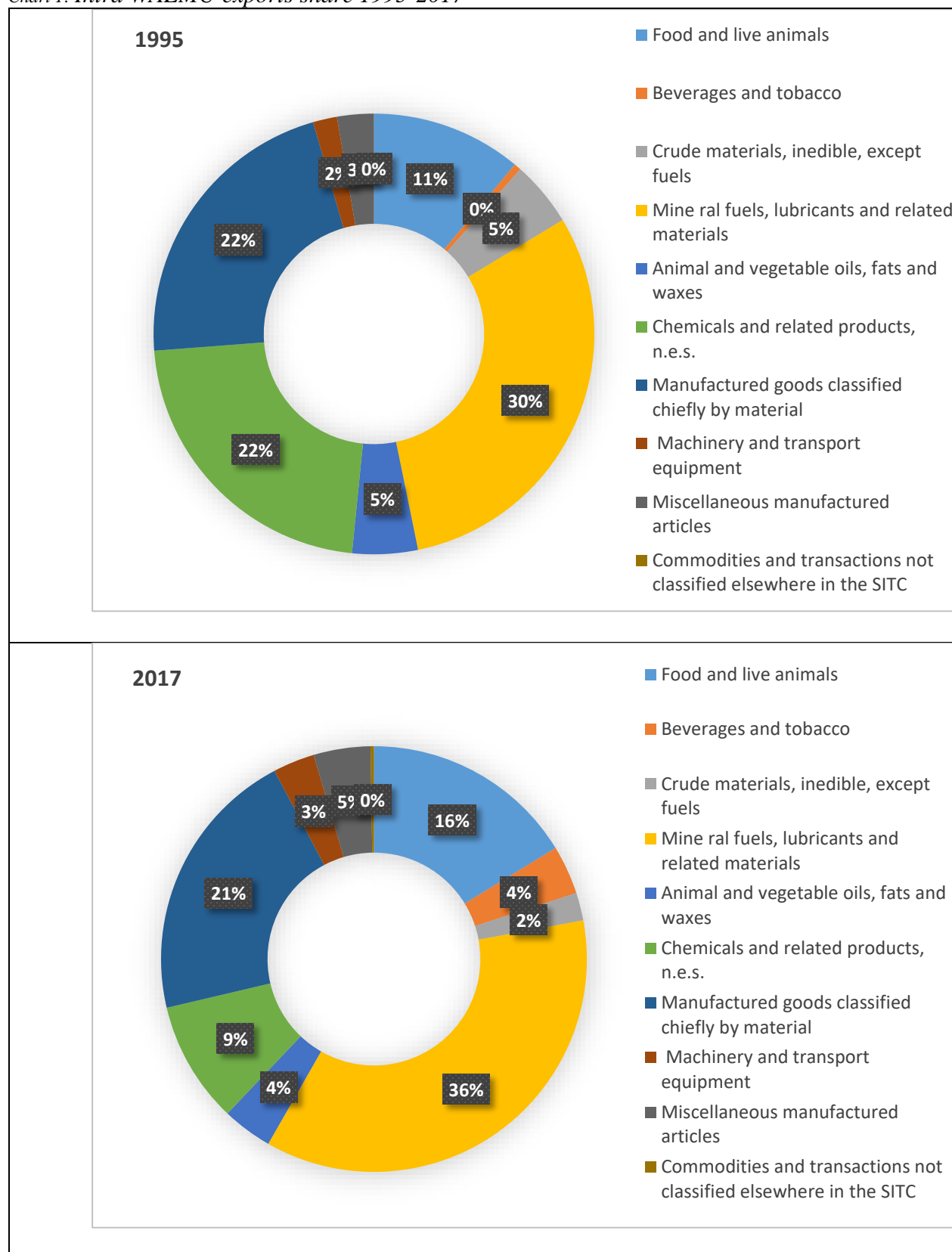|	2015		WAEMU			
	Imports total	Exports total	Share (%) of total imports		Percentage (%) of total exports	
	Millions of €uro		2010	2015	2010	2015
Benin	2 231	564	11	11	10	14
Burkina Faso	2 687	1 963	23	15	6	9
Côte d'Ivoire	8 595	10 680	1	2	9	13
Guinea-Bissau	265	257	23	24	10	6
Mali	3 602	2 858	29,2	33,1	9,1	12,0
Niger	2 217	712	6	8	3	9
Senegal	5 045	2 355	3	2	34	29
Togo	1 561	640	7	5	17	48

Source: World Trade Organisation, report (Organisation Mondiale du Commerce, 2017)

As we can see in this table, WAEMU countries do not trade more with each other. What do they sell on the WAEMU home market? **Error! Reference source not found.** describes the share of each product (ISIC, three digits) in the WAEMU total intra exports in 1995 and 2017. As we can see, the mineral product, fuels, lubricants and related materials constituted the main exported product during both years. The share of these products in the total export increased between 1995 and 2017. It went from 30 per cent to 36 per cent. The percentage of Industrial chemicals products, chemicals, apparel and transport equipment increases during the same period. It appears that WAEMU's total trade has been growing since 1995. Intra WAEMU export's structure has not changed significantly since 1995. The share of intra-WAEMU trade remained stable at an average of 14% between 1995 and 2017.

Finally, exports between WAEMU countries are, to a certain degree, diversified. It concerns a variety of products. But, since 1995,[7] the export composition has not changed anymore. On the home market, member's countries exports involve mainly: minerals, fuels, lubricants, and related materials; chemicals and related products; manufactured goods classified chiefly by the material; the animal and vegetable oils, fats; crude materials. Does this situation foster or not exports growth between WAEMU members?

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[7] One year after WAEMU establishment

Intra WAEMU exports share 1995-2017

1995

- Food and live animals
- Beverages and tobacco
- Crude materials, inedible, except fuels
- Mine ral fuels, lubricants and related materials
- Animal and vegetable oils, fats and waxes
- Chemicals and related products, n.e.s.
- Manufactured goods classified chiefly by material
- Machinery and transport equipment
- Miscellaneous manufactured articles
- Commodities and transactions not classified elsewhere in the SITC

2017

- Food and live animals
- Beverages and tobacco
- Crude materials, inedible, except fuels
- Mine ral fuels, lubricants and related materials
- Animal and vegetable oils, fats and waxes
- Chemicals and related products, n.e.s.
- Manufactured goods classified chiefly by material
- Machinery and transport equipment
- Miscellaneous manufactured articles
- Commodities and transactions not classified elsewhere in the SITC

Source: UNCTAD Stats, 2019

3.2. Vertical diversification and trade flow within WAEMU

Table 3Table 3 shows descriptive statistics for vertical diversification index for the three countries from 1996 to 2017

Table 3: :Descriptive statistics for vertical diversification index

Variable		Mean	Std. Dev.	Min	Max	Observations	
MHXsh_index	overall	0.2115576	0.1308391	0.0048222	0.5311021	N =	441
	between		0.0975157	0.0806889	0.3041909	n =	21
	within		0.089676	0.0091989	0.4384687	T =	21

Source: The author's calculations

The three (Côte d'Ivoire, Niger and Senegal) countries' medium- and High-tech manufactured Exports share in total manufactured exports index ranges from 0.0 to 0.5 over the period, with an average of 0.2 and a standard deviation of 0.13 (Table 3).

Chart 2: Share of Medium and High-Tech Activities in Manufacturing Export Index (MHXSh_Index) evolution for CIV, NIGER and SENEGAL from 1996 to 2016 (on average)
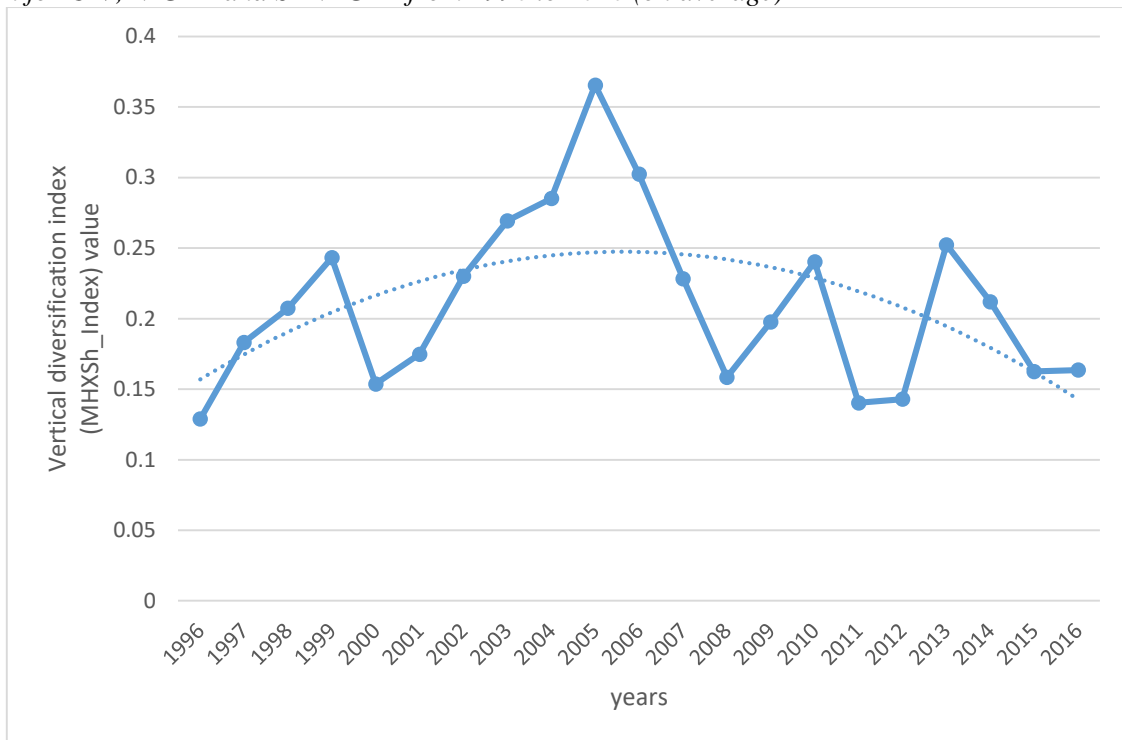

Source: UNIDO statistics, 2017

The Medium- and High-tech manufactured Exports' total manufactured exports index is shallow on average for the three countries. Its value is close to 0; therefore, the export basket of

these countries is less diversified vertically. For these countries, the evolution of the vertical diversification index does not present a trend.

The scatter plot brings out an inverted U-shaped look. This intuition would mean that, on average, the vertical diversification index is declining in these three countries over the analysis period. The countries considered are becoming less and less positioned in the value chains of manufactured products exported. These countries have not moved into adding value to the value chains of medium- and high-tech products. What is the effect of this on their exports to the sub-regional market?

Chart 3: Evolution of the Vertical Diversification Index and intra-WAEMU exports from 1996 to 2016 for Côte d'Ivoire, Niger and Senegal
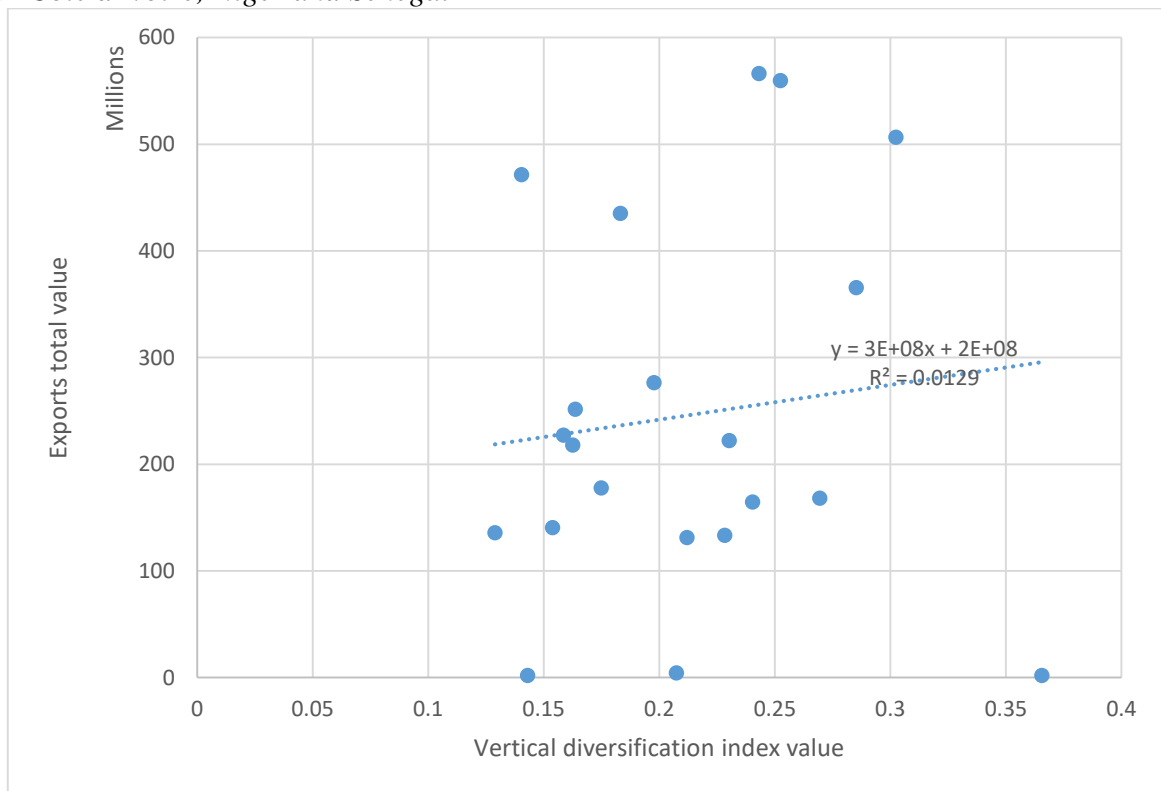

Source: The author

We note that the best linear adjustments between total exports and the average level of the vertical diversification index suggest a positive relationship between the two variables.

The evolution of the WAEMU exports concentration index on average (*Chart 4*) shows a relatively downward trend over the period.

Chart 4: Evolution of the mean of exported products concentration index from 1996 to 2017(for WAEMU)
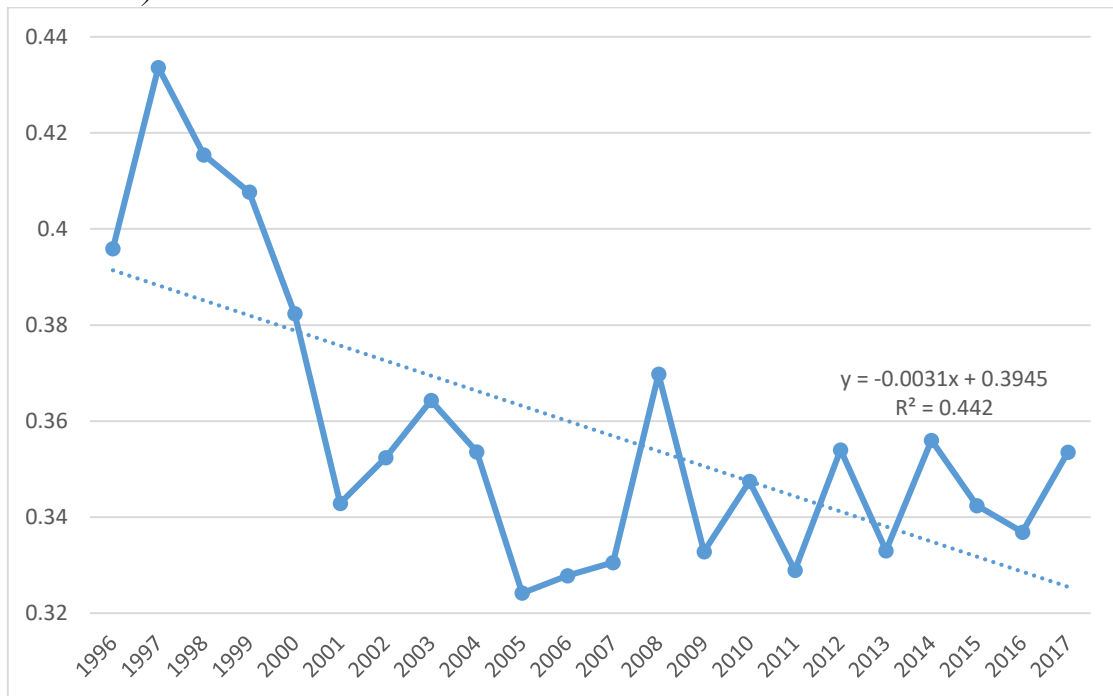
Source: UNCTAD statistics, author

So, there is an effort to diversify the products exported by the WAEMU countries over the period analyzed. WAEMU countries have generally reduced their dependence on mineral fuels, lubricants, related materials, chemicals, and associated products. However, the level of the concentration index is relatively high, so the exports are still concentrated. Table 4 shows descriptive statistics for the horizontal diversification index for the seven countries from 1996 to 2017
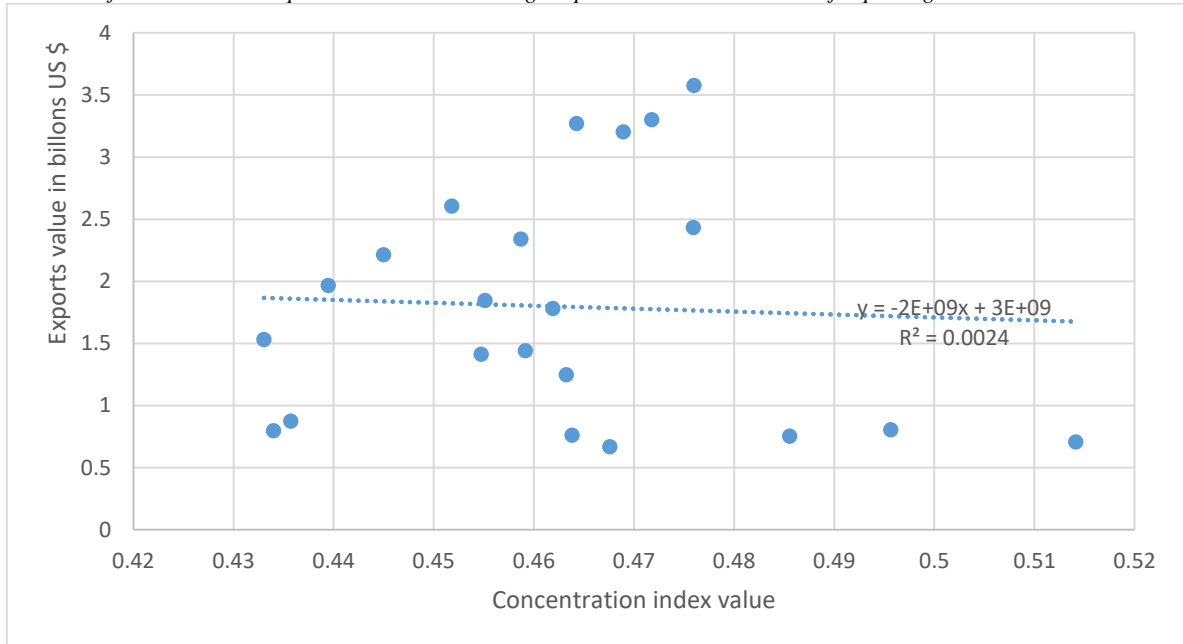
*Table 4: :*Descriptive statistics for horizontal diversification index

Variable		Mean	Std. Dev.	Min	Max	Observations
Exports Product Concentration Index for Exporter	overall	0.4625021	0.204963	0.1991224	0.8789799	N = 1232
	between		0.1840936	0.238554	0.7646451	n = 56
	within		0.0932605	0.1345045	0.7741518	T = 22

Source: The author's calculations

The WAEMU countries' export concentration index ranges from 0.2 to 0.8 over the period, with an average of 0.46 and a standard deviation of 0.2 (Table 4). The concentration index is relatively low on average over the period, but it remains over 0.25. So, exports from WAEMU member countries are, on average concentrated. A significant proportion of intra-WAEMU exports comes from a limited number of products. We note that the best *linear* adjustment between total exports and the level of the horizontal diversification index suggests a negative relationship between the two variables (Chart 5). Nevertheless, as we can see on the graph, a non-linear adjustment appears much better than the lean one (see the value of R2).

Chart 6: Evolution of intra-UEMOA exports based on the average export concentration index of exporting countries

The chart shows a scatter plot with "Exports value in billions US $" on the y-axis (0 to 4) and "Concentration index value" on the x-axis (0.42 to 0.52). The trendline equation is:

$$y = -2E+09x + 3E+09$$
$$R^2 = 0.0024$$

Source: The author

Table 5 presents the correlation matrix between the variables used in the analysis. It appears that there is a positive relationship between the vertical diversification index and total intra exports. The correlation coefficient is positive and significant. It is 0.2872. While with the concentration index, the correlation coefficient is negative and significant: -0.2381. as we can see, the correlation is low for both.

Table 5: *Correlation matrix*

	Variables	V1	V2	V3	V4	V5	V6
V1	Exports	1.0000					
V2	Exporter GDP	0.5799*	1.0000				
V3	Importer GDP	0.1533*	0.1231*	1.0000			
V4	Distance	-0.1990*	-0.0639*	-0.0639*	1.0000		
V5	Exports Product Concentration Index for Exporter	-0.2381*	-0.2677*	0.0346	-0.0737*	1.0000	
V6	MHXsh_index	0.2872*	0.4583*	-0.1338*	0.0044	-0.3129*	1.0000

Note: * significant at 5% level
Source: The author

Behind this statistical relationship and this graphical intuition, is there any substantial causal effect between exported product diversification and trade between WAEMU members' countries?

3.3. Effect of exports diversification on intra-regional trade

Trade between WAEMU members depends positively and significantly on the level of income of the importing countries, negatively on the distance between the members (looking at columns 2 to 6 of Table 6). A 1% increase in the importing country's income level leads to a rise in intra-WAEMU exports of 0.78% (Column 5, Table 6). It appears that a 10% increase in distance implies a 7% drop in exports between WAEMU member countries. Transaction costs are obstacles to expanding trade between WAEMU member countries (Column 5, Table 6).

Countries with a common border and countries with an opening to the sea trade more than other members than those that have not. Countries that shared a standard border export just over four times more to the WAEMU market than those without a common border. Countries with a maritime border export only over 51 times more to member countries (Column 5, Table 6).

Analysis of the term multilateral resistance effect shows that the term hurts exports between member countries on the exporter's side. The remoteness index estimates for the exporter are negative and significant (column 2-6, table 6). This result confirms that countries that are more isolated/remote do not trade more with each other.

Similarly, the vertical diversification of exports from WAEMU countries also does not lead to trade between members. A 1-point increase in the vertical diversification index results in a 0.15% drop in exports between members' column 3 table 4. When the two forms of diversification are combined, the result is that the current vertical and horizontal diversification efforts in Côte d'Ivoire, Niger and Senegal, do not foster more exports. It appears that the 1% increase in the number of products and technological content of exports leads to a 0.15% decrease in exports among members (Column 6, Table 6).

The horizontal diversification of the WAEMU countries is not conducive to the expansion of trade between members. A high concentration of the export basket of member countries leads to a decline in exports between member countries. See Results in table 6, column 2. A 1-point change in the concentration index results in a 1.2% decline in the value of exports between members.

Finally, horizontal, and vertical diversification levels slow down exports between WAEMU members' countries. Diversification is a challenge for west African countries (Odularu, 2009). So, adopting a diversification strategy, including manufacturing, and primary processing products, would be appropriate to stabilize export earnings and increase per capita income.

Table 6: *Estimations results*

Dependent variable: Intra WAEMU Exports	(1)	(2)	(3)	(4)	(5)	(6)
Methods	ppml	ppml	ppml	ppml	**ppml**	ppml
Variables						
Ln (Exporter GDP)	1.14***	0.59***	0.05	0.06	**0.05**	0.06
	(0.00)	(0.00)	(0.85)	(0.82)	**(0.84)**	(0.84)
Ln (Importer GDP)	-0.10	0.42**	0.78***	0.82***	**0.78*****	0.78***
	(0.58)	(0.03)	(0.00)	(0.00)	**(0.00)**	(0.00)
Ln (Distance)	0.24***	-0.27***	0.71***	0.73***	**-0.70*****	-0.70***
	(0.01)	(0.00)	(0.00)	(0.00)	**(0.00)**	(0.00)
Ln (Exporter remoteness index)	-0.01	0.68***	0.42**	-0.42**	**-0.45***	-0.47**
	(0.97)	(0.00)	(0.01)	(0.02)	**(0.09)**	(0.01)
Ln (Importer remoteness index)	-0.62***	-0.16	0.04	0.06	**0.04**	0.04
	(0.00)	(0.35)	(0.87)	(0.78)	**(0.87)**	(0.87)
Contiguity	1.15***	1.22***	1.03***	1.03***	**1.04*****	1.04***
	(0.00)	(0.00)	(0.00)	(0.00)	**(0.00)**	(0.00)
Sea Openness	1.47***	1.01***	3.35***	3.41***	**3.28*****	3.24***
	(0.00)	(0.00)	(0.00)	(0.00)	**(0.00)**	(0.00)
Ln (Exports Product diversification Index for Exporter)	-1.58**			1.19		
	(0.03)			(0.17)		
Ln (Exports Product Concentration Index for Exporter)		-1.20***			**-0.10**	
		(0.00)			**(0.84)**	
ln (Medium- and High-tech manufactured Exports share in total manufactured exports index)			-0.15*	-0.13*	**-0.15***	
			(0.05)	(0.10)	**(0.05)**	
ln (Diver_H*Diver_V)						**-0.15***
						(0.07)
Constant	14.96***	17.51***	16.39***	16.04***	**16.67*****	16.81***
	(0.00)	(0.00)	(0.00)	(0.00)	**(0.00)**	(0.00)
Observations	1,212	1,212	438	438	**438**	438
R-squared	0.76	0.77	0.81	0.82	**0.81**	0.81
r2	0.757	0.770	0.814	0.817	**0.814**	0.813
RESET test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000

Note: Robust p-value in parentheses, *** p<0.01, ** p<0.05, * p<0.1/ / Diver_H*Diver_V=Conc_Index * MHXsh_Index)

Source: Authors' calculations

As a robustness check, we estimate the gravity model by applying the Negative binomial regression, the Tobit and the OLS estimators (Yoto, Roberta, Monteiro, & Larch, 2016; Head & Mayer, 2014). As shown in Appendix 3, the coefficient of interest has the same sign in the regression. Diversification indexes have adverse effects on exports between WAEMU members states. Both horizontal and vertical diversification does not lead to increase exports between countries. On the horizontal side, exported goods are similar, and there is no opportunity to trade more. On the vertical side, the lack of complementary in production system appears as a limiting factor to increase trade flows.

4. Conclusion and policy implications

This study aimed to assess the effect of vertical diversification on trade flows between WAEMU member countries. The literature review has established that both horizontal and vertical product diversification is a catalyst for economic growth and trade. This positive effect is possible if countries carry out some institutional reforms, including protecting property rights and judiciary transparency. Also, lower transaction costs contribute to the growth of trade in the face of export diversification. We use data from seven countries in WAEMU. For the vertical diversification index, data are available for only three exporters toward the regional market. Descriptive statistics show that the level of export horizontal diversification index decreases over time, but WAEMU exports remain concentrated on a few numbers of product: primary goods (mineral fuels, lubricants, and related materials; chemicals and related products; manufactured goods classified chiefly by the material; animal and vegetable oils, fats and waxes; crude materials, inedible, except fuels). Exports from WAEMU countries are not diversified horizontally. The level of vertical diversification index for the three countries is relatively low also. So, vertical diversification is far from being achieved by these countries. The econometric assessment showed that this level of diversification, both horizontal and vertical, slows down trade between member countries.

Because of these results, it is worth noting that diversification could be a factor in strengthening trade integration in WAEMU. It would be necessary to extend the level of horizontal diversification (still relatively very low). Ensure that member countries' exports concern a wide variety of products. This recommendation will require consideration of policies to detect the needs of WAEMU's economic agents to match the exportable supply to the WAEMU sub-regional market.

Deepen the vertical diversification of exported products with the increase in the share of medium- and high-tech products in the exports of WAEMU member countries. This recommendation requires a profound transformation of the production structure of member countries economies. However, at the regional level, the development of value chains could be an appropriate response to improving the vertical diversification of member countries' exports. Manufactured products in line with the population's demand must be critical for developing regional value chains. The products to be promoted can be both intermediate and final consumption if they are high value-added products.
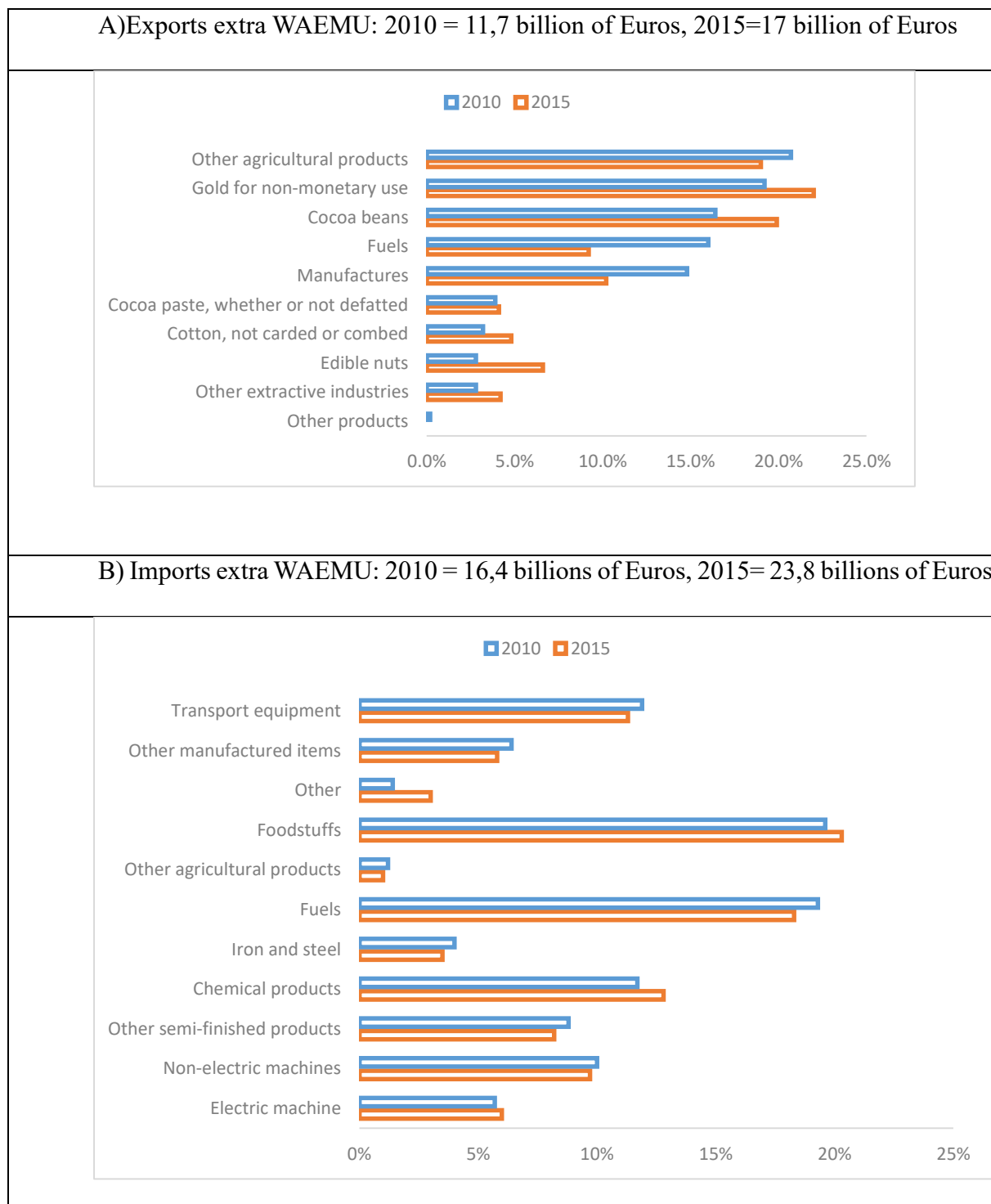
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Appendices

Appendix 1: *Structure of merchandise trade, 2010 and 2015*

A)Exports extra WAEMU: 2010 = 11,7 billion of Euros, 2015=17 billion of Euros

B) Imports extra WAEMU: 2010 = 16,4 billions of Euros, 2015= 23,8 billions of Euros

Source: World Trade Organisation, report (Organisation Mondiale du Commerce, 2017)

Intra WAEMU exports share 1995-2004

1995

- Food and live animals
- Beverages and tobacco
- Crude materials, inedible, except fuels
- Mine ral fuels, lubricants and related materials
- Animal and vegetable oils, fats and waxes
- Chemicals and related products, n.e.s.
- Manufactured goods classified chiefly by material
- Machinery and transport equipment
- Miscellaneous manufactured articles
- Commodities and transactions not classified elsewhere in the SITC

- Food and live animals
- Beverages and tobacco
- Crude materials, inedible, except fuels
- Mine ral fuels, lubricants and related materials
- Animal and vegetable oils, fats and waxes
- Chemicals and related products, n.e.s.
- Manufactured goods classified chiefly by material
- Machinery and transport equipment
- Miscellaneous manufactured articles
- Commodities and transactions not classified elsewhere in the SITC

Source: UNCTAD Stats, 2018

Appendix 3: Robustness's check results

Methods	OLS			Negative binomial regression			Tobit regression		
Dependent variables:	Ln (Intra Export)			Intra Export			Ln (Intra Export)		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ln (Exporter GDP)	-0.43	2.02**	-0.59	1.45***	0.40	0.40	2.01**	-0.43	-0.44
	(0.60)	(0.02)	(0.53)	(0.00)	(0.39)	(0.40)	(0.02)	(0.61)	(0.60)
Ln (Importer GDP)	1.38	-0.57	1.57	0.05	0.45	0.45	-0.55	1.39	1.39
	(0.11)	(0.51)	(0.10)	(0.88)	(0.36)	(0.36)	(0.53)	(0.12)	(0.11)
Ln (Distance)	-2.19***	-0.82*	-2.23***	-0.67***	-1.67***	-1.67***	-0.82*	-2.20***	-2.20***
	(0.00)	(0.06)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.00)	(0.00)
Ln (Exporter remoteness index)	-0.26	0.57	-0.28	0.23	-0.06	-0.06	0.57	-0.24	-0.26
	(0.70)	(0.50)	(0.71)	(0.45)	(0.84)	(0.84)	(0.50)	(0.70)	(0.69)
Ln (Importer remoteness index)	0.04	-1.45*	0.23	-0.69**	-0.81*	-0.81*	-1.43*	0.05	0.05
	(0.96)	(0.08)	(0.80)	(0.03)	(0.08)	(0.08)	(0.09)	(0.96)	(0.95)
Contiguity	0.59	1.52***	0.59	1.40***	0.67***	0.67***	1.53***	0.59	0.59
	(0.21)	(0.01)	(0.30)	(0.00)	(0.00)	(0.00)	(0.01)	(0.21)	(0.21)
Sea Openness	5.87***	2.03***	6.05***	2.02***	4.28***	4.27***	2.03***	5.90***	5.88***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ln (Medium- and High-tech manufactured Exports share in total manufactured exports index)	-0.28***		-0.28***		-0.16*	-0.16		-0.28***	-0.28***
	(0.00)		(0.00)		(0.10)	(0.10)		(0.00)	(0.00)

Ln (Exports Product Concentration Index for Exporter)	-0.04	-0.78***		-0.23		-0.02	-0.78***		-0.04
	(0.91)	(0.00)		(0.17)		(0.97)	(0.00)		(0.91)
Constant	21.60***	16.29***	19.53***	11.48***	28.15***	28.23***	15.99***	21.39***	21.48***
	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Observations	421	1,070	421	1,212	438	438	1,070	421	421
Number of ind	21	55	21				55	21	21
chi2	473.7	618.1	382.6	660.6	529.4	529.4	597.4	478.9	478.5
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
r2_o	0.853	0.636	0.851						
Random effect	Yes	Yes	Yes						

Note: *** p<0.01, ** p<0.05, * p<0.1 and pval in parentheses

Source: The Author